Cleveland Road, West Dapto Planning Proposal Flora and Fauna Assessment

Newquest Property Pty Ltd

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DOCUMENT TRACKING

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Template 2.8.1

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List of Abbreviations

Abbreviation	Description
BC Act	*Biodiversity Conservation Act 2016*
BOS	Biodiversity Offset Strategy
CRZ	Core Riparian Zone
DA	Development Application
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DCP	Development Control Plan
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
KFH	Key Fish Habitat
LEP	Local Environmental Plan
LGA	Local Government Area
NRAR	Natural Resources Access Regulator
TEC	Threatened Ecological Community
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone
WCC	Wollongong City Council
WM Act	*Water Management Act 2000*

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by Newquest Property Pty Ltd to prepare this flora and fauna report to assess the potential impacts of the proposed rezoning at Cleveland Road, West Dapto (the 'study area'). The study area includes land to the north and south of Cleveland Road, within the suburbs of Huntley, Cleveland and Horsley, in the Wollongong Local Government Area (LGA).

Most of the study area is presently zoned RU2 rural landscape, apart from the northern vegetated areas which are zoned E2 Environmental Conservation. The planning proposal aims to rezone this land to R2 Low Density Residential and R3 Medium Density Residential to allow for a residential subdivision, with riparian and vegetated areas rezoned to E3 Environmental Management and E2 Environmental Conservation, two small business areas will be zoned B2 Local Centre and one B6 Enterprise Corridor, recreation areas in the south and east RE1 Public Recreation and roads (which are zoned as per Figure 2).

A planning proposal will be submitted to Wollongong City Council and will be assessed under Part 3 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report assessed the potential impacts to threatened ecological values listed under the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Recommendations for further work required at the development application stage (Part 4 of the EP&A Act) and approval pathway options have been provided.

Field survey was conducted across the study area and identified a range of ecological values, including three threatened ecological communities (TEC) listed under the BC Act - Illawarra Lowlands Grassy Woodland, Swamp Oak Floodplain Forest and Freshwater Wetlands. Some portions of these communities also met the condition thresholds for listing under the EBPC Act including Illawarra and South Coast Lowland Forest and Woodland and Coastal Swamp Oak (*Casuarina glauca*) Forest. Exotic pasture from past farming practices forms the largest vegetation zone across the study area.

The study area also contained numerous first, second and third order streams, as well as Mullet Creek, which is a fourth order stream. Potential habitat for threatened species includes remnant vegetation, farm dams, freshwater wetlands and hollow bearing trees. Based on previous records (DPIE 2020) and the habitat features present in the study area, 14 threatened fauna species and three threatened flora species are considered likely to occur.

Parts of the study area are mapped under the Biodiversity Values Map, Wollongong City Council (WCC) Biodiversity Overlay and Coastal Wetlands mapped under the Coastal Management SEPP are also present. These mapped areas will be affected by the proposed rezoning. All the TECs listed above will also be affected, however most of the large, good condition patches will be retained. Illawarra Lowlands Grassy Woodland endangered ecological community (EEC) is a listed entity for a Serious and Irreversible Impact (SAII) under the BC Act. At the DA stage, the consent authority will need to form an opinion as to whether the proposed development is likely to have a SAII on Illawarra Lowlands Grassy Woodland EEC..

The development footprint presented in this planning proposal has used the avoid, minimise and mitigate principles to retain areas of higher constraint and ecological value, concentrating development

in cleared areas. Potential approvals pathways and requirements such as Biodiversity Certification, preparation of a Biodiversity Development Assessment Report and an EPBC Act referral are discussed.

1. Introduction

1.1 Description of the project

This Flora and Fauna Assessment was prepared on behalf of Newquest Property Pty Ltd to accompany a Planning Proposal to rezone the 366 ha study area, within the suburbs of Cleveland, Horsley and Huntley in the Wollongong local government area (LGA). The proposed rezoning will allow for land currently zoned RU2 Rural Landscape to be rezoned to R2 Low Density Residential and R3 Medium Density Residential to allow for a residential subdivision. A majority of the riparian and vegetated areas will be rezoned to E3 Environmental Management and E2 Environmental Conservation (if not already). Two small business areas will be zoned B2 Local Centre and one B6 Enterprise Corridor. Recreation areas in the south and east will be rezoned to RE1 Public Recreation. Overall, the zoning will allow for the creation of approximately 3,000 residential lots, three sporting fields, two local business centres two sporting fields, one local park and passive open spaces.

The study area forms part of the West Dapto Urban Release Area. West Dapto has been identified as a regionally significant housing release area for the Illawarra region. Wollongong City Council has proposed to apply the Biodiversity Certification Assessment Methodology to the study area. The certification would identify and protect high conservation areas of land and identify areas suitable for development. If the certification process is successful, any certified land will not be required to be subject to further biodiversity assessments. However, if any development applications are submitted prior to certification, biodiversity assessments will be required in accordance with the *Biodiversity Conservation Act 2016*.

1.2 Study area

The study area is around 366 ha in size and is located to the north and south of Cleveland Road within the suburbs of Huntley in the west, Cleveland, and Horsley in the north (Figure 1). The study area is bounded by Mullet Creek to the south, the South Coast railway line to the east and existing residential development within Horsley to the north.

A majority of the study area is zoned as RU2 Rural Landscape, apart from the vegetated northern section of the study area which is zoned E2 Environmental Conservation under the Wollongong Local Environmental Plan (LEP) 2009. Parts of the study area are mapped as terrestrial biodiversity and riparian land under the Wollongong LEP 2009. A separate riparian land assessment has been undertaken by ELA (2020).

The study area is characterised by low lying, relatively flat farmland, which is currently used for grazing. There are small areas of remnant vegetation, farm dams and natural drainage lines, sometimes forming small wetlands.

Properties included in this assessment are listed in Table 1.

Table 1: Properties included in the study area

Lot	DP
1	532391
1	156208
59	1125379
1 and 2	730326
200 and 201	803810
401 and 402	1254873
310, 312 and 313	1188000
1	1126171
100	1086479
1	999485
A	156446
1	194419
1	741423

Within this report, the *study area* refers to the lots listed above. The *locality* refers to a 1 km radius around the study area.

1.3 Scope of works

This report will accompany a planning proposal for the rezoning of the study area as shown in Figure 2. The purpose of this report is to:

- document the existing environment, based on a desktop review and field survey
- outline the legislative context for the proposal
- discuss potential impacts associated with the proposal
- identify and describe ecological constraints.

This report considers the *Biodiversity Conservation Act 2016* (BC Act), *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report also outlines the legislative context of any future developments if a Part 4 development application is submitted, including whether future development of the site would trigger the Biodiversity Offsets Scheme under the BC Act.

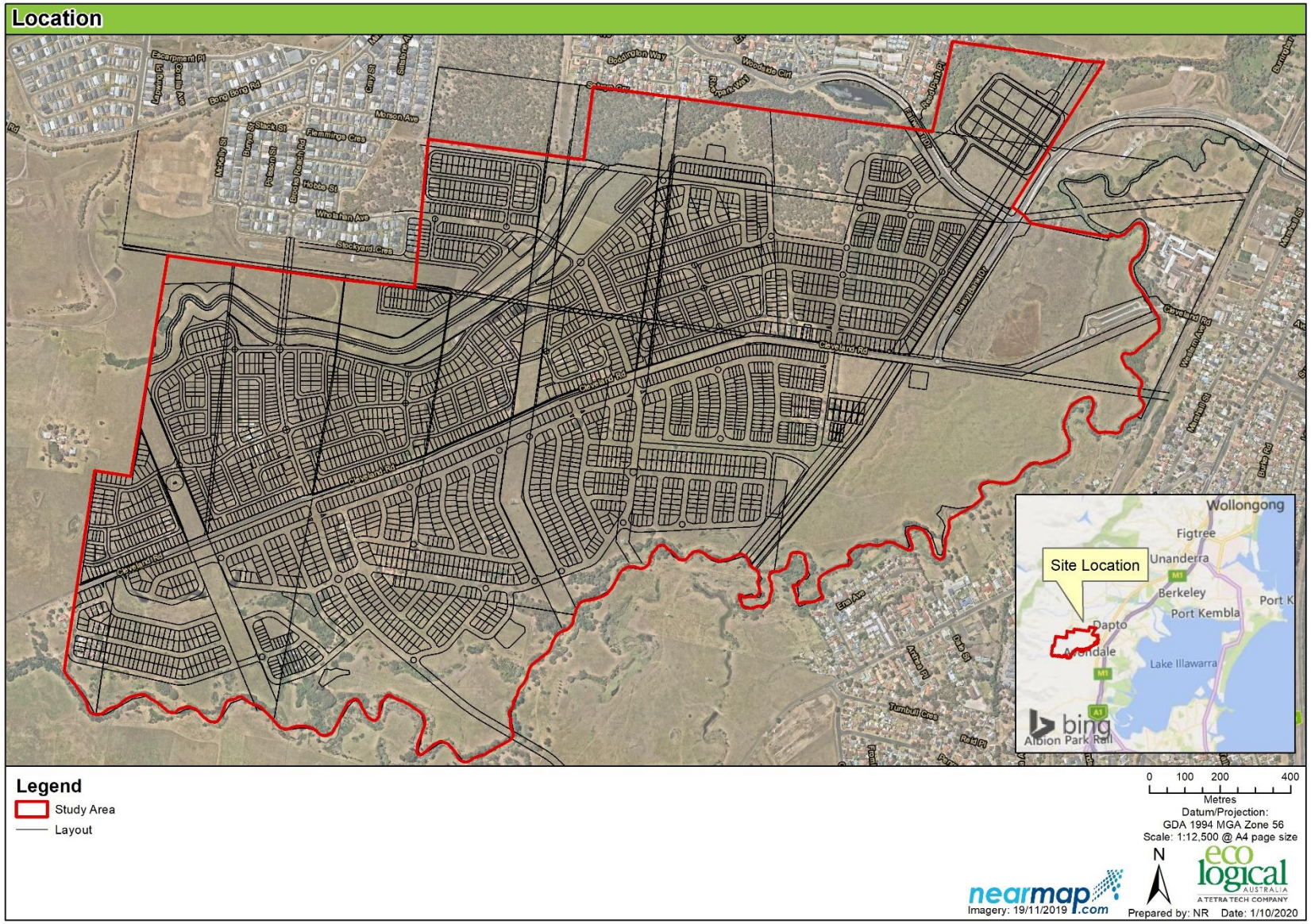
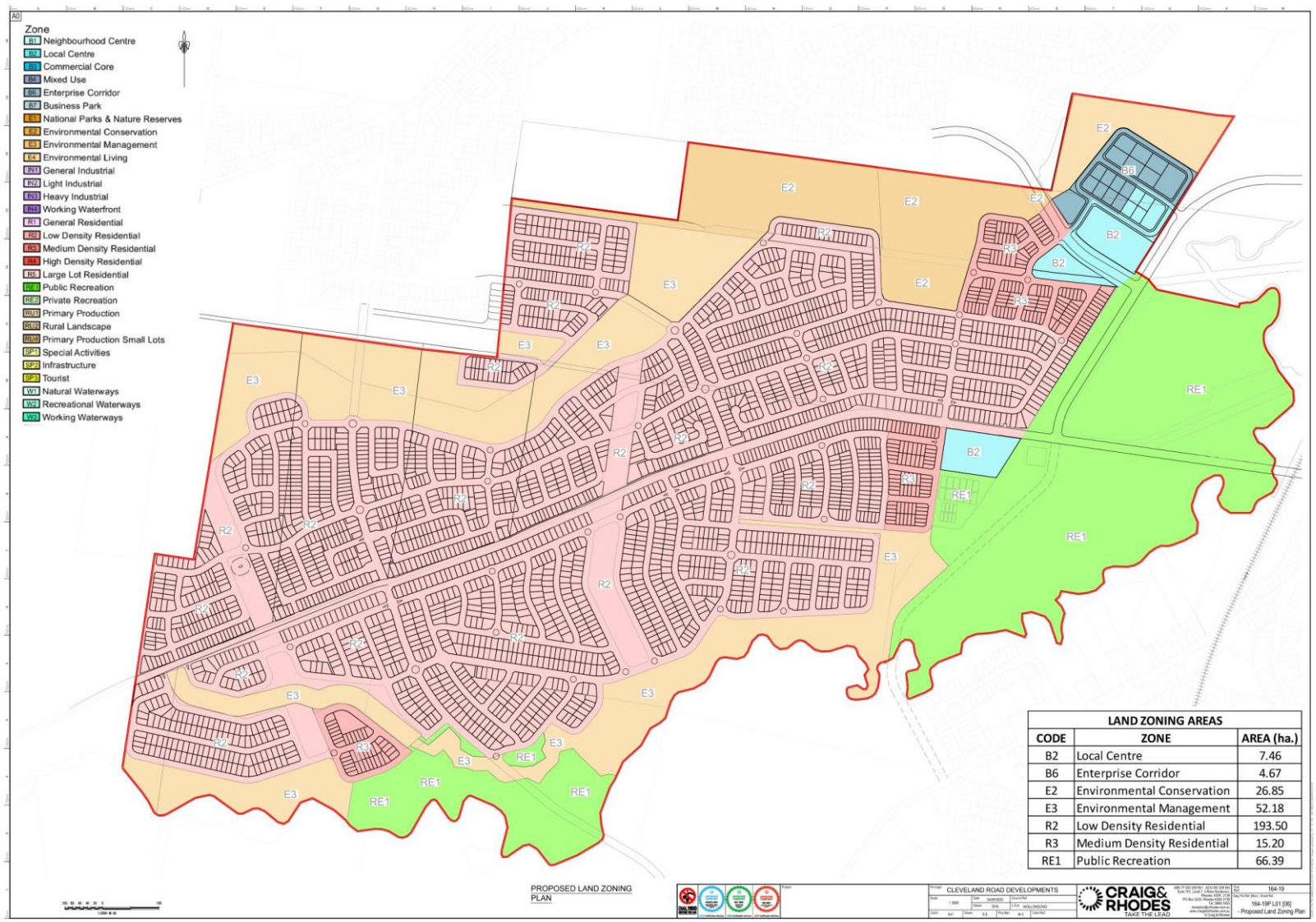


Figure 1: Location of the study area



LAND ZONING AREAS		
CODE	ZONE	AREA (ha.)
B2	Local Centre	7.46
B6	Enterprise Corridor	4.67
E2	Environmental Conservation	26.85
E3	Environmental Management	52.18
R2	Low Density Residential	193.50
R3	Medium Density Residential	15.20
RE1	Public Recreation	66.39

Figure 2: Proposed rezoning of the study area (Craig and Rhodes 2020)

2. Legislative Context

Table 2: Legislative context table

Name	Relevance to the project
Commonwealth	
Environment Protection and Biodiversity Conservation Act 1999	The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect Matters of National Environmental Significance (MNES), including vegetation communities and species listed under the EPBC Act. If a development is likely to have a significant impact on MNES, it is likely to be considered a 'Controlled Action' by the Commonwealth and requires assessment and approval by the Commonwealth to proceed. While a Planning Proposal is not an 'action' under the EPBC Act, this report describes the presence of potential MNES within the study area. However, assessment under the EPBC Act is not required for a proposed rezoning. Potential impacts to MNES must be considered for any future development applications.
State	
Environmental Planning and Assessment Act 1979	The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of development proposals. The proposed rezoning is to be assessed under Part 3 of the EP&A Act. The Act provides for the creation of the SEPPs, LEPs and Development Control Plans described below.
Biodiversity Conservation Act 2016	The *Biodiversity Conservation Act 2016* (BC Act) outlines the assessment requirements to determine whether a proposed development (Part 4 of the EP&A Act) is likely to significantly affect threatened species or ecological communities, or their habitats under section 7.3, and whether the Biodiversity Offsets Scheme (BOS) will be triggered. While Planning Proposals do not trigger the BOS, this report lists the potential impacts that may trigger the BOS at the Development Application (DA) stage. The BOS triggers include: • removal of native vegetation greater than the minimum lot size threshold • impacts to land that is mapped as having high biodiversity value on the Biodiversity Values Map or is considered to have Outstanding Biodiversity Value • if the development is determined to have a significant impact on any threatened flora, fauna or ecological communities listed under the BC Act (through the application of s7.3)
Fisheries Management Act 1994 **(FM Act)**	The Fisheries Management Act 1994 (FM Act) governs the management of fish and their habitat in NSW. The FM Act applies to waterways defined as 'key fish habitat' and threatened fish species, and therefore requires a separate assessment from the NSW Biodiversity Conservation Act 2016 (BC Act). The objectives of the FM Act are to conserve fish stocks and key fish habitats, conserve threatened species, populations and ecological communities of fish and marine vegetation and to promote ecologically sustainable development. The FM Act also regulates activities involving dredging and / or reclamation of aquatic habitats, obstruction of fish passage, harming marine vegetation and use of explosives within a waterway. To assess impacts to aquatic habitats, the regulatory framework of the FM Act and associated guidelines have been applied for this assessment. A riparian assessment report has been prepared by ELA (2020) and will addresses the implications of this Act in detail. In summary, no threatened aquatic species are considered likely to occur on site. Mullet Creek is mapped as Key Fish Habitat (KFH) and would be considered to by Class 2 Moderate KFH.
Water Management Act 2000 **(WM Act)**	The Natural Resources Access Regulator (NRAR) administers the NSW Water Management Act 2000 (WM Act) and is required to assess the impact of any proposed work on waterfront land. This includes

Name	Relevance to the project
	the bed and bank of any river, lake or estuary and land within 40 m of the highest bank. Certain activities within waterfront land are defined as 'controlled activities' and are subject to approval from NRAR. In order to inform a comparative and acceptable assessment of riparian impacts, the regulatory framework of the WM Act and associated guidelines have been adopted for this assessment. ELA's Riparian Assessment report (2020) provides a detailed analysis of the implications of the WM Act. In summary, the proposed layout will encroach the Vegetation Riparian Zone (VRZ) in a number of locations. ELA's Riparian Assessment proposes a number of areas which may be used for riparian offsetting purposes.
Environmental Planning Instruments	
State Environmental Planning Policy (Koala Habitat Protection) 2019	The aim of the State Environmental Planning Policy (Koala Habitat Protection) 2019 is to encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas. The City of Wollongong Local Government Area (LGA) is a listed LGA for which the State Environmental Planning Policy (Koala Habitat Protection) 2019 applies. Under the State Environmental Planning Policy (Koala Habitat Protection) 2019, any land that is mapped on the Koala Development Application map requires a Koala Plan of Management. Most of the vegetation within the study area is mapped on the Koala Development Application Map. As such, a Koala Assessment Report will need to be prepared consistent with the Koala Habitat Protection Guide. The SEPP does not apply to Part 3 EP&A Act proposals, however it will need to be addressed at the DA stage.
State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP)	Parts of the study area are mapped as "*coastal wetlands*" and the land surrounding these wetlands is mapped as "*proximity area for coastal wetlands".* Further consideration of this SEPP is provided in Section 4.1.5 and within the Riparian Assessment Report (ELA 2020).
Wollongong Local Environmental Plan 2009	The study area is zoned RU2 Rural Landscape under the Wollongong LEP. This planning proposal seeks to rezone the study area. Vegetated parts of the site are also covered by the Natural Resource Sensitivity – Biodiversity Map (Clause 7.2). This is discussed below in Section 4.1.5
Wollongong Development Control Plan 2009 (DCP)	The Wollongong DCP contains provisions relating to native vegetation and riparian values under clause 7.2 and 7.4 respectively.

3. Methodology

3.1 Literature review and database search

A review of the available databases pertaining to the ecology and environmental features of study area, and existing vegetation mapping was conducted to identify records of threatened species, populations and communities and their potential habitat. Databases and vegetation mapping that were reviewed included:

- BioNet (Atlas of NSW Wildlife) database search (5 km) threatened species, populations and ecological communities listed under the BC Act and EPBC Act (accessed on 14 January 2020)
- Biodiversity Values Map (LMBC 2020)
- NSW Planning Portal (DPIE 2020)
- EPBC Act Protected Matters Search Tool (PMST) (5 km) for threatened and migratory species, populations and ecological communities listed under the EPBC Act (accessed on 14 January 2020)
- Aerial photography and previous vegetation mapping (NPWS 2002, Tozer *et al.* 2010 and OEH 2016) to assess the extent of vegetation including mapped threatened ecological communities (TECs) listed under the BC Act and / or the EPBC Act.

- Previous flora and fauna assessments undertaken within the study area including:

    - Eco Logical Australia 2020. *Cleveland Road South, West Dapto Rezoning Planning Proposal*. Prepared for Newquest Property Pty Ltd.
    - Eco Logical Australia 2018. *Cleveland Road, West Dapto Rezoning Planning Proposal.* Prepared for Cleveland Group Holdings.
    - Ecoplanning 2019. *Flora and Fauna Assessment- Multiple Lots, 144-48 Cleveland Road, West Dapto, NSW.* Prepared for Cardno Pty Ltd.

Aerial photography (Nearmap and Google Earth) of the study area and the surrounds were also used to investigate the extent of vegetation cover and landscape features. In addition, relevant Geographic Information System (GIS) databases (soil, geology, drainage) were reviewed. Threatened species and communities identified from both the BioNet and Protected Matters Search tool were combined to produce a Likelihood of occurrence table, which lists species that are likely to occur at the site and will likely require further survey at the DA stage (Appendix B).

3.2 Field Surveys

Field survey details are listed below in Table 3.

Table 3: Field survey details

Properties	ELA staff	Dates	Survey hours	Weather conditions
Lot 401 and 402 DP1254873 Lot 402 DP1254873 Lot 310 and 312 DP1188000 Lot 100 DP1086479 Lot 200 and 201 DP803810 Lot 1 DP532391 Lot 1 DP999485 Lot 1 DP156208 Lot 59 DP1125379 Lot 1 and Lot 2 DP730326 Lot 1 DP1126171	Senior Ecologist Karen Spicer	21 and 26 May 2020	10	Cold and wet with light winds. Temperature ranged from 12 to 18.5ºC. Total rainfall during the survey was 0.4 mm on 21 May and 1 mm on 26 May with 28.8 mm fall during the days in between (Elders Weather 2020).
Lot 1 DP741423	ELA ecologist Rachel Brown	22 January May 2018	8	Sunny and humid 17.7°C to 30.2°C (BOM 2018)
Lot A DP 156446 Lot 1 DP194419 Lot 313 DP 1188000	ELA Ecologist Alex Gorey	11 and 16 May 2018	12	Extremely windy, cold and overcast on 11 May to sunny, still and warm on 16 May. Temperatures varied from 7.9°C to 18.8°C (BOM 2018).

The field survey aimed to:

- validate the existing vegetation mapping, assign a best-fit Plant Community Type (PCT) and determine the condition and extent
- assess threatened flora and fauna habitat
- map any hollow bearing trees or other habitat features such as waterbodies, rocky outcrops or woody debris
- opportunistically record threatened flora and fauna sightings.

3.2.1 Vegetation validation

Where the boundaries of vegetation communities differed from those mapped, they were modified using hard copy maps. A list of above ground vascular flora at various points throughout the study area was collected and used to determine the vegetation community likely to be present, and its condition.

Coastal Grassy Red Gum Forest (Plant Community Type (PCT) 838 and Lowland Woollybutt-Melaleuca Forest (PCT 1326) are consistent with the *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion*, listed as an Endangered Ecological Community (EEC) under the BC Act. An assessment was

undertaken to determine whether Coastal Grassy Red Gum Forest present within the study area met the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* (listed as a critically endangered ecological under the EBPC Act). The minimum requirement for a vegetation patch to meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* is:

- at least 0.5 ha in size, and
- at least 30% of total perennial understorey vegetative cover comprises native species AND
  - the patch is contiguous (within 100m) with another patch of native vegetation at least 1 ha in size OR
  - the patch has at least one large locally indigenous tree (at least 50 cm diameter at breast height) OR
  - at least one tree with hollows.

Each patch of PCT 838 and PCT 1326 was assessed using the above criteria to determine if it met the EPBC condition threshold.

Coastal Swamp Oak Forest (PCT 1232) is consistent with *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (EEC, BC Act) and is present in the study area. The community is also listed under the EPBC Act as the EEC *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. The minimum requirement for a patch of Coastal Swamp Oak Forest to meet the EPBC Act definition is:

- Meet key diagnostic characteristics (which include distribution, elevation, soil type, total crown cover of at least 10% and a canopy dominated by *Casuarina glauca*), and
- be at least 0.5 ha in size, and
- has a predominantly native understorey (non-native species comprise <20% of total understorey vegetation cover.

Each patch of PCT 1232 was assessed using the above criteria to determine if it met the EPBC condition threshold.

3.2.2 Threatened species habitat assessment

Threatened species habitat features such as hollow bearing trees, nests or fissures were identified and mapped using a handheld GPS unit. When hollow bearing trees were present, the tree species, number of hollows and size of each hollow was noted. When other habitat features were identified such as leaf litter, woody debris, water bodies or farm dams, their condition and location was marked and noted.

Any opportunistic fauna sightings were noted, and locations of threatened species were recorded with a handheld GPS.

3.2.3 Ecological constraints

Key consideration for the rezoning is to assess the ecological risks and the environmental impact approvals (EIA) process for future development. Under the BC Act, these key considerations include whether the future development will:

- Trigger the biodiversity offsets scheme (BOS) by
  - affecting land mapped on the Biodiversity Values Map

  - clearing more than the minimum lot size threshold (for this study area, the clearing threshold is 0.5 ha)
  - significantly affecting any threatened flora, fauna or ecological communities.
- Once triggered, the BOS requires that the impact is assessed through a Biodiversity Development Assessment Report (BDAR). Critical issues for this site are the potential for proposed impacts to be considered a serious and irreversible impact (SAII) by the approval authority (Council) and the cost of offsetting residual (unavoidable) impacts.

- The requirement to refer the proposed action under the EPBC Act. An action must be referred if, when determined through a self-assessment, a development is likely to have a significant impact on MNES. The Commonwealth then decides if the development is a 'Controlled Action', therefore requiring assessment and approval by the Commonwealth to proceed. This planning proposal is not an 'action' under the EPBC Act, however the constraint categories in Table 4 consider these future risks.

Table 4: Constraint ratings and reasoning

Constraint rating	Reason
Very high	• listed as a threatened ecological community under the BC Act and in good condition • listed as a threatened ecological community under EPBC Act (ie. the vegetation patch meets the condition thresholds) • is listed as a threatened species or migratory species under the BC Act or EPBC Act • is a listed entity for a serious and irreversible impact under the BC Act and occurs in a good condition • areas mapped under the biodiversity values map • coastal wetlands mapped under the Coastal Management SEPP • Mullet Creek, a 4th order riparian corridor • Freshwater wetlands (natural and not farm dams)
High	• Illawarra Grassy Woodland EEC in moderate, poor, derived native shrubland and scattered paddock tree conditions • areas mapped as *proximity area to coastal wetlands* under the Coastal Management SEPP • mapped under WCC Clause 7.2 (Biodiversity Map) • 2nd and 3rd order watercourses
Moderate	• Planted native vegetation • areas that could provide threatened species habitat eg. culverts and old farm buildings • farm dams
Low	• 1st order streams • exotic cover • exotic pasture

3.3 Survey Limitations

The assessment is not intended to provide an inventory of all species present across the study area but instead an overall assessment of the ecological values of the site with emphasis on threatened species,

threatened ecological communities and key fauna habitat features. Targeted surveys for threatened flora and fauna were not conducted as a part of this assessment. The habitat features present in the study area were used to make a preliminary assessment as to which species were likely to be present.

Vegetation mapping of an area seeks to describe the distribution of the plant species in that area at that time by defining several vegetation units (assemblages or communities), which are relatively internally homogeneous. This generalised approach can oversimplify the real situation as plants rarely occur in well-defined communities with distinct boundaries. Accordingly, vegetation units used for mapping should be viewed as indicative of their extent.

4. Results

4.1 Literature review and database search

4.1.1 Vegetation and ecological communities

Regional vegetation mapping by OEH 2016 previously mapped seven vegetation communities within the study area (Figure 3):

- Artificial wetlands
- Coastal Grassy Red Gum Forest
- Coastal Swamp Oak Forest
- Fig Trees
- Floodplain Wetland
- Lowland Woollybutt-Melaleuca Forest
- Weeds and Exotics.

The BioNet Atlas and PMST search returned a total of 6 threatened ecological communities that may occur within the locality (Appendix B).

4.1.2 Threatened flora and fauna

The BioNet Atlas and PMST search returned a total of 68 threatened fauna species (including migratory species) and 20 threatened flora species as occurring, or having the potential to occur, within a 10 km radius of the study area. No threatened fauna or flora have been previously recorded within the study area (Figure 4).

4.1.3 Biodiversity Values Map

Areas of the study area are mapped on the Biodiversity Values Map (LMBC 2020) as shown in Figure 5. In particularly, these areas include the Mullet Creek riparian corridor, three wetland areas and vegetation within northern portion of the study area.

4.1.4 State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) applies to the study area as shown in Figure 6. Parts of the study area are mapped as “coastal wetlands” and the land surrounding these wetlands is mapped as “proximity area for coastal wetlands”. Further consideration of this SEPP is provided in the Riparian Assessment Report (ELA 2020). Development within coastal wetlands is considered to be ‘designated development’ under the EP&A Act (requiring an Environmental Impact Statement) and must not be granted unless the consent authority is satisfied that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland.

Development within the *proximity area for coastal wetlands* must not be granted unless the consent authority is satisfied that the proposed development will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

4.1.5 Wollongong Local Environmental Plan 2009 Biodiversity Overlay

Many vegetated parts of the site are also covered by the *Natural Resource Sensitivity – Biodiversity Map* (Clause 7.2 WCC LEP 2009) (Figure 7). The objectives of this clause are to protect, maintain or improve the diversity and condition of native vegetation and habitat. At the DA stage, consideration of this clause must be included as follows:

(3) Development consent must not be granted for development on land to which this clause applies unless the consent authority has considered the impact of the development on—

(a) native terrestrial flora and fauna and its habitat, and

(b) native aquatic flora and fauna and its habitat, and

(c) the ecological role of the land, waterways, riparian land or wetland, and

(d) threatened species, communities, populations and their habitats.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development is consistent with the objectives of this clause and—

(a) the development is designed, sited and managed to avoid potential adverse environmental impact, or

(b) if a potential adverse environmental impact cannot be avoided, the development—

(i) is designed and sited so as to have minimum adverse environmental impact, and

(ii) incorporates effective measures so as to have minimal adverse environmental impact, and

(iii) mitigates any residual adverse environmental impact through the restoration of any existing disturbed or modified area on the site.

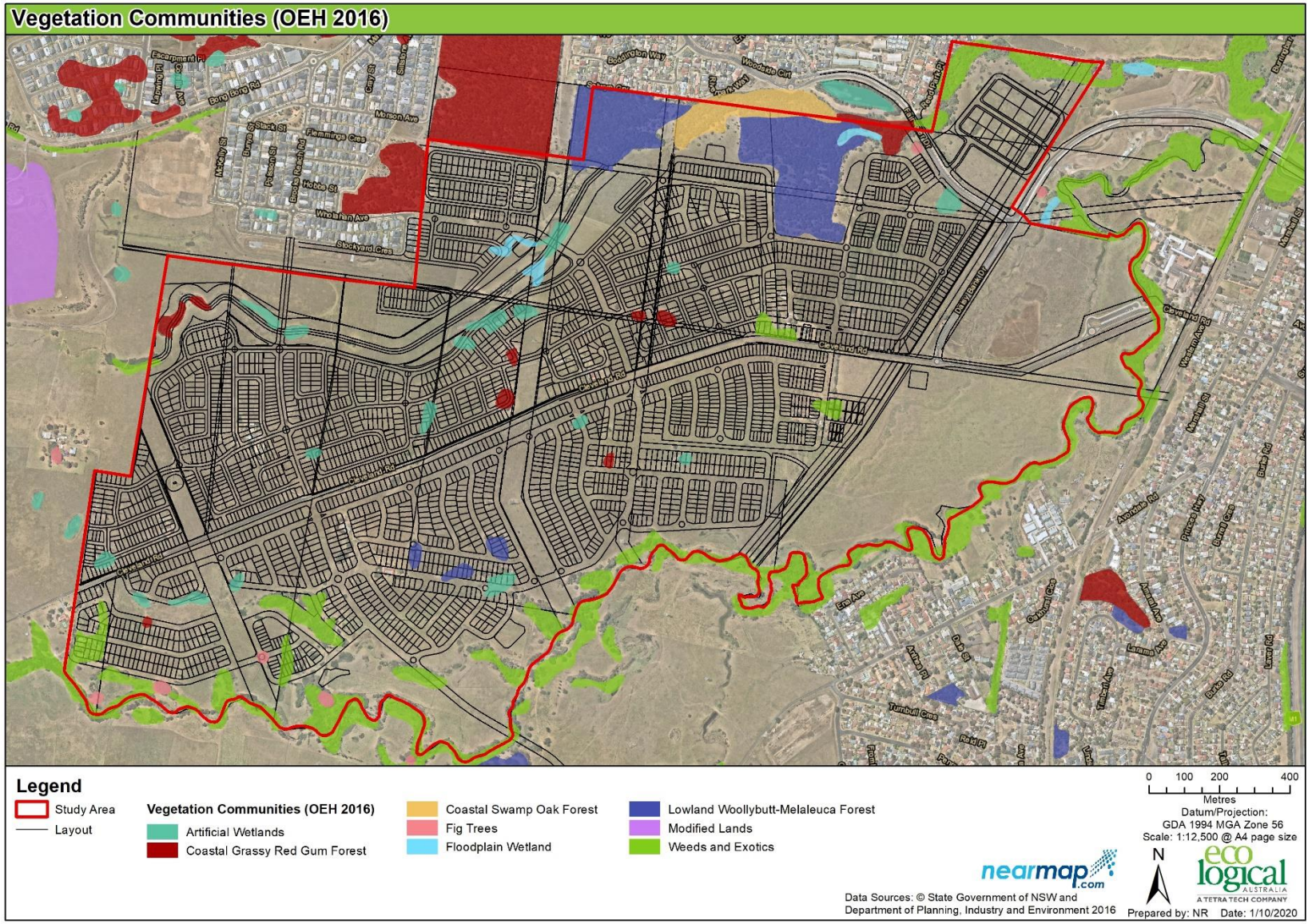


Figure 3: Previous vegetation mapping of the study area (OEH 2016)

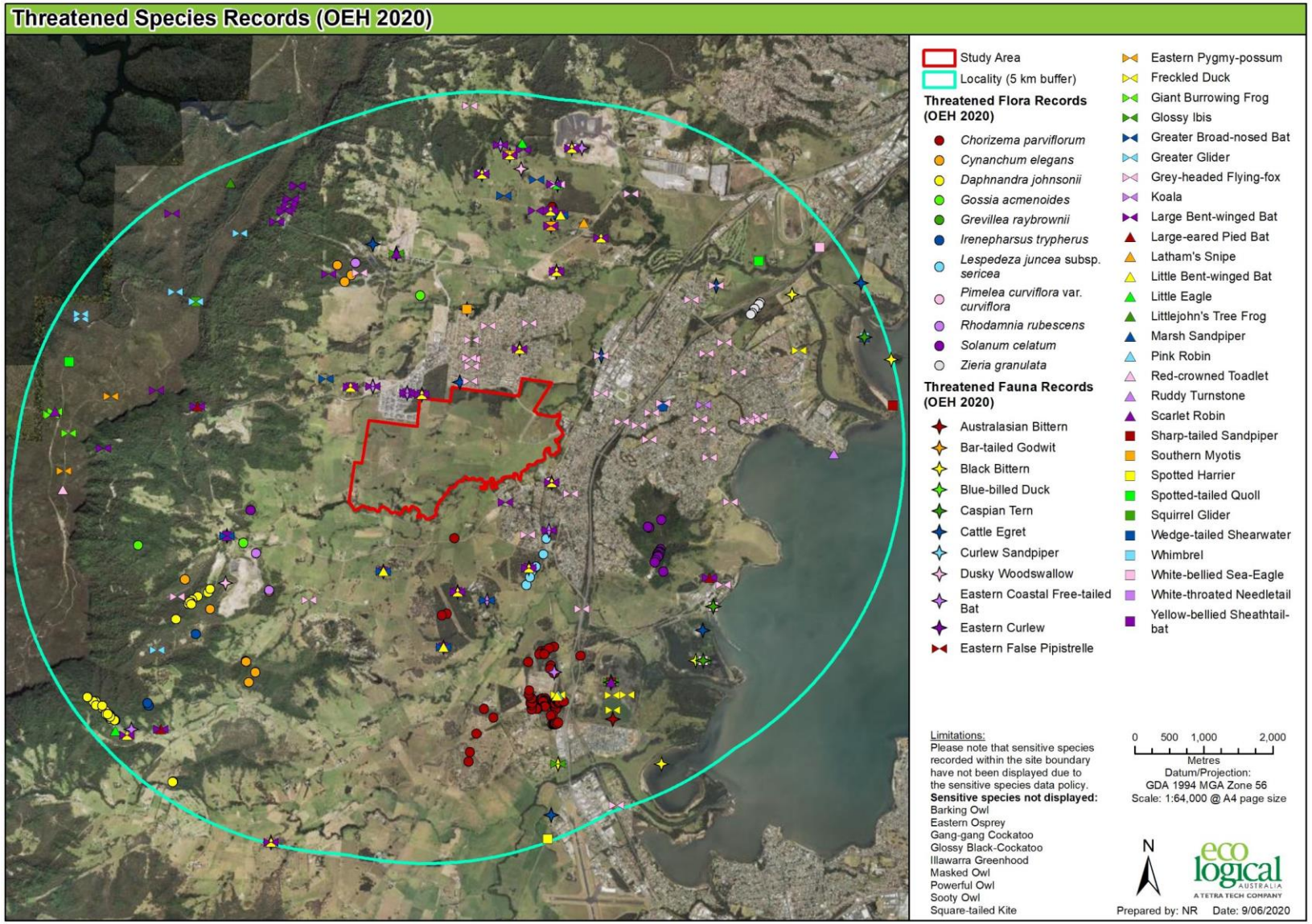


Figure 4: BioNet Atlas search results for 5 km from the study area

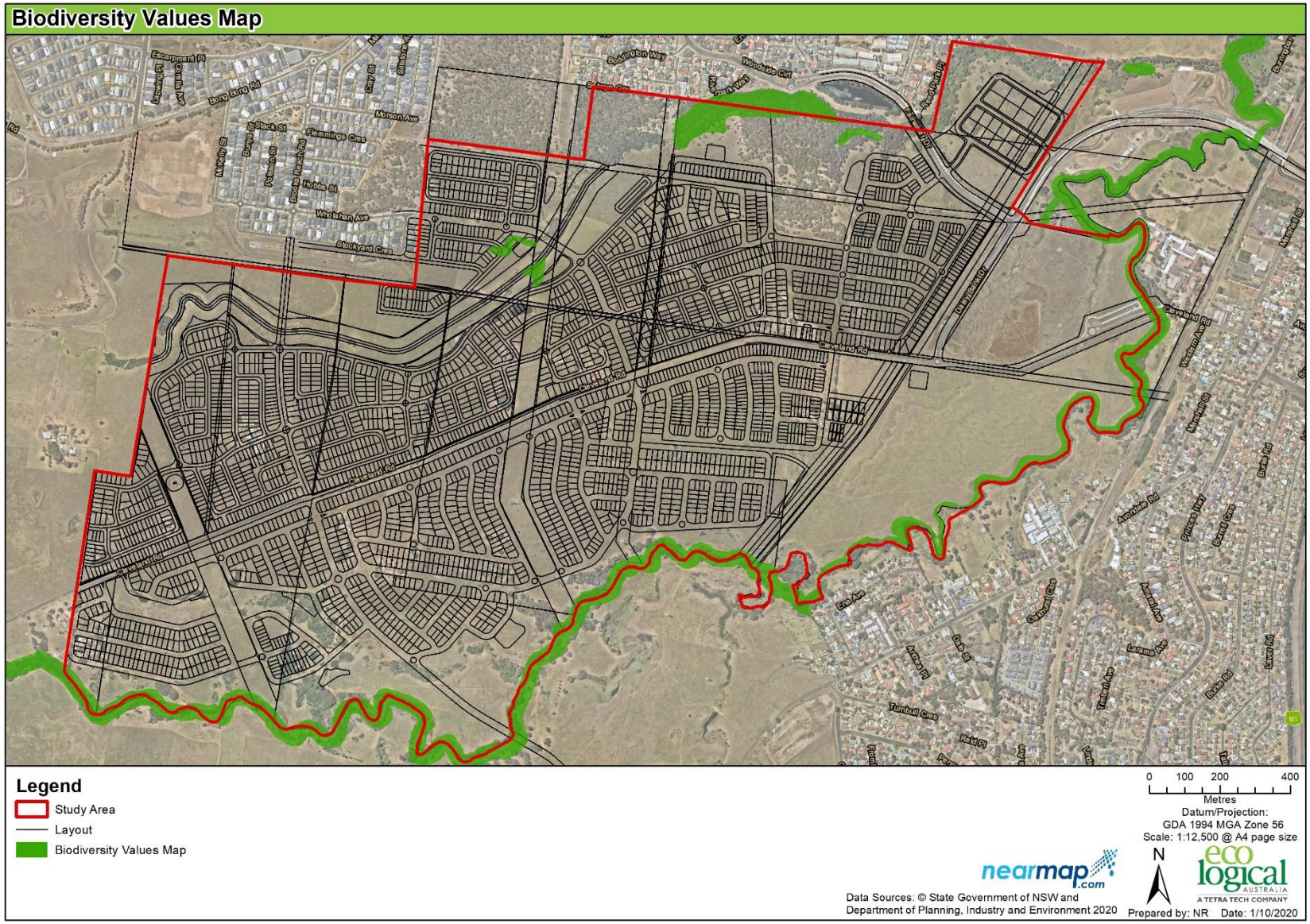


Figure 5: Biodiversity Values mapping across the study area (May 2020)

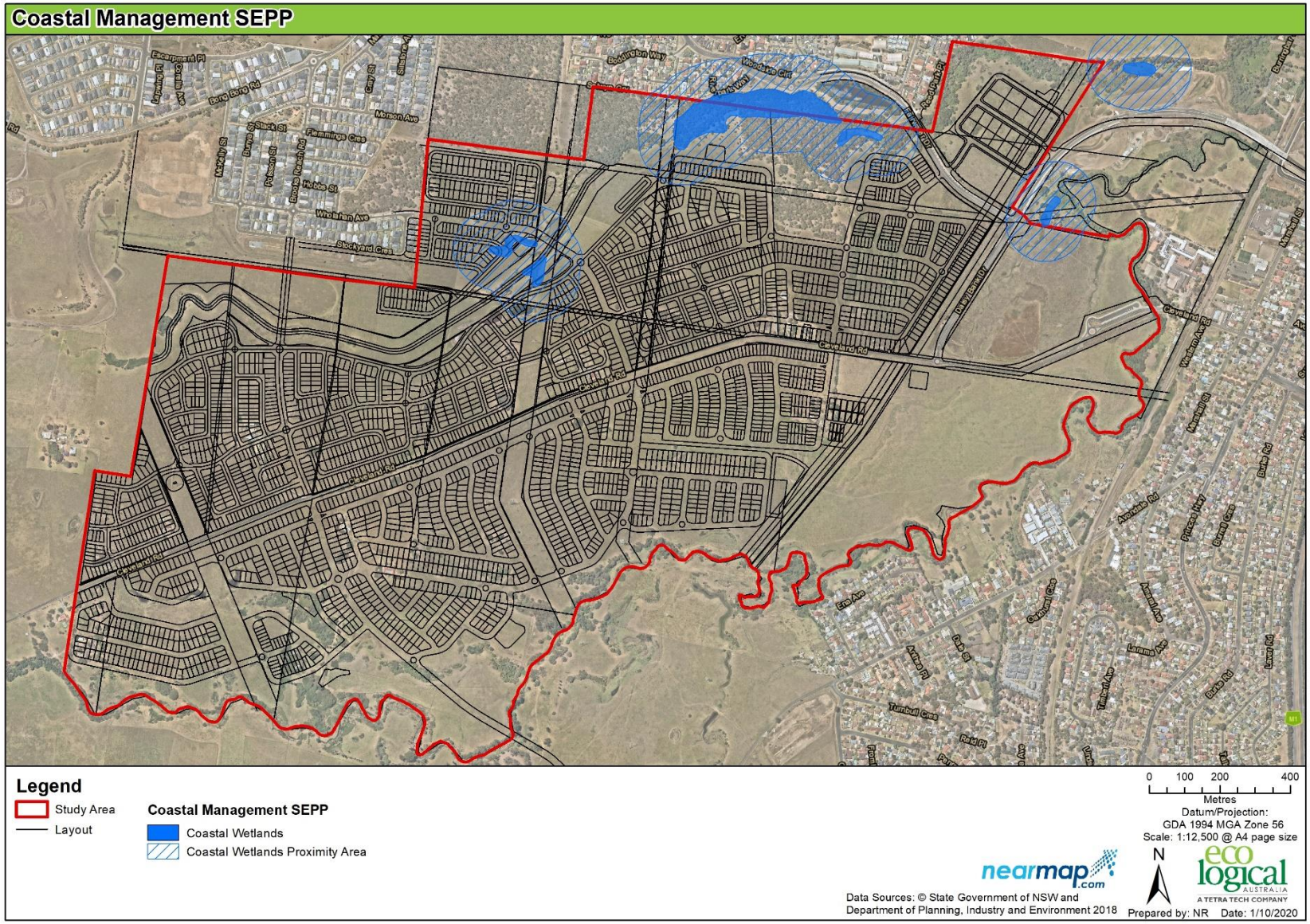


Figure 6: Coastal wetlands and proximity areas as mapped under the Coastal Management SEPP

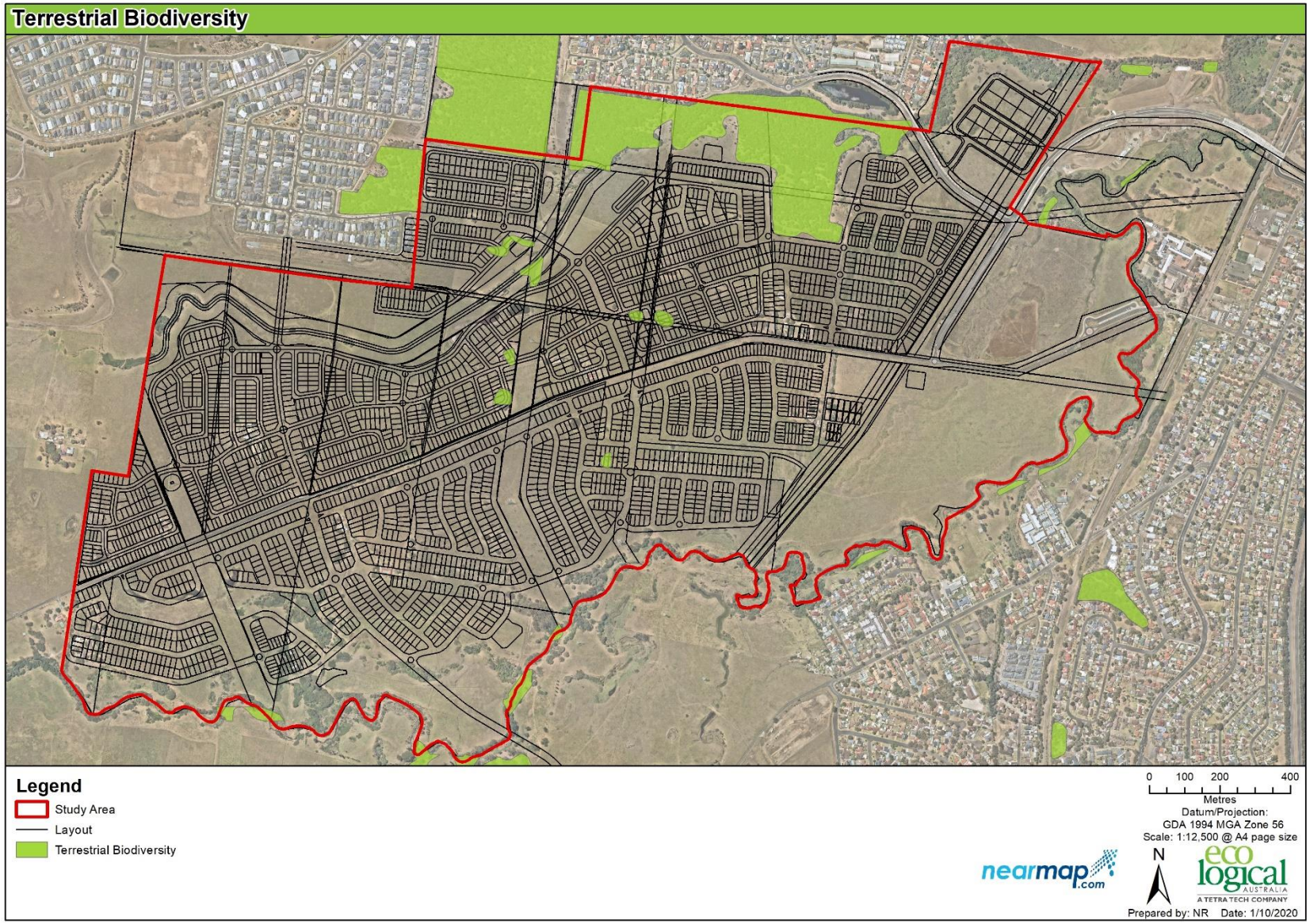


Figure 7: Wollongong LEP 2009 Natural Resource Sensitivity – Biodiversity Map (Clause 7.2 WCC LEP 2009)

4.2 Field Survey Results

4.2.1 Vegetation communities

The field survey identified four plant community types (PCTs) and four vegetation types, that did not meet a PCT, in the study area (Table 5). The PCTs were refined into vegetation zones based on structural complexity and condition, which are also listed in Table 5.

Three threatened ecological communities were identified within the study area:

- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (Endangered, BC Act) / Illawarra and South Coast Lowland Forest and Woodland (Critically Endangered, EPBC Act) – corresponds to PCT 838 and PCT 1326
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered, BC Act) / Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Endangered, EPBC Act) – corresponds to PCT 1232
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion (Endangered, BC Act, not listed under the EPBC Act) - corresponds to PCT 1071 for natural wetlands only (not farm dams).

All condition classes of PCT 838, 1326 and 1232 meet the definition of the corresponding threatened ecological community as listed under the BC Act. The condition thresholds for *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* and *Illawarra and South Coast Lowland Forest and Woodland* were applied to all vegetation zones containing the corresponding PCTs listed above, to determine whether they met the EPBC Act definition of the community. Each zone was assessed against the criteria outlined in Section 3.2.1.

Table 5 lists all the vegetation communities and their various condition states (vegetation zones), along with the area of each vegetation zone within the study area. Some condition states meet the EPBC condition thresholds, as shown in Table 5.

The validated vegetation map of the study area is shown in Figure 8. Vegetation that meets the EPBC Act condition thresholds is shown in Figure 9. A description of each vegetation zone is provided below Table 5 and Figure 8.

Table 5: Validated vegetation communities recorded within the study area, condition, conservation status and area within the study area

ELA field validated name	Plant Community Type ID and Scientific Name	Vegetation community (NPWS 2002)	Condition	BC Act	EPBC Act	Area (ha)
Coastal Grassy Red Gum Forest	838 Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Coastal Grassy Red Gum Forest MU23	Good	E	CE	3.08
			Moderate	E	Condition threshold not met	0.62
			Poor	E	Condition threshold not met	2.78
			Derived Native Shrub	E	Condition threshold not met	2.26
			Scattered Paddock Trees	E	Condition threshold not met	0.45
Lowland Woollybutt-Melaleuca Forest	1326 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Lowland Woollybutt-Melaleuca Forest MU24	Good	E	CE	5.16
			Moderate	E	Condition threshold not met	0.94
			Poor	E	Condition threshold not met	1.11
			Derived Native Shrub	E	Condition threshold not met	0.65
			Scattered Paddock Trees	E	Condition threshold not met	0.27
Coastal Swamp Oak Forest	1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Coastal Swamp Oak Forest MU36	Good	E	E	5.80
			Moderate	E	E	1.00
			Poor	E	Condition threshold not met	2.34
Freshwater wetland	1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Floodplain Wetland MU54	Good	E	Not listed	0.80
Planted native cover	-	-	-	-	-	1.33
Fig Tree	-	-	-	-	-	0.13
Exotic cover	-	-	-	-	-	9.00
Exotic pasture	-	-	-	-	-	326.38
Farm Dams	-	-	-	-	-	-
Total area						**364.09**

Key: E= Endangered, CE = Critically Endangered

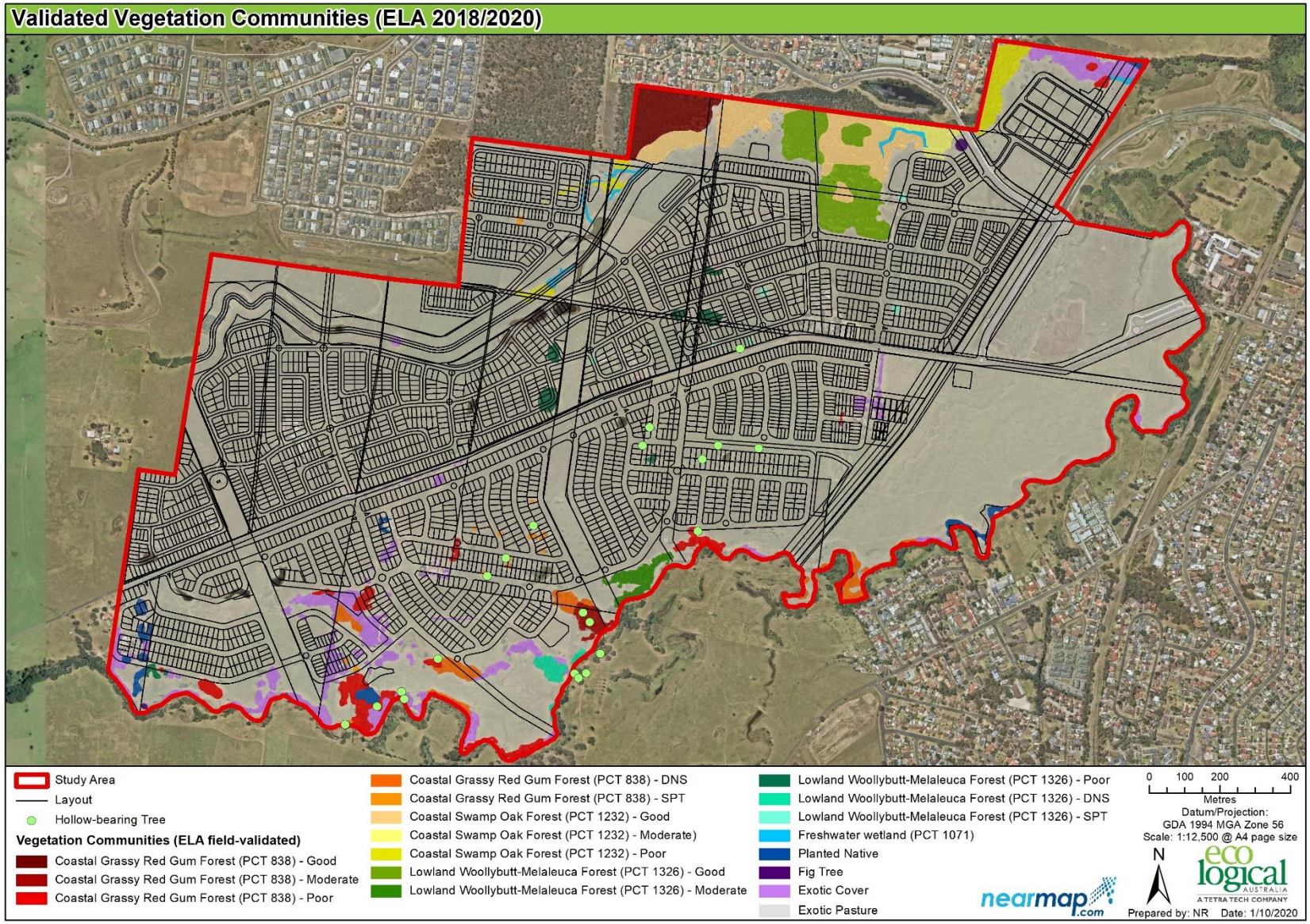


Figure 8: Validated vegetation communities and hollow bearing trees

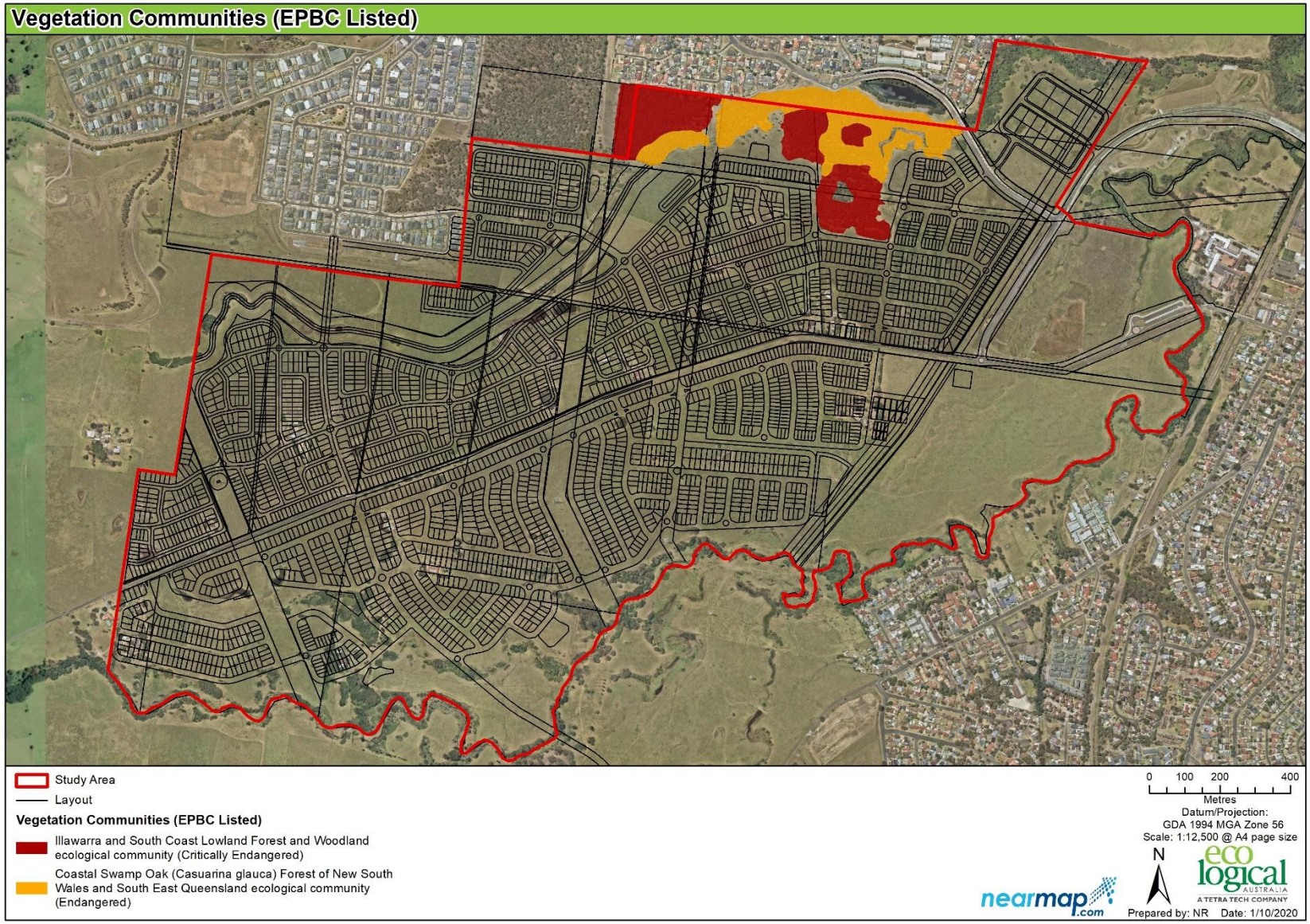


Figure 9: Vegetation within the study area that meets the condition thresholds for listing under the EPBC Act

4.2.1.1 PCT 838 Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

PCT 838 was mapped within the study area in five condition states – good, moderate, poor, derived native shrub and scattered paddock trees. Each vegetation zone is described below.

PCT 838_Good occurred as a relatively large intact patch along the northern boundary of the study area. The structure of this community included a closed sub-canopy dominated by *Melaleuca decora* and *M. styphelioides* with the odd occurrence of *Callistemon salignus.* Emergent eucalypt canopy species were sparse and included *Eucalyptus eugenioides* and *E. tereticornis,* with a single occurrence of *E. amplifolia* and *E. bosistoana* also recorded. The shrub layer vegetation was sparse but dominated by *Leucopogon juniperinus* with *Breynia oblongifolia, Bursaria spinosa* and *Streblus brunonianus* also recorded. The ground cover was diverse and included *Arthropodium milleflorum, Brunonia australis, Carex longebrachiata, Cheilanthes sieberi, Cymbopogon refractus*, *Dichondra repens, Echinopogon caespitosus, Geitonoplesium cymosum, Glycine clandestine, Lobelia purpurascens, Microlaena stipoides* and *Oplismenus imbecillis*. The climber *Parsonsia straminea* was present in the canopy. Exotic species included *Asparagus aethiopicus, Lantana camara, Ligustrum sinense, Olea europaea* subsp. *cuspidata* and *Rubus fruticosus* spp. agg., but occurred at low density. This patch met the EPBC Act condition criteria for the critically endangered community *Illawarra and South Coast Lowland Forest and Woodland* (Figure 10).

Figure 10: PCT 838 in good condition

PCT 838_Moderate condition occurred as a single patch south of Cleveland Road adjacent to Mullet Creek. It contained all structural layers, with a canopy dominated by *Eucalyptus saligna* x *botryoides*, *Eucalyptus botryoides, Eucalyptus bosistoana* and *Angophora floribunda*. The midstorey contained *Acacia mearnsii, Pittosporum undulatum* and *Pittosporum multiflorum.* The groundcover contained a mix of native and exotic grasses and forbs. The extent of native groundcover fluctuated and contained *Microlaena stipoides, Desmodium varians, Dichondra repens, Oplismenus imbecilis* and *Imperata cylindrica*. The patch of moderate PCT838_moderate condition did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* because the groundcover did not contain >30% native perennial species (Figure 11).

Figure 11: PCT838 in moderate condition in the study area

PCT838_Poor condition occurred primarily south of Cleveland Road as several separate patches, mostly associated with Mullet Creek. Not all structural layers were present. The canopy was dominated by *Eucalyptus saligna* x *botryoides*, *Eucalyptus tereticornis* and *Angophora floribunda*. The midstorey was dominated by exotic species including *Lantana camara* (Lantana), *Rubus fruticosus* spp. agg. (Blackberry), *Ligustrum lucidum* (Large-leaved Privet) and *Ligustrum sinense* (Small-leaved Privet). The groundcover was dominated by exotic species with native species occurring only occasionally. These patches contained a contiguous canopy where trees were <10 m apart. These patches did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers (Figure 12).

Figure 12: PCT 838 in poor condition

PCT 838_Derived Native Shrubland condition occurred to the south of Cleveland Road along first order creek lines and Mullet Creek. It was present as patches of shrubs with no typical diagnostic canopy species layer present. *Acacia mearnsii, Acacia falcata, Ficus macrophylla (Moreton Bay Fig), Ficus Coronata (Sandpaper Fig)* and *Pittosporum undulatum* were present as midstorey species. However, the midstorey was dominated by exotic species including *Lantana camara* (Lantana), *Rubus fruticosus* spp. agg. (Blackberry) and *Ligustrum sinense* (Small-leaved Privet). The groundcover was dominated by exotic species and contained *Ehrharta erecta, Sporobolus africanus, Setaria gracilis* and *Solanum pseudocapsicum,* with native species occurring only occasionally. *Ficus macrophylla* and *F. coronata* are likely to remain from historic clearing and while they are not characteristic of the community, they are common species on the alluvial plains and were generally retained for shelter and aesthetic purposes. These patches while species poor and lacking distinctive structural elements would correspond with the threatened *community Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* (Endangered, BC Act), but did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the patch size less than 0.5 ha and the ground cover did not contain >30% native perennial species (Figure 13).

Figure 13: PCT 838 in the derived native shrub (DNS) condition state

PCT 838_Scattered Paddock Trees, consisted of isolated *Eucalyptus tereticornis* that did not form a contiguous canopy and were >10 m apart from other canopy species. No native midstorey or groundcover was present. The groundcover was dominated by *Cenchrus clandestinus, Cynodon dactylon, Rubus fruticosus* spp. agg., *Paspalum dilatatum* and *Senecio madagascariensis*. These patches did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers (Figure 14).

Figure 14: PCT 838 Scattered Paddock Tree

4.2.1.2 PCT 1326 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

PCT 1326 was mapped within the study area in five condition states – good, moderate, poor, derived native shrubland and scattered paddock trees. Each vegetation zone is described below.

PCT 1326_Good occurred as a relatively large intact patch along the northern boundary of the study area and occupied the slightly higher elevations compared to the adjacent areas of Coastal Swamp Oak Forest (PCT 1232). The structure and composition of this community was very similar to PCT 838-Good but lacked emergent canopy species. It featured a closed sub-canopy dominated by *Melaleuca decora,* with *M. styphelioides* also present and the odd occurrence of *Casuarina glauca* as an emergency canopy tree. The native shrub layer was virtually absent. The ground cover included *Alternanthera denticulata, Brunonia australis, Centella asiatica, Carex longebrachiata, Cymbopogon refractus*, *Commelina cyanea*, *Dichondra repens, Euchiton sphaericus, Microlaena stipoides, Oplismenus imbecillis, Pandorea pandorana* and *Veronica plebeia*. The climber *Parsonsia straminea* was present in the canopy. Exotic species included *Lantana camara, Plantago lanceolata*, *Rubus fruticosus* spp. agg., *Solanum pseudocapsicum, Senecio madagascariensis* and *Sporobolus africanus* and occurred at higher densities in some areas, particularly within the southern sections of the patch, which had a sparser canopy cover. This patch met the EPBC Act condition criteria for critically endangered community *Illawarra and South Coast Lowland Forest and Woodland*.

PCT 1326_Moderate occurred as a single patch south of Cleveland along Mullet Creek. It contained a canopy of *Eucalyptus bosistoana*. The midstorey contained *Melaleuca styphelioides, Melaleuca decora* and *Alphitonia excelsa*. The midstorey and canopy also contained exotic species including *Lantana camara, Rubus fruticosus* spp. agg. and *Ligustrum lucidum*. The groundcover varied in condition. Native species present included *Blechnum cartilagineum, Pandorea pandorana, Pellaea falcata, Lomandra longifolia* and *Geranium solanderi*. Exotic species also included *Anredera cordifolia, Urtica dioica, Lantana camara* and *Tagetes minuta*. These patches did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers (Figure 15).

Figure 15: PCT 1326 in moderate condition

PCT 1326_Poor condition occurs as small vegetation patches within cleared exotic pasture on both sides of Cleveland Road. It consists of relatively closed canopy of *Melaleuca styphelioides* and *M. decora*. Some patches also included the odd *Eucalyptus tereticornis.* A native midstorey and groundcover was absent with these patches occurring as remnant trees amongst exotic pasture grasses and in some cases bare ground. The exotic ground cover included *Cenchrus clandestinus, Hypochaeris radicata, Senecio madagascarensis,* and *Sida rhombifolia.* These patches but did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers (Figure 16).

Figure 16: PCT 1326 in poor condition

PCT 1326_Derived Native Shrubland occurs south of Cleveland Road as several small patches around drainage lines and Mullet Creek. It consists of a midstorey of *Acacia mearnsii, A. longifolia, Melaleuca decora, Melaleuca styphelioides, Alphitonia excelsa* (Red Ash) and *Pittosporum revolutum* (Wild Yellow). The midstorey also contained exotic species including *Lantana camara* (Lantana), *Rubus fruticosus* spp. agg. (Blackberry), and *Ligustrum sinense* (Small-leaved Privet). No canopy species were present. The groundcover varied in condition and extent but was dominated by exotic species including *Eragrostis curvula, Ehrharta erecta, Verbena bonariensis, Tagetes minuta, Hypochaeris radicata, Modiola caroliniana* and *Cenchrus clandestinus.* Where native species were present they included *Commelina cyanea* and *Dichondra repens, Glycine tabacina, Juncus usitatus* and *Poa labillardierei.* These patches did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers (Figure 17).

Figure 17: PCT 1326 as Derived Native Shrubland in the study area

PCT 1326_Scattered Paddock Trees are scattered throughout the study area as isolated paddock trees of *Melaleuca decora* and *Melaleuca styphelioides* and are located >50 m from a vegetation patch. These trees did not form part of a contiguous canopy. The isolated trees did not form part of a patch and did not contain a midstorey. These patches did not meet the EPBC Act definition of *Illawarra and South Coast Lowland Forest and Woodland* due to the absence of native species in all structural layers.

4.2.1.3 PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

PCT 1232 was mapped within the study area in three condition states – good, moderate and poor. Each vegetation zone is described below.

PCT 1232_Good was occurs within the large northern patch of vegetation and consists of dense stands of *Casuarina glauca* canopy trees. It's located along a permanent water course and other low lying areas that flows in a north and easterly direction across the top of the study area before draining into Mullet Creek. The mid-storey was sparse apart from juvenile *Casuarina glauca.* The ground layer is also relatively sparse, but was dominated by the native grass *Oplismenus imbecillis,* with *Dichondra repens, Microlaena stipoides* and *Juncus usitatus* also common. Within the canopy, the native vine *Parsonsia straminea* was common and the mistletoe *Amyema cambagei* was also recorded. Weed species varied in density but included *Solanum pseudocapsicum, Sida rhombifolia, Ligustrum sinense* and *Araujia sericifera.* This area of PCT 1232_good condition meets the condition criteria for *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Endangered, EPBC Act) (Figure 18).

Figure 18: PCT 1232 in good condition

PCT 1232_Moderate occurred along a section of the creek line close to the northern boundary. The vegetation is essentially the same as good PCT1232_good condition, except for the cover of weed species, in particular *Lantana camara,* which forms some dense cover. This area still meets the condition criteria for *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Endangered, EPBC Act), given it is a large patch (at least 2 ha), meets the key diagnostics and contains some native understorey (Figure 19).

Figure 19: PCT 1232 in moderate condition

PCT 1232_Poor includes mature and immature stands of *Casuarina glauca* with a predominantly exotic understorey. It occurs as small patches north of Cleveland Road and east of Fairwater Drive. These patches do not meet the condition criteria for *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Endangered, EPBC Act) due to the small patch size and low cover of native species. The patch to the east of Fairwater Drive includes a sub-dense canopy of *Melaleuca styphelioides* with some *Casuarina glauca* canopy tree and a moist understorey that forms the banks of a permanent creekline. Weed invasion is dense, but mesic species associated with rainforest vegetation are also common. Such species include*, Adiantum formosum, Asplenium flabellifolium, Backhousia myrtifolia, Celastrus australis, Croton verreauxii* and *Streblus brunonianus.* Given the canopy of *Melaleuca styphelioides* and *Casuarina glauca* and the landscape position along a low-lying creekline, PCT 1232 seems a reasonable fit, but during more in depth investigation, involving analysis of floristic plot data, another PCT may result in a better fit.

4.2.1.4 PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

These freshwater wetlands occur in several locations to the north of Cleveland Road. In some cases, these wetlands have been created by artificial dam walls and in other cases, they occupy low-lying, low flow sections of the drainage lines along the north of the study area. The wetlands bounded by PCT 1232 are dominated by a dense cover of *Typha orientalis* (Figure 20). Wetlands to the south of the large vegetation patch, adjacent to patches of PCT1232_poor were dominated by *Schoenoplectus validus* and *Persicaria decipiens.* Given the low abundance of weed species, all these wetlands were assigned a good condition. Where this PCT occurs as a natural wetland and is not part of a farm dam, it is considered to meet the definition of *Sydney Freshwater Wetlands in the Sydney Basin Bioregion* (Endangered, BC Act, not listed under the EPBC Act) (Figure 20).

Figure 20: PCT 1071 located within the northern portion of the study area

4.2.1.5 Exotic cover

The majority of Mullet Creek and the surrounding riparian vegetation contained exotic species. The canopy was dominated by *Erythrina x skyesii* (Coral Tree) and the midstorey was dominated by *Celtis sinensis, Cinnamomum camphora, Ligustrum sinense, Lantana camara* and *Salix* sp. *Solanum mauritianum*. The groundcover was dominated by exotic species including patches of *Rubus fruticosus* spp. agg. Exotic cover does not form part of any native ecological community. When native species occurred, they were scattered and limited to common groundcover species including *Dichondra repens* and *Eragrostis leptostachya.*

4.2.1.6 Planted native cover

Planted native cover was present around the existing residential dwellings and along a small patch of Mullet Creek. This patch contained *Corymbia maculata* (Spotted Gum), *Acacia floribunda* (White Sally Wattle), *Allocasuarina littoralis* (Black She-oak), *Callistemon* sp., *Melaleuca* sp., and *Casuarina glauca* (Swamp Oak). Native trees planted around residential dwellings included *Corymbia citriodora* (native to Queensland)*, Corymbia maculata, Callistemon viminalis, Grevillea robusta, Eucalyptus saligna* and *Melia azedarach.* Planted native cover does not form part of any native ecological community.

4.2.1.7 Exotic pasture

Exotic pasture was the dominant vegetation community in the study area. Exotic pasture did not contain any native midstorey or canopy layers. The groundcover consisted of pasture grasses including *Cenchrus clandestinus, Cynodon dactylon* and *Paspalum dilatatum*. Invasive species such as *Rubus fruticosus* spp. agg. also occurred. Exotic pasture does not form part of any native ecological community.

4.2.1.8 Fig Trees

Some large fig trees (*Ficus macrocarpa*) have been mapped separately throughout the study area.

4.2.1.9 Farm Dams

Many farm dams occur throughout the study area. Most have some fringing vegetation, typically *Typha orientalis.* Areas where the cover of *Typha* is extensive and not just a narrow fringing strip, have been mapped as PCT 1071, but do not meet the definition of *Sydney Freshwater Wetlands in the Sydney Basin Bioregion* (Endangered, BC Act, not listed under the EPBC Act).

4.2.2 Justification for selection of PCTs

PCT 838 was assigned to patches because:

- the study area is located in the coastal lowlands of the southern Sydney Basin Bioregion, within the Illawarra IBRA sub-bioregion in which this PCT is known to occur
- the patches were located within a landscape that included previous vegetation mapping of Coastal Grassy Red Gum Forest MU23 (NPWS 2002). This landscape position was slightly higher in the landscape than the low-lying PCT 1232 and 1326.
- the canopy species comprised species typical to the community, including *Eucalyptus tereticornis, E. eugenioides, E. amplifolia* and *Melaleuca styphelioides* (sub-canopy)
- Shrub and groundcover species included the characteristic species *Breynia oblongifolia, Carex longebrachiata, Oplismenus imbecillis* and *Pandorea pandorana.*

PCT 1326 was assigned because:

- the study area is located in the coastal lowlands of the southern Sydney Basin Bioregion, within the Illawarra IBRA sub-bioregion in which this PCT is known to occur
- the PCT occurs within a landscape that included previous vegetation mapping of Lowland Woollybutt-Melaleuca Forest MU24 (NPWS 2002). This landscape position was slightly lower than PCT 838 but not directly adjacent to watercourses where PCT 1232 occurred
- while canopy species were not recorded, the sub-canopy was dominated by a mostly dense canopy of *Melaleuca decora*, a species typical to the community
- Shrub and groundcover species included the characteristic species *Cymbopogon refractus*, *Dichondra repens, Microlaena stipoides,* and *Veronica plebeia*.

Where PCT 838 and PCT 1326 occurred in a derived shrubland form, the community occurred at the same landscape position as intact patches of the community and were comprised of midstorey and groundcover species typical to the community.

PCT 1232 was assigned because:

- the study area is within the located coastal lowlands of the Sydney Basin Bioregion, within the Illawarra IBRA sub-bioregion in which this PCT is known to occur
- the PCT occurs within a landscape that included previous vegetation mapping of Coastal Swamp Oak Forest MU36, a community that aligns with this PCT. The landscape is located on the coastal floodplain adjacent to a permanent watercourse which would periodically overflow into the Swamp Oak vegetation community
- The canopy was nearly 100% cover of *Casuarina glauca* with the occasional *Melaleuca styphelioides* (sub-canopy), which are both characteristic of this community
- Saline species usually associated with this PCT are not present within the study area, indicating a more freshwater influence at this location.

PCT 1071 was assigned because:

- the study area is located in the Sydney Basin Bioregion and the Illawarra subregion, in which this PCT is known to occur
- the PCT includes both natural and artificial waterbodies
- the vegetation was comprised of sedges and rushes typical to the community.

4.2.3 Fauna Species and Habitat Assessment

Fauna survey was not undertaken as part of this assessment. Rather, an assessment of habitat values and database searches has been made to determine what fauna species are likely to occur. Table 6 below provides a summary of habitat values.

A total of 20 hollow bearing trees were identified within the study area and there are likely to be more hollow-bearing trees within the study area that were not observed during the rapid site assessment. Hollow bearing trees form potential habitat roosting and breeding habitat for microbats and birds including several threatened species.

The study area contained several farm dams that were in moderate to poor condition. Poor condition dams were overgrown with algae and did not contain fringing vegetation such as *Juncus* spp. and *Typha* spp. Moderate condition dams contained such fringing vegetation that provides habitat for threatened birds and common amphibians.

Abandoned farm houses were located on the western boundary of the study area and culverts were observed in the northern parts of the study area. These farm houses and culverts may provide roosting habitat for threatened microchiropteran bats. The abandoned farm houses and culverts were not inspected for threatened microchiropteran as part of this assessment.

There are several riparian corridors running through the study area. The 1st order riparian corridors have been dammed and were overgrown with *Cenchrus clandestinus* and are unlikely to provide habitat for any threatened species. The 2nd order riparian corridor that flows along the northern section of the study area is likely to provide a foraging resource for some species of threatened microchiropteran bat and migratory wader birds.

Mullet Creek is mapped as a 4th order stream and contained areas of running water and in some cases standing pools with native vegetation including *Azolla pinnata* (Mosquito fern), *Carex tereticaulis* (Common sedge) and *Typha* (Bullrush). Although most sections of Mullet Creek were dominated by exotic flora species, it may provide a foraging resource for some species of threatened microchiropteran bat and migratory wader birds. Reaches 2A, 2B, 2E and 3A (as per the riparian report (ELA 2020)) would also provide foraging habitat for threatened fauna.

Table 6: Fauna habitat breakdown across the study area

Habitat Features	Fauna likely to utilise features	Occurrence
Remnant native vegetation	Birds, megachiropteran bats (fruit bats), arboreal mammals, reptiles	The study area comprises large patches of native forest along the northern boundary. Most of these patches are intact or have a limited mid-story coverage. Some large remnant trees are present.
Hollow-bearing trees	Birds, microchiropteran bats (microbats) and arboreal mammals (gliders and possums)	The study area contains at least 20 hollow-bearing trees (HBT). It is highly likely that there are more that were not identified during the rapid field survey.
Stags	Birds, particularly birds of prey, reptiles, amphibians, micro bats	Several stags were observed across the study area. Similarly, to the hollow-bearing trees, it is highly likely that there are more stags that were not identified during the field survey.
Leaf litter	Reptiles, amphibians, invertebrates	Leaf litter was present within the large patches of remnant vegetation.
Coarse woody debris	Terrestrial mammals, reptiles, invertebrates	There was coarse woody debris located within along the water course, particularly within the remanent vegetation to the north.
Watercourse	Amphibians, water birds, aquatic fauna	There were several natural and artificial wetlands located across the study area located along several water course, including 1st and 2nd order drainage lines and the 4th order Mullet Creek.
Vegetative corridor	Birds, reptiles, arboreal and small mammals	The study area provides some linkage to other vegetation and aquatic habitats within the within the study area. However, the largely cleared rural landscape limits the connectivity to remnant vegetation within the region. As such, habitat connectivity would be limited to narrow corridors along water courses with the larger patch of remnant vegetation to the north acting as stepping stone habitat for highly mobile fauna such as microbats and birds. .

Fourteen threatened fauna species are predicted to use the study area for foraging or roosting (Table 7). Three threatened flora species are considered likely to occur in the study area, with potential habitat in the good quality vegetation to the north of the study area. The rest of the study area is unlikely to be habitat for threatened flora due to a long history of disturbance. The areas containing remnant patches of native vegetation were highly disturbed, contained a high level of weed invasion and showed signs of disturbance from cattle.

Table 7: Threatened species likely to occur in the study area

Scientific name	Common name	BC Act Status	EPBC Act Status	Habitat features
FAUNA				
Artamus cyanopterus	Dusky Woodswallow	V	-	Native vegetation for foraging
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Native vegetation for foraging, hollow bearing trees for roosting, abandoned buildings for roosting
Gallinago hardwickii	Latham's Snipe	-	M	Wetlands
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Native vegetation and riparian corridors for foraging
Lathamus discolor	Swift Parrot	E1	CE	Foraging within remnant vegetation
Miniopterus australis	Little Bentwing-bat	V	-	Native vegetation for foraging, hollow bearing trees for roosting, abandoned buildings for roosting
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Native vegetation for foraging, hollow bearing trees for roosting, abandoned buildings for roosting
Micronomus norfolkensis	Eastern Freetail-bat	V	-	Native vegetation for foraging, hollow bearing trees for roosting, abandoned buildings for roosting
Motacilla flava	Yellow Wagtail	-	M	Swamp margins and open cleared land
Myotis macropus	Southern Myotis	V	-	Riparian corridors for foraging, hollow bearing trees and culverts for roosting, abandoned buildings for roosting
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Native vegetation for foraging
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Foraging over woodland and roosting in tree hollows and buildings
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Native vegetation for foraging, hollow bearing trees for roosting, abandoned buildings for roosting
Tringa nebularia	Common Greenshank	-	M	Riparian corridors for foraging
FLORA				
Chorizema parviflorum	Chorizema parviflorum Benth. in the Wollongong and Shellharbour Local Government Areas	E2	-	Potential habitat within native vegetation along the northern edges of the study area containing *Eucalyptus tereticornis* including areas mapped as PCT 838
Cynanchum elegans	White-flowered Wax Plant	E1	E	Potential habitat within native vegetation along the northern edges of the study area containing *Eucalyptus tereticornis* including

Scientific name	Common name	BC Act Status	EPBC Act Status	Habitat features
				areas mapped as PCT 1326 and the patch of PCT1232 east of Fairwater Drive containing dry rainforest species
Pterostylis gibbosa	Illawarra Greenhood	E1	E	Within areas of PCT 838

Key: BC Act = listing under Biodiversity Conservation Act 2016; EPBC Act = listing under Environmental Protection and Biodiversity Conservation Act 1999

4.3 Site Constraints

The ecological constraints in the study area are described below in Table 8. The Riparian Assessment report addresses site constraints due to riparian corridors. However, for completeness, we have included the main riparian constraints in this table. The location of the ecological constraints across the study area is shown below in

Table 8: Ecological constraints within the study area

Constraint	Value	Justification	Recommendation
Very high	Illawarra Lowlands Grassy Woodland (PCT 838 and PCT 1326) – good condition	• listed as critically endangered under the EPBC Act. Impacting this vegetation may require referral to the Department of Agriculture, Water and the Environment (DAWE). Clearing >0.5 ha is likely to be 'controlled action' requiring approval from DAWE • listed as endangered under the BC Act • is a listed entity for a serious and irreversible impact (SAII) under the BC Act. Council will need to form an opinion on whether the impacts are SAII • provides threatened species habitat	• avoid impacts to these areas • retain mature trees • survey for threatened fauna species
	Swamp Oak Floodplain Forest (PCT 1232) – Good and moderate condition	• listed as endangered under the EPBC Act • listed as endangered under the BC Act • provides threatened species habitat • partially mapped under the Biodiversity Values Map. Clearing this vegetation will trigger the Biodiversity Offset Scheme • partially mapped as Coastal Wetlands under the Coastal Management SEPP	• retain and enhance all mapped coastal wetlands where possible. Prioritise retention of larger wetlands.
	Coastal wetlands	• mapped under the Coastal Management SEPP 2018	• retain and enhance all mapped coastal wetlands where

Constraint	Value	Justification	Recommendation
		• the SEPP requires that coastal wetlands be protected or enhanced • affecting coastal wetlands is a 'designated development' under the EP&A Act, requiring preparation of an EIS and offsets • mapped under the Biodiversity Values Map	possible. Prioritise retention of larger wetlands.
	Mullet Creek (reach 4A in riparian report ELA 2020)	• fourth order stream • requires 40 m riparian buffer either side of stream, measured from top of bank • mapped as Key Fish Habitat • mapped under the Biodiversity Values Map • any impacts to riparian corridor would require application for a controlled activity approval • any encroachment of development in the outer 50% of the riparian buffer would require offsetting elsewhere along the corridor • partially covered by terrestrial biodiversity overlay (WLEP 2009) • partially covered by riparian lands overlay (WLEP 2009) • vegetated with Illawarra Lowlands Grassy Woodland, endangered under BC Act	• retain this creek • survey for threatened fauna species • implement Vegetation Management Plan to revegetate Mullet Creek riparian corridor • any impacts to BVM would trigger the BOS and require offsetting under the BC Act
	Freshwater Wetlands in the Sydney Basin Bioregion (corresponds to PCT 1071 for natural wetlands -not farm dams)	• listed as Endangered under the BC Act, not listed under the EPBC Act) - corresponds to PCT 1071 for natural wetlands only (not farm dams	• retain natural wetlands
High			
	Illawarra Lowlands Grassy Woodland - moderate condition	• listed as endangered under the BC Act • contained native species in all structural layers • contained some mature trees • contains potential foraging and roosting habitat for threatened fauna • some areas area located along a 4th order stream and would fall within riparian corridor • partially covered by the terrestrial biodiversity overlay	• avoid impacts to these areas • retain mature trees • survey for threatened fauna species

Constraint	Value	Justification	Recommendation
		• subject to SAII considerations under the BC Act	
	Illawarra Lowlands Grassy Woodland - poor condition	• listed as endangered under the BC Act • contains potential foraging and roosting habitat for threatened fauna • partially located along a 4th order stream and would fall within riparian corridor • partially covered by the terrestrial biodiversity overlay • subject to SAII considerations under the BC Act	• avoid impacts to these areas where possible • retain mature trees where possible • survey for threatened fauna species
	Illawarra Lowlands Grassy Woodland - derived native shrubland	• listed as endangered under the BC Act • contains potential foraging habitat for threatened fauna • located along a 4th order stream and would fall within riparian corridor • partially covered by the terrestrial biodiversity overlay • subject to SAII considerations under the BC Act	• avoid impacts to these areas where possible • survey for threatened fauna species
	Illawarra Lowlands Grassy Woodland - scattered paddock trees	• listed as endangered under the BC Act • may provide foraging habitat for threatened microbats that forage over water and migratory / wader birds • some patches covered by the terrestrial biodiversity overlay • subject to SAII considerations under the BC Act	• avoid mature trees containing hollows where possible • survey for threatened fauna species
	Swamp Oak Floodplain Forest (PCT 1232) – Poor condition	• listed as endangered under the BC Act • provides threatened species habitat • occurs within riparian corridor	• retain and enhance all mapped coastal wetlands
	Proximity area for coastal wetlands	• mapped under the Coastal Management SEPP 2018 • the SEPP requires that the development within the *proximity area for coastal wetlands* will not significantly impact the biophysical, hydrological or ecological integrity of adjacent coastal wetland and	• limit development within these areas to recreational / open space areas that can protect adjacent wetlands

Constraint	Value	Justification	Recommendation
		that the quantity and quality of surface and ground water flows	
	2nd and 3rd order streams (see riparian assessment report ELA 2020)	• requires 20-30 m riparian corridor either side of stream, measured from top of bank • any impacts to riparian corridor would require application for a controlled activity approval • any encroachment of development in the outer 50% of the riparian buffer would require offsetting elsewhere along the corridor • partially vegetated with TECs including Illawarra Lowlands Grassy Woodland, Coastal Oak Floodplain Forest and Freshwater Wetlands	• retain these creeks • survey for threatened fauna species • prepare and implement Vegetation Management Plans for riparian corridors as required
Moderate	Planted native cover	• does not form part of a native ecological community • does not contain any habitat features that would support hollow dwelling fauna • may provide foraging habitat for threatened microbats •	• development suitable in these areas
	Dams	• may provide foraging habitat for threatened microbats that forage over water and migratory / wader birds • would provide habitat for non-threatened native fauna	• minimise development in these areas / carefully manage impacts • survey for threatened fauna species
Low	Exotic pasture	• does not form part of a native ecological community • unlikely to provide habitat for threatened fauna species • would not provide habitat for threatened flora species	• development suitable in these areas
	Exotic cover (outside of riparian corridors)	• does not form part of a native ecological community • unlikely to provide habitat for threatened fauna species • would not provide habitat for threatened flora species	• development suitable in these areas
	1st order streams	• some portions do not meet the definition of a stream	• development suitable in these areas provided riparian averaging and

Constraint	Value	Justification	Recommendation
		• can apply to extinguish first order streams through Natural Resources Access Regulator (DPI Water) • portions of the 1st order streams that meet the definition of a stream that are extinguished would need to be offset	offsetting is adhered to

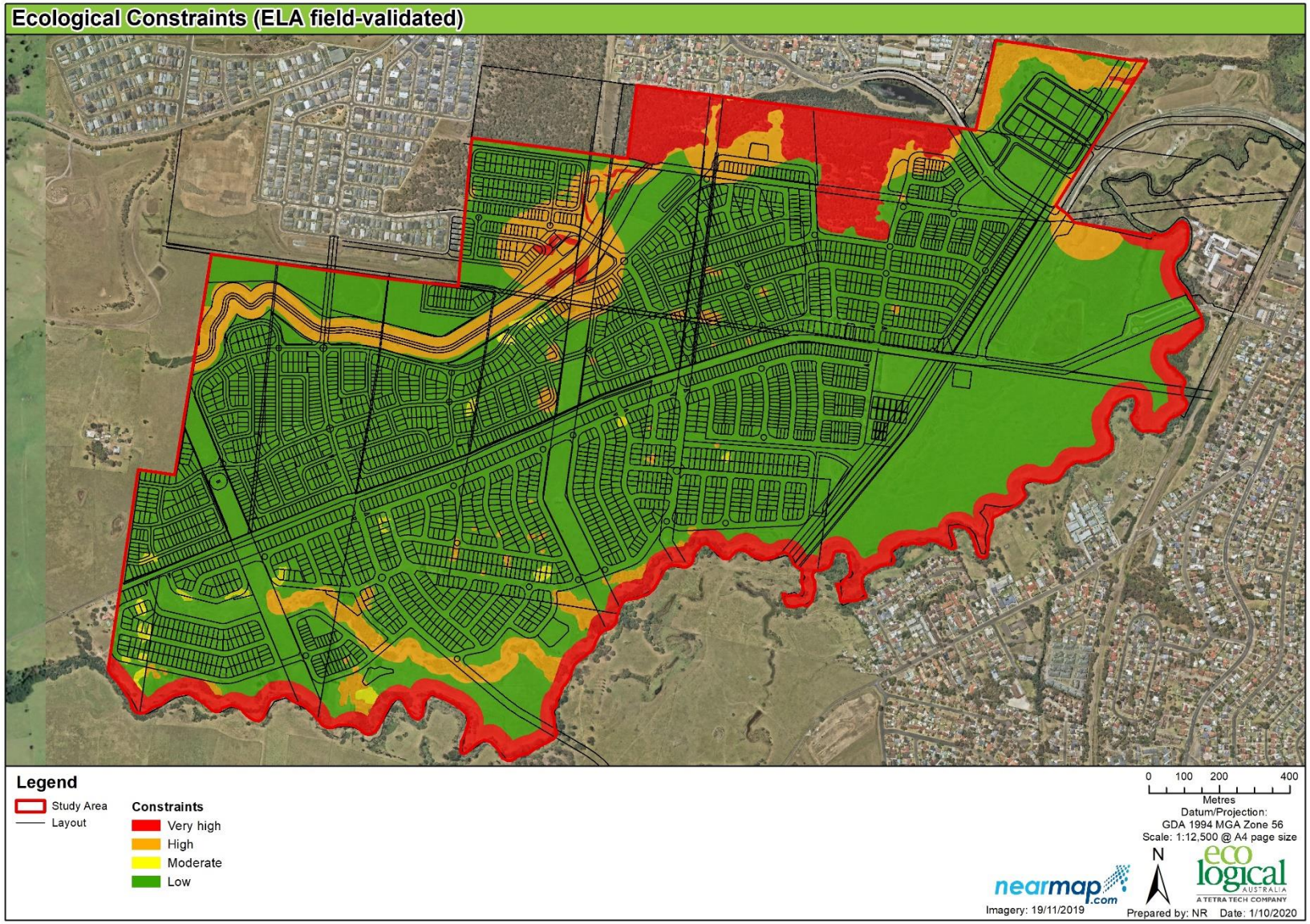


Figure 21: Areas of constraint across the study area

5. Potential impacts and approvals pathways

5.1 Avoid, minimise and mitigate

The iterations in design of the Neighbourhood Plan were aimed at avoiding, where possible, impacts to threatened ecological values and other constraints described in sections 3.2.3 and 4.3. Where impacts were unavoidable, they were minimised by concentrating the development footprint in areas where the constraints were low to moderate.

The configuration of the proposed planning proposal is shown in Figure 22.

5.2 Potential direct impacts

The proposed rezoning and subsequent development would result in direct impacts from construction of the roads and shared path network, the building footprints and open space facilities. The riparian assessment report (ELA 2020) details impacts to riparian land, but a summary is included below. These activities would have the following direct impacts (Figure 22):

- encroachment into 0.9 ha of the vegetated riparian zone (VRZ) based on the WM Act guidelines
- encroachment into 4.56 ha of the VRZ when the WCC riparian corridor widths are applied (this is unlikely to be required, as NRAR has given in principle support to the proposed riparian treatments. It is assumed that NRAR corridor widths would be adopted).
- removal of 4.12 ha of Coastal Grassy Woodland EEC in good, moderate, poor, DNS and SPT conditions
- removal of 0.81 ha of Coastal Swamp Oak Forest EEC
- removal of 0.47 ha of Freshwater Wetlands EEC
- impacts to Coastal Wetlands and buffer areas mapped under the Coastal Management SEPP including:
  - 0.68 ha of mapped coastal wetlands, and
  - 12.21 ha of land mapped as *Proximity to Coastal Wetlands*
- removal of habitat bearing trees (11 to be removed but likely more will be recorded at the DA stage)
- removal of potential threatened species habitat
- affecting land mapped under the WCC biodiversity overlay
- affecting land mapped under the Biodiversity Values Map (Coastal Wetlands)

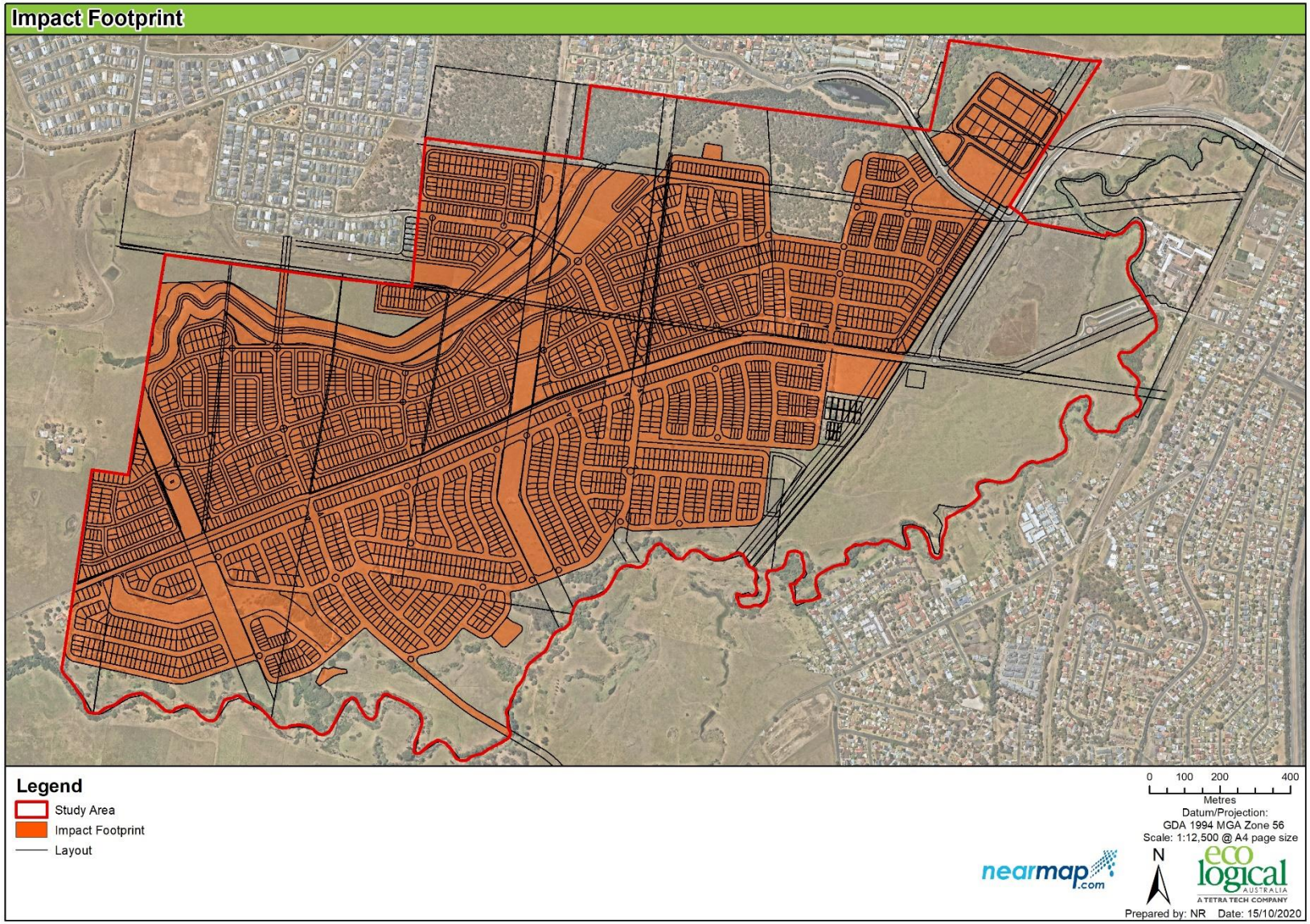


Figure 22: Proposed subdivision layout and impact footprint

Table 9: Direct impacts to native vegetation communities resulting from the planning proposal

ELA field validated name	Plant Community Type ID and Scientific Name	Condition	BC Act	EPBC Act	Total Area (ha)	Direct Impact Area (ha)
Coastal Grassy Red Gum Forest	838 Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Good	E	CE	3.08	0
		Moderate	E	Condition threshold not met	0.62	0
		Poor	E	Condition threshold not met	2.78	0.54
		Derived Native Shrub	E	Condition threshold not met	2.26	0.48
		Scattered Paddock Trees	E	Condition threshold not met	0.45	0.41
Lowland Woollybutt-Melaleuca Forest	1326 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Good	E	CE	5.16	0.01
		Moderate	E	Condition threshold not met	0.94	0.002
		Poor	E	Condition threshold not met	1.11	1.01
		Derived Native Shrub	E	Condition threshold not met	0.65	0.01
		Scattered Paddock Trees	E	Condition threshold not met	0.27	0.26
Coastal Swamp Oak Forest	1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Good	E	E	5.80	0
		Moderate	E	E	1.00	0.06
		Poor	E	Condition threshold not met	2.34	0.67
Freshwater wetland	1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Good	E	Not listed	0.80	0.47
Planted native cover	-		-		1.33	0.49
Fig Tree	-				0.13	0

Key: E= Endangered, CE = Critically Endangered

5.3 Potential indirect impacts

The rezoning and subsequent development is also likely to result in the following indirect impacts:

- increased sediment, erosion and nutrient flow
- edge effects, such as possible increase in weeds around the proposed footprint
- soil and vegetation disturbance
- changes to hydrology.

5.4 Potential approvals pathways

ELA understands that the proponent is investigating the options for environmental approval pathways for the site. The primary options are currently a Biodiversity Development Assessment Report or Biodiversity Certification for the study area, with a Part 4 development application with Council as the determining authority.

5.4.1 State approvals

5.4.1.1 Biodiversity Certification

Biodiversity certification is a streamlined biodiversity assessment process for areas of land that are proposed for development. The process identifies areas of land to be developed and areas of land to be retained and attempts to balance impact and conservation within the biodiversity certified land boundary. The intention is that all impacts associated with the development are accounted for in onsite conservation. An application for biodiversity certification can be made at the rezoning stage as part of a Part 3 application under the EP&A Act. Consultation with Council is recommended to identify the suitable proponent to complete a biodiversity certification application for the study area.

Where land is certified, development may proceed without the usual requirement for a detailed ecological impact assessment. As biodiversity certification addresses the potential impacts on biodiversity during the early planning of land use change, it encourages planning authorities and landholders to design their development footprint in a way that avoids and minimises impacts on biodiversity values and protects those areas. The assessment process is completed when preparing a Biodiversity Certification Assessment Report (BCAR). To complete the BCAR, survey across the study area would be required to identify any threatened flora or fauna species.

Wollongong City Council has made an application to certify land at West Dapto, including the study area. Direction 2.4 of the Illawarra-Shoalhaven Regional Plan & Direction 2.4.1 is to finalise biodiversity certification for West Dapto. At the time of writing of this report, the status of the biodiversity certification application is unknown.

Indicative credit calculations for impacts assuming the land would be biodiversity certified has not been included as part of this assessment.

5.4.1.2 Biodiversity Development Assessment Report

If the proponent chooses to proceed under a local Part 4 development application (DA), then a Biodiversity Development Assessment Report (BDAR) would be required. The triggers for requiring a BDAR that apply to this proposed subdivision include removal of native vegetation within land mapped

under the Biodiversity Values Map (see Section 4.1.3) and native vegetation removal above the clearing threshold of 0.5 ha.

If this option is pursued, the rezoning of the study area under Part 3 of the EP&A Act would be completed prior to the commencement of a (DA). The impact assessment would be completed as part of the BDAR. The BDAR would be assessed consistent with the BC Act and biodiversity offsets would be calculated. The BDAR would assess impacts to the following:

- threatened ecological communities
- threatened flora and fauna in the form of ecosystem and species credit species
- Serious and Irreversible Impact entities
- areas mapped by the Biodiversity Values Map
- prescribed biodiversity matters such as non-native habitat bearing vegetation (eg. old farm buildings and culverts)
- ability to avoid, minimise and mitigate impacts to threatened ecological values.

Offset obligations would be calculated as per the Biodiversity Assessment Method and the online credit calculator. There are options for credit offsets to be made onsite, through creation of a Stewardship Site Agreement or offsite via purchase of credits from the market or the Biodiversity Conservation Trust. The viability and costs associated with these options can be further investigated at a later date.

5.4.2 Australian Government approvals

5.4.2.1 EPBC Act referral

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where 'Matters of National Environmental Significance' may be affected. Under the Act any action which "has, will have, or is likely to have a significant impact on a Matter of National Environmental Significance" is defined as a "controlled action", and requires approval from the Minister for the (or her delegate) Commonwealth Department of Agriculture, Water and the Environment (DAWE) which is responsible for administering the EPBC Act. The proposed action is likely to operate on the following Matter of NES:

- Loss of foraging habitat for Grey-headed Flying Fox

- Minor direct impacts to Coastal Swamp Oak (*Casuarina glauca*) Forest (Endangered, EPBC Act) and Illawarra and South Coast Lowland Forest and Woodland (Critically Endangered, EPBC Act) (Table 9)

Given that nearly all of the EPBC Act listed vegetation will be retained and the loss of foraging habitat for listed threatened species will be relatively minor, a referral to the Commonwealth DAWE is unlikely to be required. However, further detailed field survey at the DA stage may record additional MNES or vegetation patches that meet the condition criteria.

On 24 March 2020 DAWE gazetted Amending Agreement No. 1 to the Bilateral Agreement between NSW and the Commonwealth, which is applicable to State Significant Projects. At the same time, the Commonwealth endorsed the NSW BOS, meaning that for proposed actions that are controlled, the BOS can be used to discharge Commonwealth offset obligations.

5.5 Recommendations

Regardless of planning approval pathway selected, there will be a requirement to carry out further surveys for threatened species. Many species have the potential to occur on the site or use habitat present (Appendix B, Table 7). Some species require targeted survey for both State and Australian government approvals.

It is recommended that future development and approvals for the study area consider conservation measures to secure the retained vegetation. This could include:

- Zoning, such as E2 – Environmental Conservation
- Conservation instrument such as 88B covenant over preserved vegetation
- Controlling provisions in a Development Control Plan for the site
- Preparation and implementation of a Vegetation Management Plan (or multiple plans)
- Biocertification for the entire site, with key conservation zones protected
- Biodiversity Stewardship Agreement Site administered under the BC Act
- Voluntary Planning Agreement between the proponent and a government agency.

It is recommended that a Construction Environment Management Plan is also prepared with the subdivision DA. Further investigation would be required under the State Environmental Planning Policy (Koala Habitat Protection) 2019 to determine if the preparation of a Koala Plan of Management would be required at the DA stage.

6. Conclusion

Eco Logical Australia Pty Ltd (ELA) was engaged by Newquest Property Pty Ltd to prepare this Flora and Fauna Assessment to support a planning proposal for the proposed residential subdivision within the suburbs of Huntley, Cleveland and Horsley within the Wollongong LGA. The study area forms part of the West Dapto Urban Release Area. West Dapto has been identified as a regionally significant housing release area for the Illawarra region.

The study area is 366 ha and is located to the north and south Cleveland Road. The proposed rezoning will allow for land currently zoned RU2 to be rezoned to R2 and R3 to allow for a residential subdivision including creation of around 3,000 residential lots, two sporting fields (rezoned to RE1), two local business centres (rezoned to B2 and B6) and one park plus open space areas (rezoned to RE1 and E3). Vegetated areas along the northern boundary will retain the E2 zoning.

Field survey was conducted across the study area and identified a range of ecological values, including three threatened ecological communities (TEC) listed under the BC Act - Illawarra Lowlands Grassy Woodland, Swamp Oak Floodplain Forest and Freshwater Wetlands. Some portions of these communities also met the condition thresholds for listing under the EBPC Act including Illawarra and South Coast Lowland Forest and Woodland and Coastal Swamp Oak (*Casuarina glauca*) Forest. However, exotic pasture from past farming practices forms the largest vegetation zone across the study area.

We note that Illawarra Lowlands Grassy Woodland EEC is a listed entity for a Serious and Irreversible Impact (SAII) under the BC Act. As such, at the DA stage, the consent authority will need to form an opinion as to whether the proposed development is likely to have a SAII on Illawarra Lowlands Grassy Woodland EEC.

The study area also contained numerous first, second and third order streams, as well as Mullet Creek, which is a 4th order stream. Potential habitat for threatened species includes remnant vegetation, farm dams, freshwater wetlands and hollow bearing trees. Based on previous records (DPIE 2020) and the habitat features present in the study area, 14 threatened fauna species and three threatened flora species are considered likely to occur.

Parts of the study area are mapped under the Biodiversity Values Map, WCC Biodiversity Overlay and Coastal Wetlands mapped under the Coastal Management SEPP are also present. All of these mapped areas will be impacted. All the three TEC listed above will also be impacted as part of the proposed rezoning.

The development footprint presented in this planning proposal has used the avoid, minimise and mitigate principles to retain areas of higher constraint and ecological value and concentrate development in cleared areas. This report also outlined the potential approvals pathways such as Biodiversity Certification, preparation of a Biodiversity Development Assessment Report and an EPBC Act referral.

7. References

Bureau of Meteorology: *Past Data Climate Statistics*. Accessed 17 May 2018. Available at http://www.bom.gov.au/nsw/?ref=hdr

Department of Agriculture, Water and the Environment (DAWE) 2020. *EPBC Act Protected Matters Search Tool:* http://www.environment.gov.au/epbc/pmst/. Accessed January 2020.

Department of the Environment (DotE) 2013. 'Matters of National Environmental Significance: Significant impact guidelines 1.1: *Environment Protection and Biodiversity Conservation Act 1999'*. Canberra, ACT.

Department of Environment and Climate Change (2007) *Threatened species assessment guidelines. The assessment of significance*.

Department of the Environment and Energy (2018). *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community.* Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf.

Department of Planning and Environment (2020). *Biodiversity Values Map and Threshold Tool*. Accessed 2 June 2020. Available at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

Eco Logical Australia 2020. Cleveland Road South, West Dapto Rezoning Planning Proposal. Prepared for Newquest Property Pty Ltd.

Eco Logical Australia 2018. Cleveland Road, West Dapto Rezoning Planning Proposal. Prepared for Cleveland Group Holdings.

Ecoplanning 2019. Flora and Fauna Assessment- Multiple Lots, 144-48 Cleveland Road, West Dapto, NSW. Prepared for Cardno Pty Ltd.

National Parks and Wildlife Service 2002. *Wollongong LGA Bioregional Assessment (Part 1): Native Vegetation of the Illawarra Escarpment and Coastal Plain.* Report for the Commission of Inquiry into Planning and Development on the Illawarra Escarpment. NSW National Parks and Wildlife Service, Sydney.

NSW Department of Planning, Industry and Environment (DPIE) 2020. Threatened Species Database (5 km radius search). EES Sydney, NSW. Accessed January 2020.

NSW Department of Planning, Industry and Environment (DPIE) 2020. Threatened Species Profiles. Available: http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?

Office of Environment and Heritage (2020), *Vegetation Information System*. Available at http://www.environment.nsw.gov.au/research/Vegetationinformationsystem.htm

Office of Environment and Heritage (2016). *Illawarra Plant Community Type Vegetation Map, 2016. VIS_ID 4678*. Accessed 2 June 2020. Available at https://datasets.seed.nsw.gov.au/dataset/illawarra-compiled-plant-community-type-map-2016-vis-id-4678

Tozer, M.G., Turner, K. Keith, D.A., Tindall, D., Pennay, C., Simpson, C., Mackenzie, B., Beukers, P. and Cox, S., 2010. Native vegetation of the southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11(3): 359-406.

Wollongong City Council (2009) Development Control Plan. Available at http://www.wollongong.nsw.gov.au/development/regulations/Pages/dcp.aspx

Wollongong City Council (2009) Local Environmental Plan. Available at http://www.wollongong.nsw.gov.au/development/regulations/Pages/lep.aspx#gref

Wollongong City Council (2018) *West Dapto Urban Release Area - Project History*. Available at http://www.wollongong.nsw.gov.au/services/majorprojects/westdaptourbanrelease/Pages/WestDaptoProjectHistory.aspx

Appendix A Flora List

Family	Scientific Name	Common Name	Exotic	High Threat Weed
Acanthaceae	*Thunbergia* spp.		*	
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair		
	Adiantum formosum	Giant Maidenhair		
	Pellaea falcata	Sickle Fern		
Alliaceae	*Agapanthus* spp.		*	
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed		
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily		
Apiaceae	*Centella asiatica*	Indian Pennywort		
	Centella cordifolia			
Apocynaceae	*Araujia sericiflora*	Moth Vine	*	
	Gomphocarpus fruiticosis	Narrow-leaved Cotton Bush		
	Parsonsia straminea	Common Silkpod		
Araeceae	*Spathiphyllum wallisii*	Peace Lilly	*	
Araucariaceae	*Araucaria heterophylla*	Norfolk Island Pine	*	
	Araucaria heterophylla	Norfolk Island Pine	*	
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	*	YES
Aspleniaceae	*Asplenium flabellifolium*	Necklace Fern		
Asteraceae	*Ageratina adenophora*	Crofton Weed	*	YES
	Bidens pilosa	Cobbler's Pegs	*	
	Cirsium vulgare	Spear Thistle	*	
	Conyza bonariensis	Flaxleaf Fleabane	*	
	Cotula spp.			
	Delairea odorata	Cape Ivy	*	YES
	Euchiton sphaericus	Star Cudweed		
	Hypochoeris radicata	Catsear	*	
	Senecio madagascariensis	Fireweed	*	YES
	Sonchus oleraceus	Common Sowthistle	*	
	Tagetes minuta	Stinking Roger	*	
	Taraxacum officinale	Dandelion	*	
Azollaceae	*Azolla pinnata*			
Basellaceae	*Anredera cordifolia*	Madeira Vine	*	YES
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	*	
	Pandorea pandorana	Wonga Wonga Vine		

Family	Scientific Name	Common Name	Exotic	High Threat Weed
	Tecoma capensis	Cape Honeysuckle	*	
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern		
	Doodia aspera	Prickly Rasp Fern		
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	*	YES
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		
	Casuarina glauca	Swamp Oak		
Celastraceae	*Celastrus australis*	Staff Climber		
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		
	Salsola australis			
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		
	Tradescantia fluminensis	Wandering Jew	*	YES
Convolvulaceae	*Dichondra repens*	Kidney Weed		
Cuppressaceae	*Cuppressus* sp.	Cypress	*	
Cyperaceae	*Carex longebrachiata*			
	Carex tereticaulis			
	Cyperus eragrostis	Umbrella Sedge	*	YES
	Fimbristylis dichotoma	Common Fringe-sedge		
	Lepidosperma laterale	Variable Sword-sedge		
	Schoenoplectus validus			
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath		
Euphorbiaceae	*Croton verreauxii*	Green Native Cascarilla		
	Ricinus communis	Castor Oil Plant	*	YES
Fabaceae (Caesalpinioideae)	*Senna pendula*		*	YES
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		
	Erythrina x Sykesii	Coral tree	*	
	Glycine clandestina	Twining glycine		
	Trifolium repens	White Clover	*	
	Trifolium spp.	A Clover	*	
Fabaceae (Mimosoideae)	*Acacia falcata*	Hickory Wattle		
	Acacia floribunda	White Sally		
	Acacia implexa	Hickory Wattle		
	Acacia longifolia			
	Acacia mearnsii	Black Wattle		
Geraniaceae	*Geranium homeanum*			

Family	Scientific Name	Common Name	Exotic	High Threat Weed
	Geranium solanderi	Native Geranium		
Goodeniaceae	*Brunonia australis*	Blue Pincushion		
Juncaceae	*Juncus acutus*	Sharp Rush	*	YES
	Juncus kraussii	Sea Rush		
	Juncus subsecundus	Finger Rush		
	Juncus usitatus			
Lamiaceae	*Plectranthus parviflorus*			
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	YES
Lobeliaceae	*Lobelia purpurascens*	Whiteroot		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		
Loranthaceae	*Amyema cambagei*	Needle-leaf Mistletoe		
	Amyema gaudichaudii			
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		
	Geitonoplesium cymosum	Scrambling Lily		
Lythraceae	*Lagerstroemia indica*		*	
Malaceae	*Cotoneaster coriaceus*		*	
	Abutilon grandifolium		*	
	Commersonia fraseri	Brush Kurrajong		
	Hibiscus heterophyllus	Native Rosella		
	Lagunaria patersonia	Norfolk Island Hibiscus		
	Modiola caroliniana	Red-flowered Mallow	*	
	Sida rhombifolia	Paddy's Lucerne	*	
Meliaceae	*Melia azedarach*	White Cedar		
Monimiaceae	*Hedycarya angustifolia*	Native Mulberry		
Moraceae	*Ficus coronata*	Creek Sandpaper Fig		
	Ficus macrophylla			
	Ficus rubiginosa	Port Jackson Fig		
	Morus sp.	Mulberry		
	Streblus brunonianus	Whalebone Tree		
Myoporaceae	*Myoporum acuminatum*	Boobialla		
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle		
	Callistemon salignus	Willow Bottlebrush		
	Callistemon viminalis	Weeping Bottlebrush		
	Corymbia citriodora	Lemon-scented Gum	*	
	Corymbia maculata	Spotted Gum		

Family	Scientific Name	Common Name	Exotic	High Threat Weed
	Eucalyptus amplifolia	Cabbage Gum		
	Eucalyptus bosistoana	Coast Grey Box		
	Eucalyptus eugenioides	Thin-leaved Stringybark		
	Eucalyptus saligna	Sydney Blue Gum		
	Eucalyptus tereticornis	Forest Red Gum		
	Melaleuca armillaris	Bracelet Honey-myrtle		
	Melaleuca decora			
	Melaleuca styphelioides	Prickly-leaved Tea Tree		
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	*	YES
	Notelaea longifolia f. longifolia			
	Olea europaea	Common Olive	*	YES
Oxalidaceae	*Oxalis perennans*			
Passifloraceae	*Passiflora* sp.	Passionfruit	*	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn		
	Pittosporum multiflorum	Orange Thorn		
	Pittosporum revolutum	Rough Fruit Pittosporum		
	Pittosporum undulatum	Sweet Pittosporum		
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	
	Veronica plebeia	Trailing Speedwell		
Poaceae	*Arundo donax*	Giant Reed	*	YES
	Austrodanthonia bipartita	Wallaby Grass		
	Axonopus fissifolius	Narrow-leafed Carpet Grass	*	YES
	Cenchrus clandestinus	Kikuyu Grass	*	
	Chloris gayana	Rhodes Grass	*	YES
	Cymbopogon refractus	Barbed Wire Grass		
	Cynodon dactylon	Common Couch		
	Echinopogon caespitosus	Bushy Hedgehog-grass		
	Ehrharta erecta	Panic Veldtgrass	*	YES
	Entolasia marginata	Bordered Panic		
	Entolasia stricta	Wiry Panic		
	Eragrostis curvula	African Lovegrass	*	YES
	Eragrostis leptostachya	Paddock Lovegrass		
	Imperata cylindrica	Blady Grass		

Family	Scientific Name	Common Name	Exotic	High Threat Weed
	Microlaena stipoides	Weeping Grass		
	Oplismenus aemulus			
	Oplismenus imbecillis			
	Panicum effusum	Hairy Panic		
	Paspalum dilatatum	Paspalum	*	YES
	Poa labillardierei	Tussock		
	Setaria gracilis		*	
	Setaria parviflora		*	
	Sporobolus africanus	Parramatta Grass	*	
	Stenotaphrum secundatum	Buffalo Grass	*	YES
Polygonaceae	*Persicaria decipiens*	Slender Knotweed		
	Persicaria hydropiper	Water Pepper		
	Rumex obtusifolius	Broadleaf Dock	*	
Primulaceae	*Anagallis arvensis*	Scarlet Pimpernel	*	
	Myrsine variabilis			
Proteaceae	*Grevillea robusta*	Silky Oak		
Pteridaceae	*Cheilanthes sieberi*	Rock Fern		
Rhamnaceae	*Alphitonia excelsa*	Red Ash		
Rosaceae	*Rubus fruticosus* spp. agg.	Blackberry	*	YES
	Rubus parvifolius	Native Raspberry		
Rutaceae	*Murraya paniculata*		*	
Salicaceae	*Salix babylonica*	Weeping Willow	*	
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	*	
	Solanum pseudocapsicum	Madeira Winter Cherry	*	
	Solanum seaforthianum	Climbing Nightshade	*	YES
Thelypteridaceae	*Christella dentata*	Binung		
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi		
	Typha sp.	Typha		
Ulmaceae	*Celtis sinensis*	Japanese Hackberry	*	
	Trema tomentosa	Native Peach		
	Ulmus parvifolia	Chinese Elm	*	
Urticaceae	*Urtica dioica*	Giant Nettle	*	
Verbenaceae	*Lantana camara*	Lantana	*	YES
	Verbena bonariensis	Purpletop	*	
	Verbena rigida	Veined Verbena	*	

Family	Scientific Name	Common Name	Exotic	High Threat Weed
	Verbena rigida	Veined Verbena	*	
Violaceae	*Melicytus dentatus*	Tree Violet		

Appendix B Likelihood of occurrence table

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the site inspection and professional judgement. Some Migratory or Marine species identified from the Commonwealth database search have been excluded from the assessment, due to lack of habitat. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
ECOLOGICAL COMMUNITIES						
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions / Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community		E	E	Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period (Sloss et al., 2007). These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). The ecological community can also occur on organosols (peaty soils). Occurrences of swamp oak trees on rocky headlands or other consolidated substrates are not considered to be a part of the ecological community, but areas where soils transition into unconsolidated sediments may contain the ecological community. The ecological community is typically found where groundwater is saline or brackish, but can occur in areas where groundwater is relatively fresh. It is typically found on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. These are typically associated with low-lying coastal alluvial floodplains and alluvial flats (Keith and Scott, 2005). Minor occurrences can be found on coastal dune swales or flats, particularly deflated dunes and dune soaks.	Yes	Yes
Coastal Upland Swamps in the Sydney Basin Bioregion		E	E	May include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. Endemic to NSW and confined to the Sydney Basin Bioregion. It occurs in the eastern Sydney Basin from the Somersby district in the north (Somersby-Hornsby plateaux) to the Robertson district in the south (n the Woronora plateau).	No	No
Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion / Illawarra and South Coast Lowland Forest and Woodland		E	CE	Illawarra coastal plain and escarpment foothills. Recorded from the LGAs of Wollongong, Shellharbour and Kiama, and Shoalhaven. Occurs in near coastal areas below about 200 metres on gently undulating terrain. Occurs on Berry Siltstone, Budgong Sandstone and Quaternary Alluvium."	Yes	Yes

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E	-	Found on the river flats of the coastal floodplains. Known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	No	No
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion / Subtropical and Temperate Coastal Saltmarsh		E	V	Within a relatively narrow margin of the Australian coastline, within the subtropical and temperate climatic zones south of the South- east Queensland IBRA bioregion. Typically restricted to the upper intertidal environment; mainly associated with the soft substrate shores of estuaries and embayments (sandy and/or muddy) and on some open, low wave energy coasts)."	No	No
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion		-	E	Generally confined to the Sydney Basin bioregion, including the Moss Vale, Ettrema, Burragorang, Sydney Cataract, and Wollemi IBRA sub-regions. However, some patches may extend into in the Kanangra and Oberon IBRA sub-regions of the South Eastern Highlands bioregion. Found on igneous rock (predominately Tertiary basalt and microsyenite). Typically occurs at elevations between 650 and 1050 m above sea level.	No	No
FLORA						
Acacia bynoeana	Bynoe's Wattle	E1	V	Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Heath or dry sclerophyll forest on sandy soils.	No	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Allocasuarina glareicola	-	E1	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora.*	No	No
Caladenia tessellata	Thick Lip Spider Orchid	E1	V	Currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Grassy sclerophyll woodland on clay loam or sandy soils, or low woodland with stony soil.	No	No
Chorizema parviflorum	Chorizema parviflorum Benth. in the Wollongong and Shellharbour Local Government Areas	E2	-	Between Austinmer and Albion Park in the local government areas of Wollongong and Shellharbour. Woodland or forest dominated by *Eucalyptus tereticornis* (Forest Red Gum) and/or *E. longifolia* (Woollybutt). At Austinmer, recorded from a coastal headland.	Potential	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	In NSW, recorded mainly on coastal and near coastal ranges north from Victoria to near Forster, with two isolated occurrences inland north-west of Grafton. Coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest.	No	No
Cynanchum elegans	White-flowered Wax Plant	E1	E	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley. Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia* subsp. i*ntegrifolia* (Coastal Tea-tree– Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	Potential	Yes

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Daphnandra johnsonii	Illawarra Socketwood	E1	E	Restricted to the Illawarra region, in the Shoalhaven, Kiama, Shellharbour and Wollongong areas. Rainforest and moist eucalypt forest on rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes.	Unlikely	No – lack of suitable habitat
Genoplesium baueri	Bauer's Midge Orchid	E1	E	Has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. Dry sclerophyll forest and moss gardens over sandstone.	No	No
Haloragis exalata subsp. *exalata*	Square Raspwort	V	V	Disjunct distribution in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Protected and shaded damp situations in riparian habitats.	Unlikely	No
Irenepharsus trypherus	Illawarra Irene	E1	E	Recorded within the local government areas of Kiama, Shellharbour, Shoalhaven, Tallaganda, Wingecarribee, and Wollongong, including Minnamurra Falls, the Jamberoo area, and Morton and Macquarie Pass National Parks. Moist sclerophyll forest, *Backhousia myrtifolia* (Ironwood) thickets, and rainforest, on steep rocky slopes near cliff lines and ridge tops.	No	No
Lespedeza juncea subsp. *sericea*	*Lespedeza juncea* subsp. *sericea* in the Wollongong LGA	E2	-	This population occurs south of Dapto in the Wollongong local government area. Located in open forest dominated by *Eucalyptus tereticornis* (Forest Red Gum), *E. longifolia* (Woollybutt) and *Melaleuca decora* (White Feather Honeymyrtle), on Budgong Sandstone.	No	No
Melaleuca biconvexa	Biconvex Paperbark	V	V	Only found in NSW, populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Damp places, often near streams or low-lying areas on alluvial soils.	No	No
Pimelea spicata	Spiked Rice-flower	E1	E	Two disjunct areas; the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). Well-structured clay soils. *Eucalyptus moluccana* (Grey Box) communities and in areas of ironbark on the Cumberland Plain. Coast Banksia open woodland or coastal grassland in the Illawarra.	Unlikely	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Pterostylis gibbosa	Illawarra Greenhood	E1	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). Open forest or woodland, on flat or gently sloping land with poor drainage.	Potential	Yes particularly within the Illawarra Grassy Woodlands
Pterostylis saxicola	Sydney Plains Greenhood	E1	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines, adjacent to sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	No	No
Pultenaea aristata	Prickly Bush-pea	V	V	Restricted to the Woronora Plateau. Dry sclerophyll woodland or wet heath on sandstone.	No	No
Solanum celatum	-	E1	-	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Rainforest clearings and wet sclerophyll forests.	No	No
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	Subtropical and littoral rainforest on gravels, sands, silts and clays.	Unlikely	No
Thesium australe	Austral Toadflax	V	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands. Grassland on coastal headlands or grassland and grassy woodland away from the coast.	No	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Zieria granulata	Illawarra Zieria	E1	E	Restricted to the Illawarra region, primarily on the coastal lowlands between Oak Flats and Toolijooa. Sclerophyll forest, scrub, woodland and rainforest margins. Typically on rocky ridges and outcrops in shallow volcanic soils, also moist slopes of the Illawarra escarpment and low-lying areas on Quaternary sediments.	No	No
FAUNA						
Actitis hypoleucos	Common Sandpiper	-	M	Summer migrant. In NSW, widespread along coastline and also occurs in many areas inland. Coastal wetlands and some inland wetlands, especially muddy margins or rocky shores. Also estuaries and deltas, lakes, pools, billabongs, reservoirs, dams and claypans, mangroves.	No	No
Anous stolidus	Common Noddy	-	M	Casual visitor to coastal NSW. Marine.	No	No
Anthochaera phrygia	Regent Honeyeater	E4A	CE	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions. Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana* (River Oak).	No	No
Artamus cyanopterus	Dusky Woodswallow	V	-	Dusky woodswallows occurs throughout most of New South Wales, however, most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, but also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or	Potential	Yes

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
				woodland. Primarily eats invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. Nest sites vary greatly, but generally occur in shrubs or low trees, living or dead, horizontal or upright forks in branches, spouts, hollow stumps or logs, behind loose bark or in a hollow in the top of a wooden fence post.		
Apus pacificus	Fork-tailed Swift	-	M	Recorded in all regions of NSW. Riparian woodland., swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	Unlikely	No
Botaurus poiciloptilus	Australasian Bittern	E1	E	Found over most of NSW except for the far north-west. Permanent freshwater wetlands with tall, dense vegetation, particularly *Typha* spp. (bullrushes) and *Eleocharis* spp. (spikerushes).	Unlikely	No
Calidris acuminata	Sharp-tailed Sandpiper	-	M	Summer migrant. Widespread in most regions of NSW, especially in coastal areas, but sparse in the south-central Western Plain and east Lower Western Regions. Shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	No	No
Calidris canutus	Red Knot	-	E, M	Summer migrant to Australia. In NSW, widespread in suitable habitat along the coast. Occasionally recorded inland in all regions. Intertidal mudflats, sandflats sheltered sandy beaches, estuaries, bays, inlets, lagoons, harbours, sandy ocean beaches, rock platforms, coral reefs, terrestrial saline wetlands near the coast, sewage ponds and saltworks. Rarely inland lakes or swamps.	No	No
Calidris ferruginea	Curlew Sandpiper	E1	CE, M	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands in the Murray-Darling Basin. Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	No	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Calidris melanotos	Pectoral Sandpiper	-	M	Summer migrant to Australia. Widespread but scattered in NSW. East of the Great Divide, recorded from Casino and Ballina, south to Ulladulla. West of the Great Divide, widespread in the Riverina and Lower Western regions. Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	No	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	In NSW, distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. Isolated records known from as far north as Coffs Harbour and as far west as Mudgee. Tall mountain forests and woodlands in summer; in winter, may occur at lower altitudes in open eucalypt forests and woodlands, and urban areas.	Unlikely	No
Calonectris leucomelas	Streaked Shearwater	-	M	Regular summer visitor south to Wollongong, less common further south. Marine.	No	No
Cercartetus nanus	Eastern Pygmy-possum	V	-	In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Rainforest, sclerophyll forest (including Box-Ironbark), woodland and heath.	No	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes. Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	Unlikely	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Circus assimilis	Spotted Harrier	V	-	Found throughout the Australian mainland, except in densely forested or wooded habitats, and rarely in Tasmania. Grassy open woodland, inland riparian woodland, grassland, shrub steppe, agricultural land and edges of inland wetlands.	No	No
Dasyornis brachypterus	Eastern Bristlebird	E1	E	There are three main populations: Northern - southern Qld/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Central and southern populations inhabit heath and open woodland with a heathy understorey. In northern NSW, habitat comprises open forest with dense tussocky grass understorey.	No	No
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld. Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	No	No
Diomedea antipodensis	Antipodean Albatross	V	V	Regularly occurs off the NSW south coast from Green Cape to Newcastle during winter. Marine.	No	No
Diomedea exulans	Wandering Albatross	E1	V, M	Has been recorded along the length of the NSW coast. Marine.	No	No
Diomedea gibsoni	Gibson's Albatross	V	V	Regularly occurs off the NSW coast usually between Green Cape and Newcastle. Marine.	No	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range. Tall (greater than 20m) moist habitats.	Likely	Yes
Fregata ariel	Lesser Frigatebird	-	M	In NSW, irregularly observed after tropical cyclones south to central coast, sometimes observed south to Merimbula. Marine.	No	No
Gallinago hardwickii	Latham's Snipe	-	M	Migrant to east coast of Australia, extending inland west of the Great Dividing Range in NSW. Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	Potential	Yes, within the wetland areas
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Distributed along the coastline of mainland Australia and Tasmania, extending inland along some of the larger waterways, especially in eastern Australia. Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	Likely	Yes
Heleioporus australiacus	Giant Burrowing Frog	V	V	South eastern NSW and Victoria, in two distinct populations: a northern population in the sandstone geology of the Sydney Basin as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Unlikely	No
Hieraaetus morphnoides	Little Eagle	V	-	Throughout the Australian mainland, with the exception of the most densely-forested parts of the Dividing Range escarpment. Open eucalypt forest, woodland or open woodland, including sheoak or Acacia woodlands and riparian woodlands of interior NSW.	Unlikely	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Hirundapus caudacutus	White-throated Needletail	-	M	All coastal regions of NSW, inland to the western slopes and inland plains of the Great Divide. Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	Unlikely	No
Hoplocephalus bungaroides	Broad-headed Snake	E1	V	Largely confined to Triassic and Permian sandstones within the coast and ranges in an area within approximately 250 km of Sydney. Dry and wet sclerophyll forests, riverine forests, coastal heath swamps, rocky outcrops, heaths, grassy woodlands.	No	No
Hydroprogne caspia	Caspian Tern	-	M	Widespread in coastal and inland NSW. Coastal offshore waters, beaches, mudflats, estuaries, rivers, lakes.	No	No
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1	E	Found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River. Heath or open forest with a heathy understorey on sandy or friable soils.	No	No
Lathamus discolor	Swift Parrot	E1	CE	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes. Box-ironbark forests and woodlands.	Potential	Yes
Limosa lapponica	Bar-tailed Godwit	-	M	Summer migrant to Australia. Widespread along the coast of NSW, including the offshore islands. Also numerous scattered inland records. Intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons, bays, seagrass beds, saltmarsh, sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Rarely inland wetlands, paddocks and airstrips.	No	No

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Litoria aurea	Green and Golden Bell Frog	E1	V	Since 1990, recorded from ~50 scattered sites within its former range in NSW, from the north coast near Brunswick Heads, south along the coast to Victoria. Records exist west to Bathurst, Tumut and the ACT region. Marshes, dams and stream-sides, particularly those containing *Typha* spp. (bullrushes) or *Eleocharis* spp. (spikerushes). Some populations occur in highly disturbed areas.	No	No
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria. The species has not been recorded in southern NSW within the last decade. Breeding habitat is the upper reaches of permanent streams and perched swamps. Non-breeding habitat is heath-based forests and woodlands	Unlikely	No
Lophoictinia isura	Square-tailed Kite	V	-	In NSW, it is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast. Timbered habitats including dry woodlands and open forests, particularly timbered watercourses.	Unlikely	No
Macronectes giganteus	Southern Giant Petrel	E1	E, M	Common visitor off the coast of NSW. Marine.	No	No
Macronectes halli	Northern Giant-Petrel	V	V, M	Common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Marine.	No	No
Miniopterus australis	Little Bentwing-bat	V	-	East coast and ranges south to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	Likely	Yes
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga. Rainforest, wet and dry sclerophyll	Likely	Yes

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
				forest, monsoon forest, open woodland, paperbark forests and open grassland.		
Mixophyes balbus	Stuttering Frog	E1	V	Along the east coast of Australia from southern Qld to north-eastern Victoria. Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	No	No
Monarcha melanopsis	Black-faced Monarch	-	M	In NSW, occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park and Wombeyan Caves. It is rarely recorded farther inland. Rainforest, open eucalypt forests, dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills, Brigalow scrub, coastal scrub, mangroves, parks and gardens.	Unlikely	No
Micronomus norfolkensis	Eastern Freetail-bat	V	-	Found along the east coast from south Qld to southern NSW. Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Likely	Yes
Motacilla flava	Yellow Wagtail	-	M	Regular summer migrant to mostly coastal Australia. In NSW recorded Sydney to Newcastle, the Hawkesbury and inland in the Bogan LGA. Swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land, lawns.	Potential	Yes
Myiagra cyanoleuca	Satin Flycatcher	-	M	In NSW, widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Eucalypt-dominated forests, especially near wetlands, watercourses, and heavily-vegetated gullies.	No	No
Myotis macropus	Southern Myotis	V	-	In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers. Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Likely	Yes

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution / Habitat	Likelihood of occurrence	Further survey recommended
Neophema chrysogaster	Orange-bellied Parrot	E4A	CE	Breeds in Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern SA and southern Victoria. Occasional reports from NSW, most recently Shellharbour and Maroubra in May 2003. Winter habitat is mostly within 3 km of the coast in sheltered bays, lagoons, estuaries, coastal dunes and saltmarshes. Also small islands and peninsulas, saltworks, golf courses, low samphire herbland and taller coastal shrubland.	No	No
Ninox strenua	Powerful Owl	V	-	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains. Woodland, open sclerophyll forest, tall open wet forest and rainforest.	Unlikely	No
Numenius madagascariensis	Eastern Curlew	-	CE, M	Summer migrant to Australia. Primarily coastal distribution in NSW, with some scattered inland records. Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish lakes, saltworks and sewage farms.	No	No
Oxyura australis	Blue-billed Duck	V	-	Widespread in NSW, but is most concentrated in the southern Murray-Darling Basin area. Coastal and inland wetlands and swamps.	Unlikely	No
Pandion cristatus	Eastern Osprey	V	-	Common around the northern NSW coast, and uncommon to rare from coast further south. Some records from inland areas. Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.	No	No
Petaurus norfolcensis	Squirrel Glider	V	-	Widely though sparsely distributed on both sides of the Great Dividing Range in eastern Australia, from northern Qld to western Victoria. 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.	No	No
Petrogale penicillata	Brush-tailed Rock-wallaby	E1	V	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	No	No

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Petroica boodang	Scarlet Robin	V	-	In NSW, it occurs from the coast to the inland slopes. Dry eucalypt forests and woodlands, and occasionally in mallee, wet forest, wetlands and tea-tree swamps.	Unlikely	No
Phascolarctos cinereus	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands. Eucalypt woodlands and forests.	No	No
Plegadis falcinellus	Glossy Ibis	-	M	Recorded over much of NSW. Spring/summer breeding migrant to southern Murray-Darling region and Macquarie Marshes. Edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Occasionally estuaries, deltas, saltmarshes and coastal lagoons.	Unlikely	No
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Coastal heaths and dry and wet sclerophyll forests.	No	No
Pseudomys novaehollandiae	New Holland Mouse	-	V	Fragmented distribution across eastern NSW. Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	No	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria. Subtropical and temperate rainforests, tall sclerophyll forests and	Likely	Yes

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				woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.		
Rhipidura rufifrons	Rufous Fantail	-	M	Coastal and near coastal districts of northern and eastern Australia, including on and east of the Great Divide in NSW. Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	No	No
Rostratula australis	Australian Painted Snipe	E1	E	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Swamps, dams and nearby marshy areas.	No	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Occurs throughout northern, central and south-eastern Australia. Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies. Roosts in tree hollows, other animal nests and buildings.	Potential	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Both sides of the great divide, from the Atherton Tableland in Qld to north-eastern Victoria, mainly along river systems and gullies. In NSW it is widespread and extends to the coast over much of its range. Woodland, moist and dry eucalypt forest and rainforest.	Unlikely	No
Stictonetta naevosa	Freckled Duck	V	-	Inland river systems, occurring as far as coastal NSW in times of drought. Freshwater swamps and creeks, lakes, reservoirs, farm dams and sewage ponds.	Unlikely	No
Thalassarche cauta	Shy Albatross	V	V	Occurs along the east coast south from Stradbroke Island and across the south coast to Carnarvon in WA. It is commonly recorded off southeast NSW, though rarely north of Sydney. Marine.	No	No
Thalassarche cauta cauta	Shy Albatross	V	V	Occurs along the east coast south from Stradbroke Island and across the south coast to Carnarvon in WA. It is commonly recorded off southeast NSW, though rarely north of Sydney. Marine.	No	No

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Thalassarche melanophris	Black-browed Albatross	V	V	Regularly recorded off the NSW coast during May-November. Marine.	No	No
Tringa nebularia	Common Greenshank	-	M	Summer migrant to Australia. Recorded in most coastal regions of NSW; also widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).	Potential	No
Tyto novaehollandiae	Masked Owl	V	-	Recorded over approximately 90% of NSW, excluding the most arid north-western corner. Most abundant on the coast but extends to the western plains. Dry eucalypt forests and woodlands from sea level to 1100 m.	Unlikely	No
Tyto tenebricosa	Sooty Owl	V	-	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	Unlikely	No

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