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Flora and Fauna Assessment

Lot 22 // DP 619150; 45 Noongah Street & Lot 95 // DP 13116; 25 Gwynn Hughes Street, Bargo, NSW, 2574

Proposed rezoning

Prepared for: Precise Planning

23 January 2018

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Glossary and abbreviations

ABBR./TERM	DESCRIPTION
BC Act	*Biodiversity Conservation Act 2016*
DCP	Development Control Plan
DotE	Commonwealth Department of the Environment (now DoEE)
DoEE	Commonwealth Department of the Environment and Energy
EEC	Endangered ecological community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
HBT	Hollow bearing tree
LEP	Local Environment Plan
LGA	Local Government Area
mm/cm/m/km	millimetres/centimetres/metres/kilometres
SEPP44	*State Environmental Planning Policy No 44 – Koala Habitat Protection*
SSTF	Shale Sandstone Transition Forest
TEC	Threatened ecological community
UGRSW	Upper Georges River Sandstone Woodland
VRZ	Vegetated riparian zone
WLEP	Wollondilly Local Environment Plan
WoNS	Weed of National Significance
*	Denotes exotic species

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1. Introduction

1.1 Purpose of report and legislative context

This flora and fauna assessment has been undertaken to a proposal to rezone Lot 22 // DP 619150 (45 Noongah Street, Bargo) and Lot 95 // DP 13116 (25 Gwynn Hughes, Bargo, NSW). This report addresses the legislative context provided in (**Table 1.1**).

The purpose of this report is to identify and assess the flora and fauna within the study area and to identify ecological values and constraints that may affect rezoning and future residential development.

Table 1-1: Legislative framework addressed in this report.

Instrument	Considerations	Context
Commonwealth		
Environment Protection and Biodiversity Conservation (EPBC) Act 1999	Matters of National Environmental Significance	An action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance.
State (New South Wales)		
Biodiversity Conservation Act 2016	Part 4, Divisions 2 and 5	Lists threatened species, populations, ecological communities and key threatening processes to be considered under Section 5A EP&A Act.
Biosecurity Act 2015	Priority weeds	Describes the state and regional priorities for weeds in New South Wales.
Environmental Planning and Assessment (EP&A) Act 1979	Section 5A	Assessment of the potential for an action or activity to have a significant effect on threatened species, populations or ecological communities, or their habitats.
Local		
Wollondilly Local Environment Plan (WLEP) 2011	Clause 7.2: Biodiversity Protection	The objective of this clause is to maintain terrestrial biodiversity by protecting native flora and fauna, protecting the ecological processes necessary for their continued existence, and encouraging the conservation and recovery of native flora and fauna and their habitats.
Wollondilly Development Control Plan (WDCP) 2016	Chapter 9.1 – Environmental Protection	To improve and maintain environmental outcomes for the areas mapped as natural resources biodiversity and natural resources water under WLEP 2011, as well as unmapped areas of biodiversity and/or riparian value. Maintain habitat and riparian corridors to area identified as environmentally sensitive land.

This report does not include impact assessments pursuant to section 5A of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Significant Impact Guidelines). However, from data collected, a list of species likely to require assessment for a Development Application have been nominated.

1.2 Site description

1.2.1 Subject site and study area

The *Threatened species assessment guidelines: the assessment of significance* (DECC 2007) defines the ***subject site*** as the area 'directly impacted upon by the proposal', and includes all vegetation proposed to be removed following approval of the subdivision. The ***study area*** is defined as the subject site and all areas that are indirectly impacted upon by the proposal. For the remainder of this report the subject site is considered synonymous with the study area, and will be referred to as such.

The study area includes Lot 22 // DP 619150 (45 Noongah Street) and Lot 95 // DP 13116 (25 Gwynn Hughes, Bargo, NSW) (**Figure 1.1**), situated in the Wollondilly Local Government Area (LGA). The study area comprises 20.6 ha and contains exotic pastures, intact bushland and riparian land. Three watercourses run through the study area forming part of the Hornes Creek catchment, which is a tributary of the Bargo and Nepean Rivers. The study area contains a 1st order stream and two 3rd order streams which intersect in the north east of the site to form a 4th order stream (**Figure 1.2**). These watercourses are buffered by riparian vegetation of differing widths, disturbance histories and weed densities. The riparian vegetation along Hornes Creek is moderately infested with exotic species, such as *Cinnamomum camphora** (Camphor Laurel), *Ligustrum lucidum** (Large-leaved Privet), *Ligustrum sinense** (Small-leaved Privet) and *Lonicera japonica** (Japanese Honeysuckle).

The cleared areas of the study area are highly modified, consisting of approximately 90 – 95% weed cover. Surrounding the exotic pasture is established canopy with an underscrubbed midstorey, mostly consisting of herbaceous weeds and grasses. At the time of field survey the cleared areas were unmanaged, thus most exotic grasses and herbs were in seed. An intact area of native vegetation occurs in the north of the study area. Generally, there are few exotics in this area, however, weed cover and abundance increases near 35 Gwynn Hughes Street, and to the east, adjacent with Hornes Creek. A diverse assemblage of flora is found in this section of the study area, which contains remnant vegetation good condition and suitable habitat for small passerine birds.

1.2.2 Locality

Unless otherwise stated, the locality is described as the area within 5 km of the study area (**Figure 1.3**). The locality includes areas of vegetated land, particularly to the west, south and north east of the study area. Bargo State Conservation Area and Nattai National Park are situated to the west. Wilsons Drive and several fire trails traverse the land between the study area and the two conservation areas, which are otherwise connected by a continuous expanse of bushland. Approximately 1 km to the east of the study area is the township of Bargo, which consists mostly of residential houses on land zoned as R2 – *Low Density Residential* under the *Wollondilly Local Environmental Plan* (WLEP 2011).

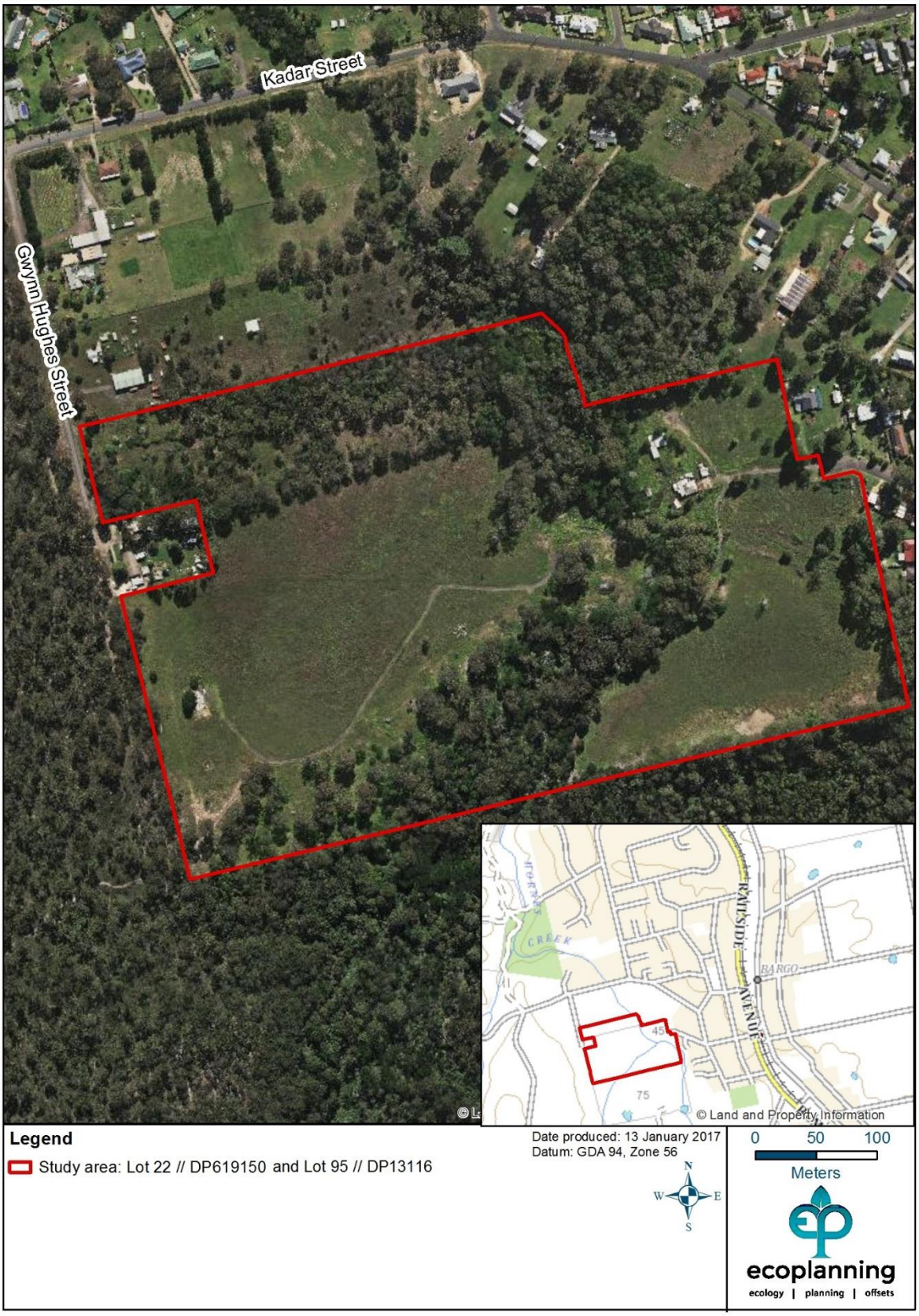


Figure 1.1: Study area

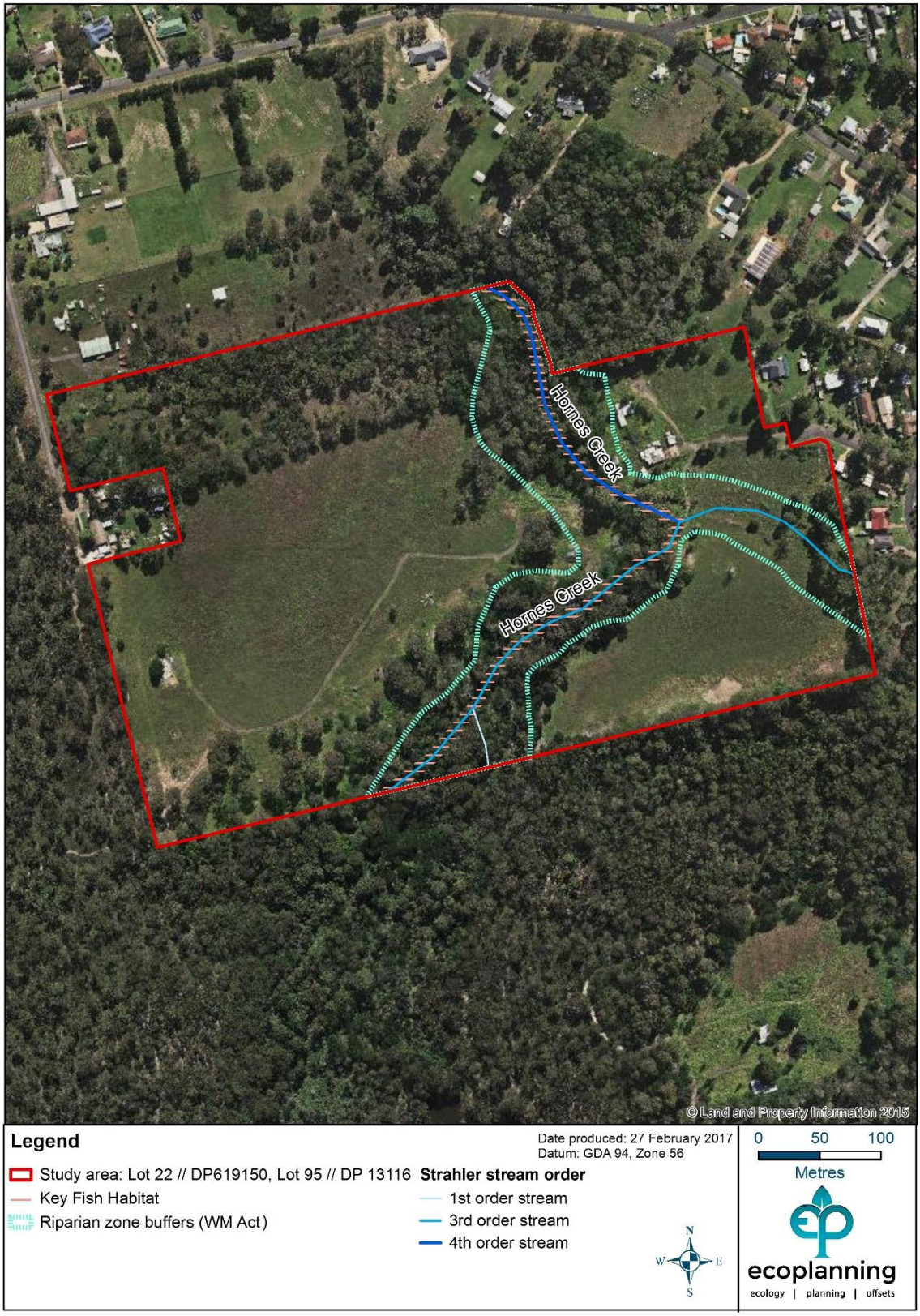


Figure 1.2: Strahler stream order and associated VRZ for the watercourses in the study area.

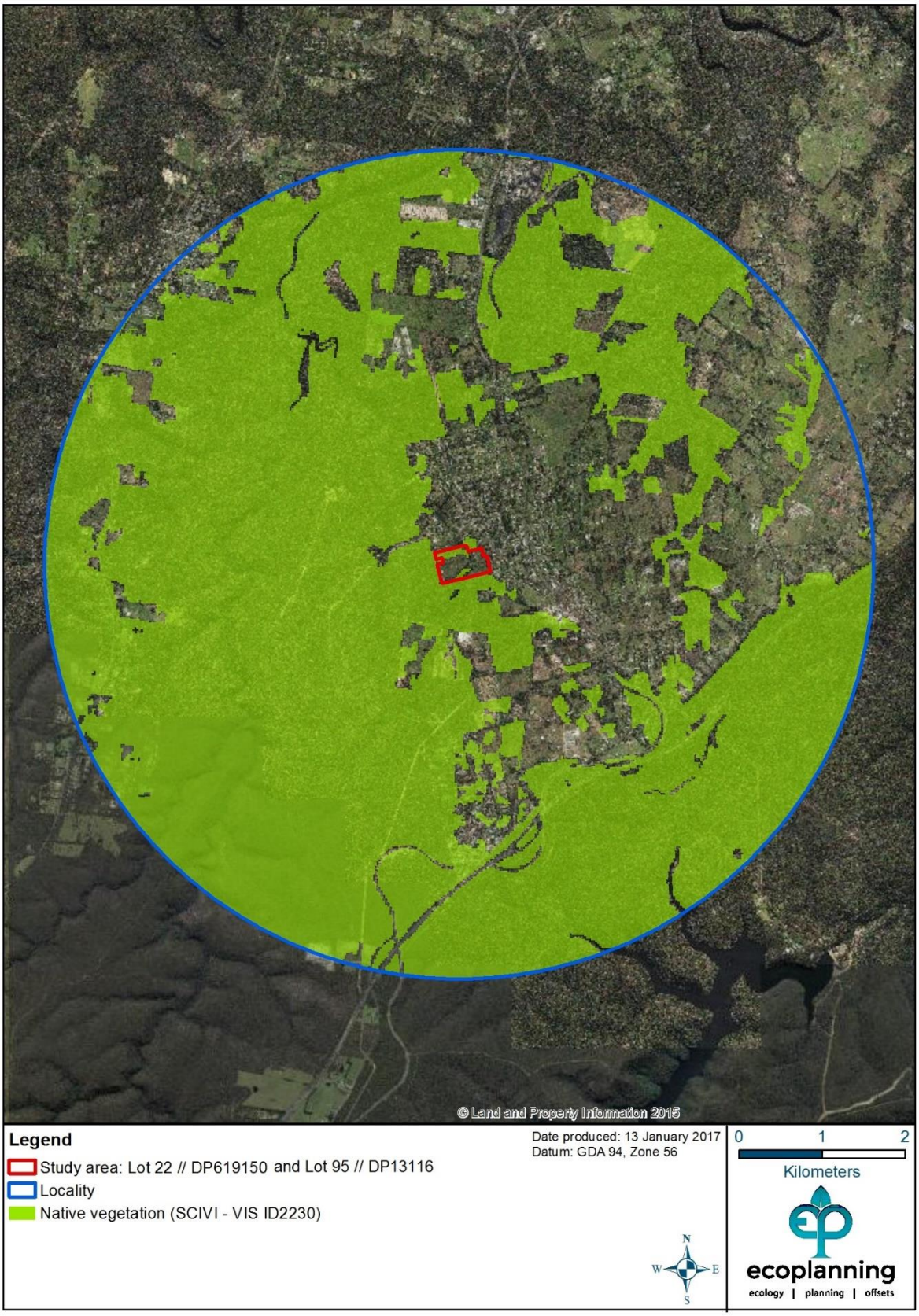


Figure 1.3: Locality (5 km), showing areas of native vegetation in green (Tozer et al. 2010).

1.3 Description of the planning proposal

The study area is currently zoned as RU4 – *Primary Production Small Lots* in the north (Lot 95 // DP 13116) and R2 – *Low Density Residential* (Lot 22 // DP 619150) in the south (WLEP 2011). Residences are permitted in R2 and RU4 zoned land, and grazing is permissible in the RU4 zoned land. The proposal will result in the rezoning of the study area to RU5 – *Large Lot Residential,* with a minimum lot size of 4,000 m². An indicative location of the proposed lots, roads and creek crossing is provided in **Figure 1.4**. The proposed layout of the site is subject to future change and will be determined prior to development application.

Figure 1.4: Indicative location of lots and proposed creek crossing.

2. Methods

2.1 Literature and database review

A site specific literature and database review was undertaken prior to undertaking field survey and the preparation of this report. This included desktop analysis of aerial photography and regional scale resources from the following sources:

- NSW Planning Viewer (NSW Dept. of Planning and Environment 2017)
- BioNet Atlas of NSW Wildlife (NSW Office of Environment and Heritage 2017)
- Protected Matters Search Tool (Commonwealth Department of Environment and Energy 2017)
- Native vegetation of the Cumberland Plain (NPWS 2002)
- SIX Maps (LPI 2017)
- Atlas of Living Australia (NCRIS 2017)
- Native Vegetation of South East NSW (Tozer et al.2010)
- Niche Environmental and Heritage (2015). Biodiversity Constraints Assessment for proposed subdivision at 45 Noongah Street and 25 Gwynn Hughes Street, Bargo
- Martins (2015) Watercourse classification – 45 Noongah Street & 25 Gwynn Hughes Road, Bargo, NSW.

Policies and guidelines relating to the proposal:

- Threatened Species Assessment Guidelines – the Assessment of Significance (DECC 2007)
- Office of Water Guidelines for Vegetation Management Plans on Waterfront Land (NSW Department of Primary Industries 2012)

Threatened species, populations and migratory species recorded during the literature and database review were consolidated and their likelihood of occurrence was considered by:

- review of location and date of recent (<5 years) and historical (>5-20 years) records
- review of available habitat within the study area and surrounding areas
- review of the scientific literature pertaining to each species and population
- applying expert knowledge of each species

The potential for threatened species, populations and/or migratory species to occur was then considered and the necessity for targeted field surveys was determined. Following field surveys and review of available habitat within the study area, the potential for species to utilise the site and to be affected directly or indirectly by the proposal were considered as either:

- “Recent record” = species has been recorded in the study area within the past 5 years
- “High” = species has previously been recorded in the study area (>5 years ago) or in proximity to (for mobile species), and/or habitat is present that is likely to be used by a local population

- "Moderate" = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- "Low" = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- "Not present" – suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area

2.2 Field survey

A field survey was undertaken on 13th and 31st January 2017 by Thomas Hickman (Ecologist, Ecoplanning). The field survey included a flora, fauna habitat and vegetation community assessment over a total of 4 person hours.

2.2.1 Vegetation communities and flora

The field survey involved traversing the study area, whilst recording native and exotic flora species, with a focus on identifying viable habitat for threatened flora species. Areas of intact, resilient vegetation were surveyed more extensively than degraded areas of the site. Nomenclature follows the Flora of NSW (Harden 1990-2002) and updates provided in PlantNET (RBGDT 2017).

Field survey was undertaken to validate regional vegetation mapping of NPWS (2002) and Tozer (et. al 2010) to site specific accuracy. Additional mapping of the study area was also consulted prior to field survey, including the vegetation mapping undertaken by Niche Environment and Heritage (e.g. June 2015). Vegetation communities were checked against described threatened ecological communities (TEC) listed under either the EPBC Act or the *Biodiversity Conservation Act 2016* (BC Act) that were known to occur or had been previously mapped near the study area.

Epacris purpurascens var. *purpurascens, Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea), Persoonia *bargoensis*, *Persoonia hirsuta* and *Persoonia glaucescens* are threatened flora species that were considered likely to occur onsite considering the large number of records in the locality. Thus, field survey focussed on potential habitat for these species.

2.2.2 Fauna and fauna habitat

Opportunistic fauna survey was undertaken for birds, amphibians, reptiles and mammals, which included opportunistic observations along with signs of direct and indirect occupancy (i.e. scats, owl pellets, fur, bones, tracks, bark scratches, foliage chew marks and chewed cones of *Allocasuarina* spp. or *Pinus* spp. as well as some of the other cultivars known to be utilised).

Fauna habitat searches were conducted for potential foraging, roosting, breeding or nesting habitat of nocturnal and diurnal species. This includes inspection for the presence of tree hollows, stags, bird nests, possum dreys, decorticating bark, rock shelters, rock outcrops/crevices, mature / old growth trees, food trees (*Banksia* spp., *Allocasuarina* spp., and winter-flowering eucalypts), culverts, dens, dams, riparian areas and refuge habitats of man-made structures.

Primary sources of literature accessed for species nomenclature include:

- Birds - Christidis and Boles (2008)
- Mammals - Van Dyck and Strahan (2008)
- Reptiles and amphibians - Cogger (2014)
- Terrestrial invertebrates - Australian Faunal Directory (AG, 2015)

2.2.3 Survey limitations

The flora survey aimed to record as many species as possible. However, it is acknowledged that this is not a definitive list of the flora within the study area. Additional species would be recorded during a longer survey over various seasons. Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to validate the vegetation communities and vegetation condition in the study area, and detect any threatened flora.

A full fauna survey following *Threatened Species Survey and Assessment Guidelines* (OEH 2013) was not undertaken as sufficient detail to determine the likelihood of occurrence of threatened and migratory species for the purpose of this report was achieved through habitat assessment during the field survey.

2.3 Ecological constraints

Ecological values identified through literature review and field survey were ranked according to their rarity and abundance as ecological constraints. Ecological values were scored from "no value" to "high" ecological values (refer to **Table 2-1**).

Table 2-1: Ranking ecological constraints

Level of Ecological Constraint	Description
High	• TEC in good condition • 10 m strip along the northern perimeter of the study area, to include all threatened flora records and UGRSW in a 'low' and 'moderate' condition • Hollow bearing trees • Riparian corridor (vegetation riparian zone - VRZ)
Moderate	• TEC in low/poor condition • Native vegetation (not TEC) in good condition
Low	• Native vegetation (not TEC) in low to moderate condition
None	• Exotic pasture

3. Results

3.1 Literature and database review

3.1.1 Topography, drainage, soils and biodiversity layer

Hornes Creek is the main watercourse in the study area and forms part of the Hornes Creek catchment, a tributary to the Bargo and Nepean Rivers. The site contains one 1st order stream and two 3rd order streams, which intersect in the north east of the site to form a 4th order stream (**Figure 1.2**). The study area is mostly flat, with some sections in the east sloping towards the Hornes Creek.

Regional scale soil landscape mapping (DECCW 2009) maps the western half of the study area as Lucas Heights (lh) Residual (z) soil landscape group. Soils of the Lucas Heights Group are derived from the Mittagong Formation, which is located stratigraphically between the Ashfield Shale and Hawkesbury Sandstone, usually as a shallow layer. Minor areas of Hawkesbury Sandstone and Ashfield Shale sporadically form surface soil materials within this landscape".

DECCW (2009) provide the following relevant soil formation descriptions:

- Lucas Heights Residual soil landscape – lhz: plateaued on Hawkesbury Sandstone and Mittagong Formation (of sandstone-quartz, shale, siltstone/mudstone and sandstone/lithic). The soils are Yellow and Brown Kurosols (Yellow and Brown Podzolic Soils), Yellow and Brown Kandosols (Yellow and Brown Earths) and Lateritic Red Kurosols/Kandosols (Lateritic Red Earths/Podzolic Soils). This soil landscape is used extensively for urban development and can be affected by sheet and wind erosion if vegetation cover is not maintained.

The eastern half of the study area is mapped in the regional scale soil landscape mapping (DECCW 2009) as Blacktown (bt) Residual (z). Soils of the Blacktown Group are derived from Wianamatta Group shales, which occur extensively on the Cumberland Lowlands around Blacktown, Mount Druitt and Leppington. A small patch of the Blacktown Group occurs in the Bargo area, which is otherwise surrounded by the Lucas Heights soil landscape.

3.1.2 Threatened species, populations and migratory species

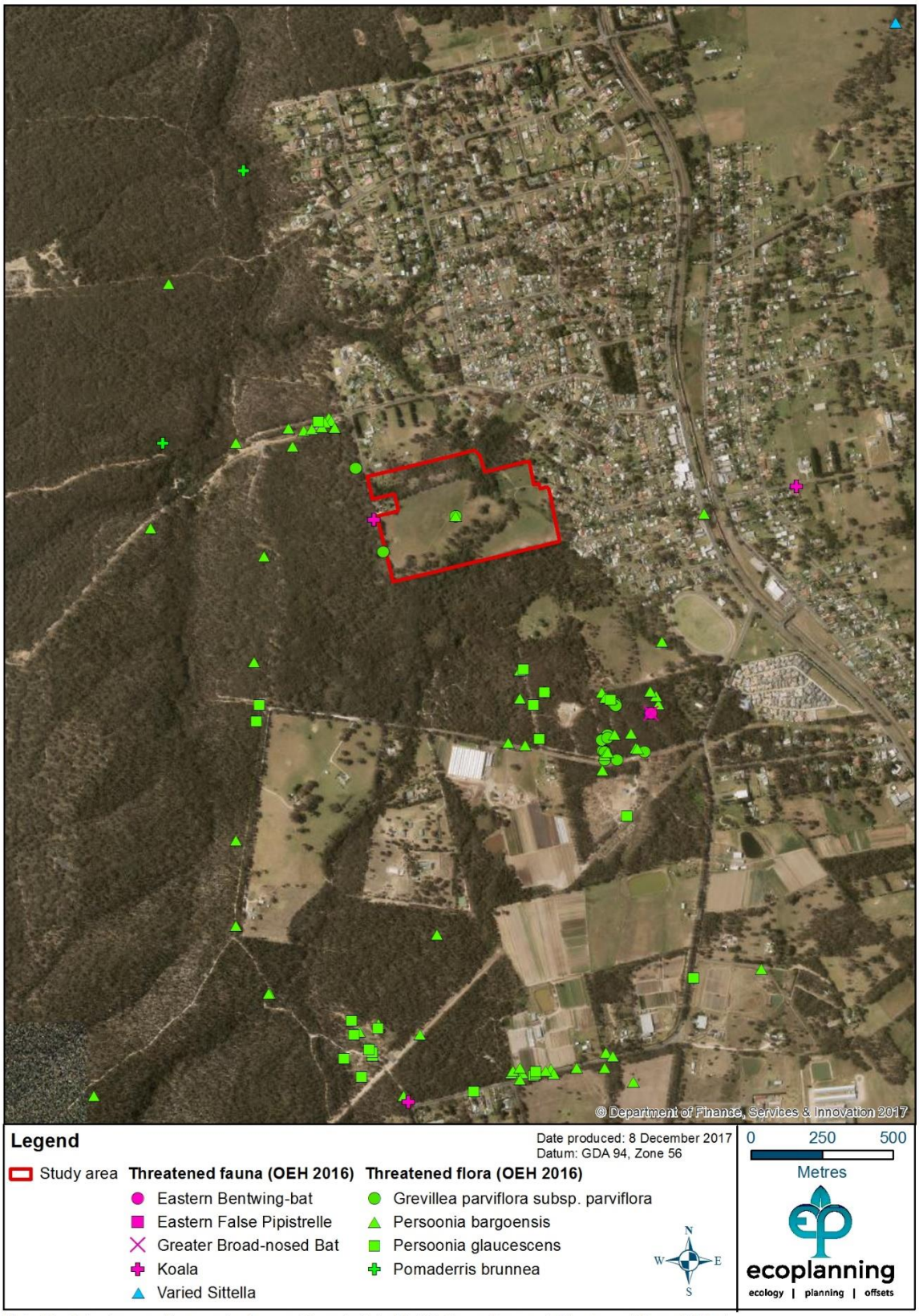
A search of relevant databases and literature identified a potential 29 threatened species in the locality including seven threatened flora species and 22 threatened fauna species (11 birds, six microbats, one flying-fox, one amphibian, three arboreal/semi-arboreal mammals). As there are many records in the search area, those records within 2 km of the study area are displayed in **Figure 3.1**.

The nearest fauna records include, *Phascolarctos cinereus* (Koala), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat). The Koala record is the closest historic record (26/08/2016), observed on the western perimeter of the study area on Gwynn Hughes Street (OEH 2017). In considering the recent Koala record and multiple historical records in

the locality, there is a moderate to high possibility that Koala may use the study area, particularly given that suitable feed trees occur onsite. Several threatened microbat species have been recorded in the locality, however, there are generally few records, most of which are >800 m from the study area.

The likelihood of occurrence analysis undertaken prior to the field survey reduced the primary list to 21 threatened species that have recently been recorded or have a moderate or high potential to use the study area and be impacted by the proposed works. Field survey further reduced this list to 11 species (see **Appendix A**). These include:

- Threatened birds
  - *Daphoenositta chrysoptera* (Varied Sittella)
  - *Hieraaetus morphnoides* (Little Eagle)
  - *Petroica boodang* (Scarlet Robin)
- Threatened mammals
  - *Phascolarctos cinereus* (Koala)
  - *Pteropus poliocephalus* (Grey-headed Flying-fox)
  - *Chalinolobus dwyeri* (Large-eared Pied Bat)
  - Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)
  - *Myotis macropus* (Southern Myotis)
  - *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- Threatened plants
  - *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)
  - *Persoonia bargoensis* (Bargo Geebung)



Note: The following sensitive species have not been included in this figure: Persoonia hirsuta, and Powerful Owl.

Figure 3.1: Threatened species records

3.1.3 Vegetation and threatened ecological communities

Desktop assessment identified two native vegetation communities within the study area (NPWS 2002), as provided in Table 3-1 and **Figure 3.2**. These communities are, Shale Sandstone Transition Forest (SSTF) (MU2) and Upper Georges River Sandstone Woodland (UGRSW) (MU32). SSTF in the Sydney Basin Bioregion is listed as a Critically Endangered Ecological Community under the EPBC Act and BC Act. SSTF occurs at the edges of the Cumberland Plain where shale soils based soils integrate with sandstone derived sandy soils. The presence of Wianamatta group soils adjacent to sandstone derived soils (i.e. the Lucas Heights formation) is a likely location for SSTF to occur. Upper Georges River Sandstone Woodland mapped in the north of the study area is not listed as an endangered ecological community (EEC) under the EPBC Act or BC Act. The Wollondilly biodiversity layer does not cover any part of the study area.

Table 3-1: Vegetation community nomenclature

Vegetation communities (NPWS 2002)	Threatened Ecological Communities	BC Act	BC Act
Shale Sandstone Transition Forest -High Sandstone Influence (MU2)	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	CE
Upper Georges River Sandstone Woodland (MU32)	N/A	N/A	N/A

CE = critically endangered; E = endangered

NPWS (2002) mapping identified all of the northern vegetation of the study area and majority of the vegetation onsite as UGRSW, as well as the vegetation associated with the riparian corridor in the south of the study area. Additional regional vegetation mapping of the subject (Tozer et al. 2010) identified three vegetation communities within the study area (**Figure 3.3**). These are:

- Southern Highlands Shale Woodland (WSF p.268)
- Hinterland Sandstone Gully Forest (DSF p.142)
- Cumberland Shale Sandstone Transition Forest (GW p2)

Only a small portion of SSTF was identified by Tozer et al. (2010), with several small sections mapped in the north and the south of the study area. The riparian vegetation in the south of the site and the western portion of the vegetation in the north was mapped as Hinterland Sandstone Gully Forest, with the eastern portion of the northern vegetation subsequently mapped as Southern Highlands Shale Woodland.

Figure 3.2: Regional vegetation mapping of the study area (NPWS 2002).

Figure 3.3: Regional vegetation mapping of the study area (Tozer et al. 2010).

3.2 Field survey

3.2.1 Vegetation communities and flora species

Field survey confirmed the regional vegetation mapping NPWS (2002) to be consistent with the vegetation in the study area. Based on the floristic composition of the vegetation in the study area, three separate communities of differing condition classes were identified (**Figure 3.4**), and are listed below:

- Upper Georges River Sandstone Woodland (MU32)
- Shale Sandstone Transition Forest (MU2)
- Alluvial Woodland (MU11)

3.2.2 Upper Georges River Sandstone Woodland (MU32)

The native vegetation in the north of the study area is consistent with the vegetation community UGRSW (NPWS 2002), and contains a diversity of native groundcovers, grasses, shrubs and canopy species (**Figure 3.5**). The native canopy species include *Eucalyptus punctata* (Grey Gum) and *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum). The midstorey contains a range of native shrubs, however, the most abundant species include *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle), *Allocasuarina littoralis* (Black She-oak), *Persoonia linearis* (Narrow-leaved Geebung), *Banksia spinulosa* (Hairpin Banksia), *Hakea gibbosa* (Needlebush) and *Kunzea ambigua* (Tickbush). The groundlayer consists of a diversity of native grasses and forbs including *Dianella longifolia* (Blue Flax-lily), *Themeda triandra* (Kangaroo Grass), *Imperata cylindrica* (Blady Grass) and *Aristida vagans* (Threeawn Speargrass).

In the areas mapped as UGRSW 'disturbed shrubby', exotic grasses, including *Andropogon virginicus** (Whisky Grass) and *Pennisetum clandestinum** (Kikuyu), occur. In the western section of the zone exotic species including *Crocosmia crocosmiiflora** (Montbretia), *Ligustrum lucidum*, Ligustrum sinense**, *Lonicera japonica** and *Rubus fruticosus** (Blackberry) constitute a majority of the vegetation (**Figure 3.6**). The increase in exotic species in this area is likely due to increased disturbance factors associated with the adjacent residential property. An area of underscrubbed UGRSW occurs in between the intact vegetation and exotic pasture to the south (**Figure 3.7**).

3.2.3 Shale Sandstone Transition Forest (MU2)

SSTF is described by OEH (2016a) as occupying the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. An area of SSTF 'underscrubbed' vegetation occurs in the centre of the site, on the northern side of the watercourse and along the eastern edge (**Figure 3.8**). The field validated extent of SSTF was consistent with the regional mapping (NPWS 2002). Several large canopy species, including *Eucalyptus piperita* (Sydney Peppermint), *Eucalyptus punctata* (Grey Gum) and *Eucalyptus crebra* (Narrow-leafed Ironbark) occur within the area, some of which contain several moderate – large sized hollows. Native midstorey, groundcover and grass species occur sporadically through the area, including *Bursaria spinosa* subsp. *spinosa* (Blackthorn), *Commelina cyanea, Lomandra longifolia* (Spiny-headed Mat-rush) and *Pteridium esculentum* (Common Bracken). However, due to the extensive disturbance caused by past grazing this area mostly consists of large patches of *Sida rhombifolia** (Paddy's Lucerne) and *Ehrharta erecta** (Panic Veldtgrass).

3.2.4 Alluvial Woodland (MU11)

Alluvial Woodland (MU11), which is a sub-community of the River-Flat Eucalypt Forest EEC, is described by OEH (2016b) as occupying river flats of the coastal floodplains, particularly in areas that are periodically inundated by water, such as river terraces and drainage lines. Therefore, Alluvial Woodland is often associated with alluvial silts, clay-loams and sandy loams. The Alluvial Woodland in the study area occurs in a 'disturbed shrubby' condition, consisting of an established canopy of *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus amplifolia* (Cabbage Gum) and *Eucalyptus piperita* subsp. *piperita* (Sydney Peppermint) (**Figure 3.9**). The native midstorey consists of *Melaleuca linariifolia* (Flax-leaved Paperbark), *Melaleuca decora*, surrounded by exotic species, including *C. camphora*, Ligustrum lucidum*, Ligustrum sinense** and *Lonicera japonica**. Native groundcovers and grasses are present along the watercourse bank, including *Microlaena stipoides* (Weeping Grass), *Pteridium esculentum* (Common Bracken) and *Goodenia heterophylla*. Occasional areas of intact native aquatic vegetation are present through the watercourse, where species including *Paspalum distichum* (Water Couch) and *Persicaria* spp. occur.

3.2.5 Cleared Land

The cleared areas of the study area are highly modified and consist predominantly of exotic pasture grasses and herbs, including *Adiantum aethiopicum** (Whisky Grass), *Hypericum perforatum** (St. John's Wort), *Pennisetum clandestinum** (Kikuyu Grass), *Plantago lanceolata** (Plantain), *Setaria parviflora** (Pigeon Grass), *Sida rhombifolia**, *Trifolium repens** (White Clover) and *Richardia brasiliensis** (White Eye) (**Figure 3.10**). The cleared land in the south east of the study area contains substantial more regenerating native species than the remainder of the cleared land. However, the area is highly modified and of low ecological value. This vegetation has been mapped to cover 10.58 ha of the study area (approximately 51.25%).

3.2.6 Flora survey

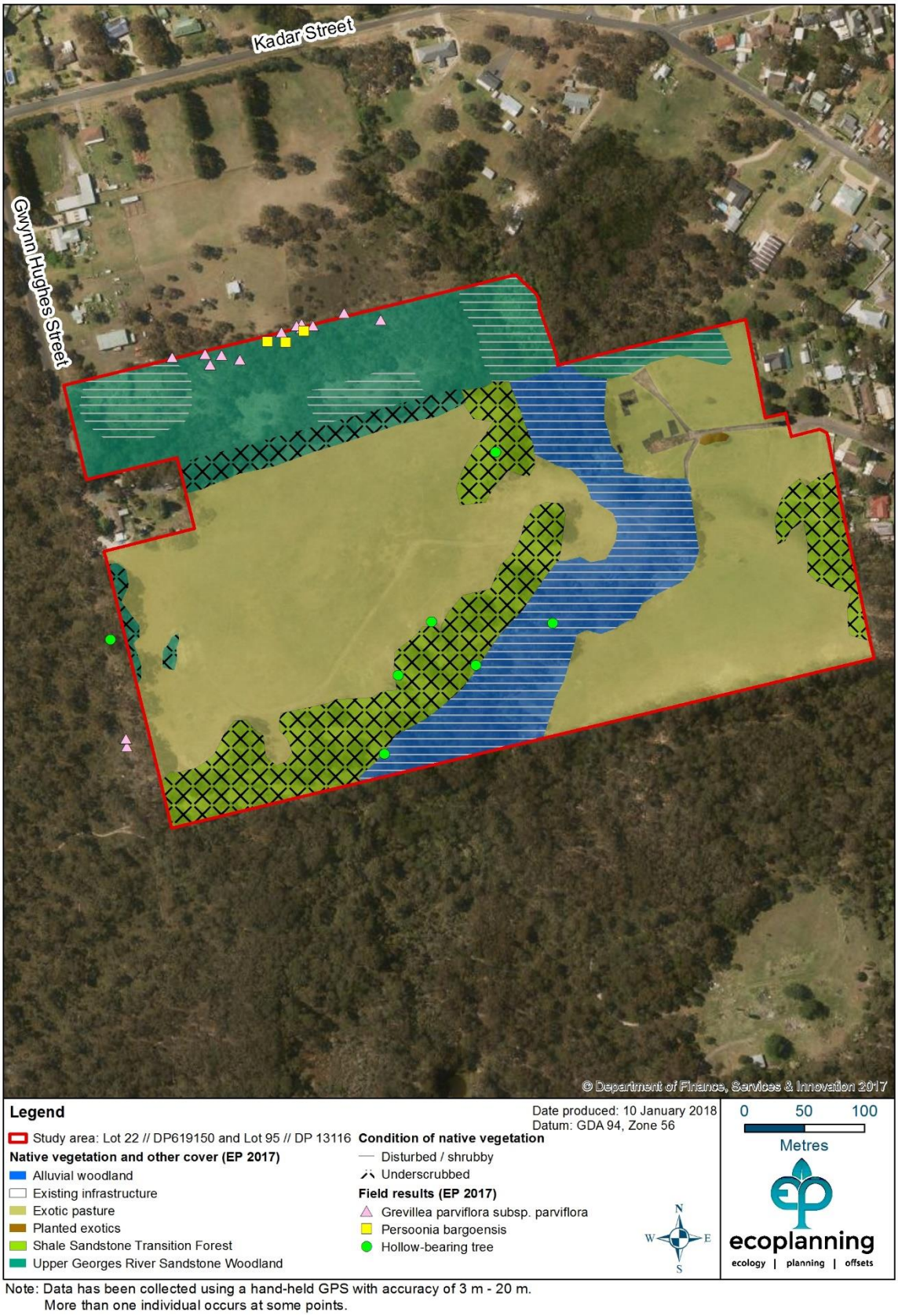
Field survey identified the presence of *Persoonia bargoensis* (**Figure 3.4** and **Figure 3.11**) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) (**Figure 3.4** and **Figure** 3.12), which were mostly confined to the northern section of the study area. A total of three *Persoonia bargoensis* and 56 *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) were recorded. A conservative estimate for the number of *Grevillea parviflora* subsp. *parviflora* was determined based on stem counts, which ranged between one and 20 at any given location. As *Grevillea parviflora* subsp. *parviflora* is known to readily sucker from its rhizome, a stem count of 56, does not necessarily equate to this many individuals.

Table 3-2: Vegetation types found in the study area showing the condition and area

Vegetation type	Vegetation zone (condition class)	Description	Area (ha)
Upper Georges River Sandstone Woodland	Intact	Intact native vegetation consistent UGRSW. The canopy consists predominantly of *Eucalyptus punctata* (Grey Gum) and *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum), with the occasional *Eucalyptus tereticornis* (Forest Red Gum). The dominant midstorey and species include *Allocasuarina littoralis* (Forest Oak), Banksia *spinulosa* (Hairpin Banksia), *Exocarpos strictus* (Dwarf Cherry), *Hakea sericea* (Needlebush and *Persoonia linearis* (Narrow-leaved Geebung). *Imperata cylindrica* (Blady Grass) and *Microlaena stipoides* (Weeping Grass) dominate the groundlayer.	2.08
	Disturbed shrubby	Vegetation is consistent with UGRSW, however, is moderately to highly disturbed. Exotic species, including *Ligustrum sinense** (Small-leafed Privet) and *Rubus fruticosus** (Blackberry), comprise the midstorey. The groundlayer consists of exotic grasses and herbs, including *Cirsium vulgare* (Spear Thistle), *Crocosmia crocosmiiflora* (Montbretia), *Paspalum dilatatum* (Paspalum) and *Pennisetum clandestinum* (Kikuyu).	1.52
	Underscrubbed	Underscrubbed vegetation consistent with UGRSW, occurring along the northern and western boundaries of the cleared pasture in the north. *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum) and *Eucalypts punctata* (Grey Gum) form an intact canopy, with non midstorey and a groundlayer that has been previously managed by grazing or mowing. The patch in the west of the site contains more resilience and a higher proportion of managed natives in the groundlayer.	0.62
Shale Sandstone Transition Forest (High Sandstone Influence)	Underscrubbed	Area of intact canopy with underscrubbed midstorey consistent with SSTF. The dominant canopy species include *Eucalyptus piperita* subsp. *piperita* (Sydney Peppermint), *Eucalyptus punctata* (Grey Gum) and *Eucalyptus* crebra (Narrow-leaved Ironbark). Re-establishing midstorey species are present through the zone, including *Bursaria spinosa* subsp. spinosa, *Kunzea ambigua* (Tick Bush), however, have a low abundance. Exotic grasses and herbaceous weed are prevalent through the zone, including *Sida rhombifolia* (Paddy's Lucerne), *Cirsium vulgare* (Spear Thistle) and *Ehrharta erecta* (Panic Veldtgrass). *Melaleuca*	2.94

Vegetation type	Vegetation zone (condition class)	Description	Area (ha)
		linariifolia (Flax-leaved Paperpark) and *Melaleuca decora* become more abundant further south, closer to the watercourses in the study area.	
Alluvial Woodland	Disturbed shrubby	Area of moderately disturbed Alluvial Woodland occurring along the riparian corridor in the centre of the study area. The canopy consists predominantly of *Eucalyptus piperita* (Sydney Peppermint), *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus amplifolia* (Cabbage Gum). Woody weeds, including *Cinnamomum camphora** (Camphor Laurel), *Ligustrum sinense** (Small-leafed Privet) and *Ligustrum lucidum** (Large-leafed Privet) have a dominant midstorey cover through the zone. Native midstorey consists of *Melaleuca decora* and *Melaleuca linariifolia* (Flax-leaved Paperbark). Groundlayer native species, include *Goodenia hederacea* (Forest Goodenia), *Microlaena stipoides* (Weeping Grass) and *Commelina cyanea.*	2.74
Other vegetation	Exotic plantings	Exotic plantings consisting mostly of *Liquidambar styraciflua* (Sweet Gum).	0.02
	Exotic pasture	Cleared land consisting mostly of exotic pasture grasses and herbs, including *Verbena bonariensis** (Purpletop), *Richardia brasiliensis** (White Eye), *Setaria parviflora** (Pigeon Grass), *Paspalum dilatatum** (Paspalum), *Pennisetum clandestinum** and *Hypericum perforatum** (St. John's Wort). Occasionally contains *Eucalyptus* spp. regrowth, ranging from 10-30 cm, particularly along the northern edge of the cleared pasture.	10.58
		Total vegetation	***20.55***

* Total area of vegetation subject to rounding errors



Note: Data has been collected using a hand-held GPS with accuracy of 3 m - 20 m.
More than one individual occurs at some points.

Figure 3.4: Field validated vegetation, threatened species records and hollow-bearing trees.

Figure 3.5: Upper Georges River Sandstone Woodland 'Intact' in the north of the study area.

Figure 3.6: Upper Georges River Sandstone Woodland 'Disturbed shrubby' in the north of the study area

Figure 3.7: Upper Georges River Sandstone Woodland 'underscrubbed' in the north of the study area.

Figure 3.8: Shale Sandstone Transition Forest 'underscrubbed' on the northern side of the watercourse.

Figure 3.9: Alluvial Woodland 'disturbed shrubby' adjacent to the watercourses in the study area.

Figure 3.10: 'Exotic pasture' in the centre of the study area.

Figure 3.11: *Persoonia bargoensis* in the study area.

Figure 3.12: *Grevillea parviflora* subsp. *parviflora* in the study area.

Flora species

A total of 79 flora species were identified in the study area during the field survey, of which were 54 native and 25 were exotic (**Appendix B**). Five noxious weeds listed under the NSW *Noxious Weeds Act 1993*, in accordance with the Wollondilly Local Control Authority, two of which are recognised as Weeds of National Significance (WoNS) (**Table 3-3**)

Table 3-3: Noxious weeds and Weeds of National Significance (WoNS)

Common name	Scientific name	Class	WoNS[1]	Requirement
African Olive	*Olea europaea* subsp. *cuspidata**	4	-	**Class 4** *The growth of the plants must be managed in a manner that continuously inhibits the ability of the plant to spread and the plants must not be sold, propagated or knowingly distributed*.
Asparagus weed	*Asparagus officinalis**	4	-	
Blackberry	*Rubus fruticosus* species aggregate*	4	Y	
Fireweed	*Senecio madagascariensis**	4	Y	
St John's Wort	*Hypericum perforatum**	4	-	

[1] http://www.weeds.org.au/WoNS/

3.2.7 Fauna habitat

The site contains a range of habitat values, with the potential to provide refuge for a diversity of native fauna. Habitat values include:

- Woodland
- Open pasture
- Dense midstorey (both native and exotic)
- Coarse woody debris
- Hollow bearing trees
- Stag trees
- Ephemeral watercourse with small pockets of water.

Habitat within the study area provides potential foraging, roosting, breeding and nesting resources. Five hollow bearing trees (HBTs) (**Figure 3.4**) were identified in the study area, most of which were scattered through the southern section of the area. The hollows identified onsite differed in their size and dimension, with the development of up to four hollows occurring within one tree (**Table 3-4** and **Figure 3.13**).

Table 3-4: Hollow bearing trees (HBTs) in the study area

HBT	Location	Description
1	-34.29092, 150.57098	1 large hollow
2	-34.29218, 150.57036	1 small hollow, approximately 15cm diameter, 6m off the ground
3	-34.29258, 150.57005	4 hollows ranging in size from small – large
4	-34.29317, 150.56990	2 large hollows where branches have broken off. Difficult to know depth or suitability as habitat from ground inspections
5	-34.29226, 150.56744	One large opening formed where a large limb has broken off
6	-34.29222, 150.57146	One moderately sized hollow approximately 10m off the ground and at the main fork of the tree.

The densely vegetated northern section of the site contains areas of thick native and exotic shrub with a *Eucalyptus* spp. and *Acacia* spp. overstorey (**Figure 3.14**). This habitat provides suitable foraging habitat and shelter for a range of bird species, particularly small passerines, such as Superb Fairy-wren (*Malurus cyaneus*) and White-browed Scrubwren *(Sericornis frontalis*). The northern section of the study area was observed to contain the highest diversity of bird species during the field survey. Several stags are located within the study area, particularly around the perimeter of the cleared land in the north west (**Figure 3.15**).

The riparian land and associated watercourse provide ideal sunning and bathing habitat for reptiles, such as the Eastern Water Dragon (*Physignathus lesueurii*). No frog species were recorded during the field survey, however, several pools were observed along the watercourse (**Figure 3.16**), which may be suitable for a range of frog species e.g. *Crinia* spp. Coarse woody debris was found in scattered areas through the site, mostly adjacent to and within the riparian zones in the south of the study area (**Figure** 3.17).

Figure 3.13: A HBT within the study area.

Figure 3.14: Open woodland with *Eucalyptus racemosa* and *Acacia* spp. overstorey.

Figure 3.15: One of several stag trees in the study area, providing perching habitat for avifauna.

Figure 3.16: One of the pools in the study area, providing habitat for frogs and bathing reptiles.

Figure 3.17: Coarse woody debris.

3.2.8 Fauna species

The field survey undertaken for this report recorded a total of 36 fauna species, of which four are introduced species. Of the 36 species, there were 31 birds (including two introduced species), two reptiles and three mammals (including two introduced species) (**Appendix D**). No threatened fauna was recorded during the field survey

Potential koala habitat

It is likely that Koala use the habitat in the study area, as a Koala was observed sitting in a *E. punctata* at the end of Gwynn Hughes Street on the 26/08/2016 (OEH, 2017). Koala are known to utilise several of the *Eucalyptus* spp. in the study area as feed trees, including *E. tereticornis* and *E. punctata*. The *State Environmental Planning Policy No 44 – Koala Habitat Protection* (SEPP44) states that for an area to be classified as potential Koala habitat at least 15% of the total number of canopy species (in both the upper and lower strata) should consist of feed trees. This classification makes a large proportion of the native vegetation onsite suitable for classification as potential Koala habitat (**Figure 3.18**). At present, it is unclear whether the study site should be classified as core Koala habitat under SEPP44. However, should further survey, or WSSC determine this land as core Koala habitat it will be necessary to produce a management plan before development consent can be granted

EPBC Act referral guidelines are in place for the Koala (DoE 2014), which aim to address the complexity of conserving this vulnerable species, given its large distribution and capability to move long distances. The guidelines provided aim to determine if a significant impact is likely and whether referral is necessary. Given the connectivity of the study area to the surrounding vegetation to the south and west of the area, the recent Koala record and presence of multiple feed trees onsite, a referral is likely. However, this remains dependent on the development proposal, including the amount of Koala habitat to be cleared, the method of clearing (i.e. clear felling or selective felling). Therefore, the direct impacts of the vegetation onsite cannot be determined until a development proposal is confirmed for the study area.

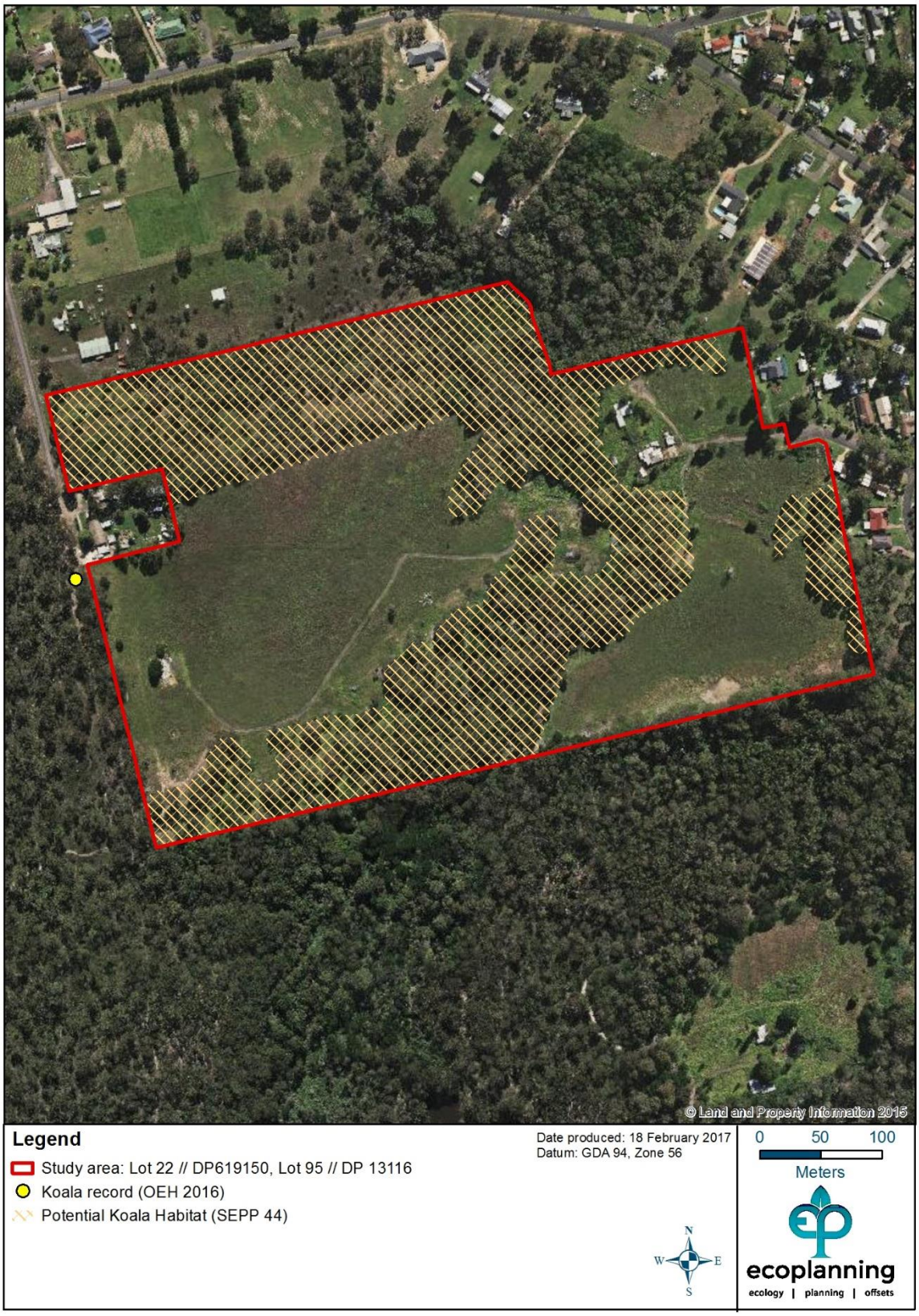


Figure 3.18: Potential Koala habitat.

3.3 Ecological constraints

Ecological constraints were identified in the study area (**Figure 3.19**) and ranked in accordance with **Table 2-1**. Areas of high ecological constraints, included the sites VRZ, and the 10 m buffers around threatened species records and HBTs. The 'underscrubbed' SSTF and 'disturbed shrubby' Alluvial Woodland has been classified as a moderate constraint. This is a result of the condition of the vegetation in these areas, which is modified, due to weed invasion, underscrubbing and grazing. However, it is noted that most of the area mapped as Alluvial Woodland is within the VRZ, thus is indirectly mapped as an area of high constraint.

The 'disturbed shrubby' vegetation in the north of the study area mapped as UGRSW has been identified as a low ecological constraint, given that is not a TEC, and has a high abundance and cover of exotic species. The remaining UGRSW is intact vegetation with a high native species richness and an intact native canopy, midstorey and groundlayer. This vegetation has connectivity to the VRZ and provides suitable habitat for a range of small passerines and is, therefore, identified as an area of moderate constraint. The remainder of the study area consists of exotic pasture and is noted considered as an area of ecological constraint.

Figure 3.19: Ecological constraints in the study area.

4. Conclusion

4.1 Recommendations

It is recommended that impacts are avoided in areas of high constraint and minimised in areas of moderate constraint, where possible. Buffers from ToB along the riparian corridors should be in accordance with the WM Act (2012) and as detailed in the report produced by Martens (2015). Martens (2015) assessed the watercourses in the study area in accordance with the Strahler system, and detailed a necessary Vegetated Riparian Zones (VRZ) for the 1st, 3rd and 4th order watercourses onsite. It is recommended that a corridor is retained within the study area, which incorporates the EEC and VRZ buffer (see Error! Reference source not found.). T his area should be rezoned as E3 – *Environmental Management* and incorporated under the Wollondilly LEP (2011) terrestrial biodiversity layer. **Figure 4.1** also includes the area of 'underscrubbed' SSTF, classified as a moderate constraint to be incorporated into the biodiversity layer. However, offsetting the impacts to this vegetation may also be a suitable outcome.

All areas of EEC, VRZ and bushland adjacent to threatened species records should be managed in accordance with a Vegetation Management Plan. This plan should detail the methodology for restoring the riparian corridor, which contains a moderate to high woody weed midstorey cover. This plan should also aim to restore the underscrubbed areas of SSTF using a combination of revegetation and regeneration methods, should appropriate offsetting not occur. Section 4.3 provides a list of threatened species that have recently been recorded, or have a moderate – high likelihood of occurring in the study area. These species should be subject to impact assessment once a development footprint has been finalised. In summary, field and desktop survey have identified significant ecological values, including threatened species, EEC and riparian corridors, which future development should be sympathetic towards.

4.2 Response to OEH comments

The comments below are in response to the advice provided by the Office of Environment and Heritage (OEH) on the proposed environmental zoning and conservation of the biodiversity values identified in the study area. OEH have specified that the proposed application of E3 – Environmental Management zoning is unlikely to ensure the long term protection of the biodiversity values in the study area. As such, OEH propose that the biodiversity values are protected through the application of an E2 – Environmental Conservation zoning.

An E2 zoning of all land identified in **Figure 3.19**, (including all 'high' ecological values, riparian buffers and SSTF in an 'underscrubbed' condition) is considered a reasonable outcome for the biodiversity values in the study area. However, it is noted that consultation with Council has resulted in no desire to take ownership of these areas, irrespective of Council's Draft Dedication of Land Policy (PLA0036). Whilst E2 is considered appropriate on public land, given that the parcel will likely remain in private ownership, E3 is considered a more appropriate zoning. Furthermore, it is noted that the site is too small for a Biobanking Agreement to be a viable option for the long term conservation of the study area.

The 10 m buffer surrounding the threatened flora records along the northern perimeter of the study area is intended for inclusion under the Natural Resources - Biodiversity layer (WLEP 2011). Additional field survey on 11 August 2017 was conducted to flag all threatened plants within the study area, which resulted in the identification of additional specimens of *Grevillea parviflora* subsp. *parviflora* to the west of previous records. As such it is recommended that a 10 m buffer around all records of threatened plants is retained. This will form a 25 m wide corridor that extends along the full extent of the northern perimeter of the study area. This will facilitate a corridor between the vegetation to the west of Gwynn Hughes Street and Hornes Creek, which will include vegetation mapped as UGRSW ('moderate' and 'low' constraint). The inclusion of additional areas of UGRSW under the biodiversity layer Natural Resources - Biodiversity layer (WLEP 2011) has not been considered, as this community is not a TEC and the vegetation contains reasonable areas of 'low' ecological value.

4.3 Threatened species, populations, ecological communities and migratory species

4.3.1 Commonwealth listings

Several Commonwealth listed threatened flora and fauna species under the EPBC Act have been assessed as having a moderate to high likelihood of occurrence, or have recently been recorded in the study area based on field assessment. These species are as follows:

Recent record in study area

- *Persoonia bargoensis*
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)

Moderate likelihood of occurring in the study area

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

High likelihood of occurring in the study area

- *Phascolarctos cinereus* (Koala)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

A Matter of National Environmental Significance assessment following the *Significant Impact Guidelines 1.1* (DotE 2014) criteria should be undertaken if the proposed development is likely to impact on the aforementioned species.

4.3.2 State listings

Several State listed threatened flora and fauna species have been assessed as having a moderate to high likelihood of occurrence, or have been recently recorded in the study area. These species are as follows:

Recent record in study area

- *Persoonia bargoensis*
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)

Moderate likelihood of occurring in the study area

- *Daphoenositta chrysoptera* (Varied Sittella)
- *Hieraaetus morphnoides* (Little Eagle)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Myotis macropus* (Southern Myotis)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)

High likelihood of occurring in the study area

- *Phascolarctos cinereus* (Koala)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

An impact assessment in accordance with s5A EP&A Act (i.e. 7-part test) and the associated guidelines (DECC 2007) should be undertaken if the proposed development is likely to impact on the aforementioned species.

Figure 4.1: Area recommended under the biodiversity layer and VRZ buffers.

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Appendix A: Species likelihood of occurrence

The potential for each threatened species, population and/or migratory species to occur was then considered and the necessity for targeted field surveys was determined. Following field surveys and review of available habitat within the study area, the potential for species to utilise the site and be affected directly or indirectly by the proposal were considered as either:

- "Recent record" = species has been recorded in the study area within the past 5 years
- "High" = species has previously been recorded in the study area (>5 years ago) or in close proximity (for mobile species), and/or habitat is present that is likely to utilised by a local population
- "Moderate" = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- "Low" = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- "Not present" – suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area

Scientific Name Common Name	Legal Status	Number of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Prior to field assessment	Post field assessment
KINGDOM: Animalia; CLASS: Amphibia						
Pseudophryne australis Red-crowned Toadlet	BC Act: V	3	3.31km (29/03/2016)	29/03/2016 (3.31km)	Low	Low
KINGDOM: Animalia; CLASS: Aves						
Artamus cyanopterus cyanopterus Dusky Woodswallow	BC Act: V	1	3.56km (2003)	20/08/2003 (3.56km)	Moderate	Low
Callocephalon fimbriatum Gang-gang Cockatoo	BC Act: V	5	3.71km (16/03/2012)	16/03/2012 (3.71km)	Moderate	Low
Calyptorhynchus lathami Glossy Black-Cockatoo	BC Act: V	1	3.27km (19/09/2014)	19/09/2014 (3.27km)	Low	Low
Climacteris picumnus victoriae Brown Treecreeper (eastern subsp.)	BC Act: V	7	3.24km (3/05/2003)	28/06/2006 (4.36km)	Moderate	Not present
Daphoenositta chrysoptera Varied Sittella	BC Act: V	9	2.34km (14/05/2011)	11/05/2017 (3.45km)	Moderate	Moderate
Haliaeetus leucogaster White-bellied Sea-Eagle	BC Act: V EPBC Act: C	1	2.43km (14/05/2011)	14/05/2011 (2.43km)	Low	Low
Hieraaetus morphnoides Little Eagle	BC Act: V	5	2.65km (21/04/2004)	19/04/2017 (4.14km)	Moderate	Moderate
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subsp.)	BC Act: V	4	3.56km (20/08/2003)	21/06/2006 (3.58km)	Low	Low
Ninox strenua Powerful Owl	BC Act: V	2	1.51km (31/10/1997)	31/10/1997 (1.51km)	Low	Not present

Scientific Name Common Name	Legal Status	Number of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Prior to field assessment	Post field assessment
Petroica boodang Scarlet Robin	BC Act: V	6	2.93km (15/06/2015)	15/06/2015 (2.93km)	Moderate	Moderate
Stagonopleura guttata Diamond Firetail	BC Act: V	2	3.9km (21/06/2006)	21/06/2006 (3.9km)	Low	Low
KINGDOM: Animalia; CLASS: Mammalia						
Chalinolobus dwyeri Large-eared Pied Bat	BC Act: V EPBC Act: V	2	3.98km (12/02/2008)	7/10/2014 (4.54km)	Moderate	Moderate
Dasyurus maculatus Spotted-tailed Quoll	BC Act: V EPBC Act: E	1	4.57km (1/01/2016)	1/01/2016 (4.57km)	Low	Not present
Falsistrellus tasmaniensis Eastern False Pipistrelle	BC Act: V	1	0.99km (13/02/2008)	13/02/2008 (0.99km)	Moderate	Low
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	BC Act: V	3	0.99km (3/02/2008)	7/10/2014 (4.54km)	Moderate	Moderate
Mormopterus norfolkensis Eastern Freetail-bat	BC Act: V	2	3.64km (23/11/1999)	12/02/2008 (3.98km)	Moderate	Low
Myotis macropus Southern Myotis	BC Act: V	2	3.7km (15/06/2015)	15/06/2015 (3.7km)	Moderate	Moderate
Petauroides volans Greater Glider	EPBC Act: V	2	4.0km (27/04/1999)	5/01/2017 (4.82km)	Low	Not present
Phascolarctos cinereus Koala	BC Act: V EPBC Act: V	56	0.28km (26/08/2016)	30/07/2017 (3.65km)	High	High
Pteropus poliocephalus Grey-headed Flying-fox	BC Act: V EPBC Act: V	1	2.43km (14/05/2011)	14/05/2011 (2.43km)	High	Moderate

Scientific Name Common Name	Legal Status	Number of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Prior to field assessment	Post field assessment
Scoteanax rueppellii Greater Broad-nosed Bat	BC Act: V	4	0.99km (13/02/2008)	28/02/2012 (4.42km)	Moderate	Moderate
KINGDOM: Plantae						
Acacia bynoeana Bynoe's Wattle	BC Act: E1 EPBC Act: V	1	4.29km (13/04/2012)	13/04/2012 (4.29km)	Low	Low
Epacris purpurascens var. *purpurascens*	BC Act: V	24	2.2km (7/05/2015)	11/06/2015 (2.6km)	Moderate	Not present
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	BC Act: V EPBC Act: V	55	0km (31/01/2017)	31/01/2017 (0km)	High	Recent record
Persoonia bargoensis Bargo Geebung	BC Act: E1 EPBC Act: V	198	0km (31/01/2017)	31/01/2017 (0km)	High	Recent record
Persoonia glaucescens Mittagong Geebung	BC Act: E1 EPBC Act: V	94	0.58km (27/05/2008)	19/01/2017 (1.22km)	High	Low
Persoonia hirsuta Hairy Geebung	BC Act: E1 EPBC Act: E	262	0.7km (6/07/2005)	7/05/2015 (4.95km)	High	Not present
Pomaderris brunnea Brown Pomaderris	BC Act: E1 EPBC Act: V	4	1.05km (27/05/2008)	27/05/2008 (1.05km)	Moderate	Low

Unless other stated, text is taken from the OEH Threatened Species (http://www.environment.nsw.gov.au/threatenedspecies/); Legal Status codes from the Atlas of NSW Wildlife: V = Vulnerable, E1 = Endangered, E2 = Endangered Population, E4A = Critically Endangered, C = China and Australia Migratory Bird Agreement (CAMBA), J = Japan and Australia Migratory Bird Agreement (JAMBA); BC Act = Biodiversity Conservation Act 2016, EPBC Act = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

Appendix B: Flora and fauna species inventories

Flora

Family	Genus	Species	Common name	Native/Exotic	Type
Altingiaceae	*Liquidambar*	*styraciflua*	Sweet Gum	Exotic	Tree
Araliaceae	*Hydrocotyle*	*sibthorpioides*		Native	Forb
Asparagaceae	*Asparagus*	*officinalis*	Asparagus	Exotic	Forb
Asteraceae	*Hypochaeris*	*radicata*	Flatweed	Exotic	Forb
Asteraceae	*Onopordum*	*acanthium*	Scotch Thistle	Exotic	Forb
Asteraceae	*Senecio*	*madagascariensis*	Fireweed	Exotic	Forb
Caprifoliaceae	*Lonicera*	*japonica*	Japanese Honeysuckle	Exotic	Scrambler
Casuarinaceae	*Allocasuarina*	*littoralis*	Black She-oak	Native	Tree
Chenopodiaceae	*Einadia*	*hastata*	Berry Saltbush	Native	Forb
Clusiaceae	*Hypericum*	*perforatum*	St. John's Wort	Exotic	Forb
Clusiaceae	*Hypericum*	*gramineum*	Small St. John's Wort	Native	Forb
Commelinaceae	*Commelina*	*cyanea*		Native	Forb
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed	Native	Forb
Dennstaedtiaceae	*Pteridium*	*esculentum*	Common Bracken	Native	Fern
Dilleniaceae	*Hibbertia*	*diffusa*	Wedge Guinea Flower	Native	Forb
Fabaceae - Faboideae	*Hardenbergia*	*violacea*	Purple Coral Pea	Native	Vine
Fabaceae - Faboideae	*Mirbelia*	*rubiifolia*	Heathy Mirbelia	Native	Shrub
Fabaceae - Faboideae	*Trifolium*	*repens*	White Clover	Exotic	Forb
Fabaceae - Mimosoideae	*Acacia*	*decurrens*	Black Wattle	Native	Tree
Fabaceae - Mimosoideae	*Acacia*	*falcata*	Hickory Wattle	Native	Shrub
Fabaceae - Mimosoideae	*Acacia*	*longifolia* var. *longifolia*	Sydney Golden Wattle	Native	Shrub
Fabaceae - Mimosoideae	*Acacia*	*elata*	Mountain Cedar Wattle		Tree

Family	Genus	Species	Common name	Native/Exotic	Type
Goodeniaceae	*Goodenia*	*hederacea*	Forest Goodenia	Native	Forb
Goodeniaceae	*Goodenia*	*heterophylla*		Native	Forb
Haloragaceae	*Gonocarpus*	*teucrioides*	Raspwort	Native	Forb
Iridaceae	*Crocosmia*	*crocosmiiflora*	Montbretia	Exotic	Forb
Lauraceae	*Cinnamomum*	*camphora*	Camphor Laurel	Exotic	Tree
Lomandraceae	*Lomandra*	*multiflora*	Many-flowered Mat-rush	Native	Rush
Lomandraceae	*Lomandra*	*longifolia*	Spiny-headed Mat-rush	Native	Rush
Lomandraceae	*Lomandra*	*obliqua*		Native	Rush
Malvaceae	*Sida*	*rhombifolia*	Paddy's Lucerne	Exotic	Forb
Myrtaceae	*Eucalyptus*	*punctata*	Grey Gum	Native	Tree
Myrtaceae	*Eucalyptus*	*amplifolia*	Cabbage Gum	Native	Tree
Myrtaceae	*Eucalyptus*	*racemosa*	Narrow-leaved Scribbly Gum	Native	Tree
Myrtaceae	*Eucalyptus*	*crebra*	Narrow-leaved Ironbark	Native	Tree
Myrtaceae	*Eucalyptus*	*tereticornis*	Forest Red Gum	Native	Tree
Myrtaceae	*Eucalyptus*	*piperita* subsp. *piperita*	Sydney Peppermint	Native	Tree
Myrtaceae	*Kunzea*	*ambigua*	Tick Bush	Native	Shrub
Myrtaceae	*Melaleuca*	*linariifolia*	Flax-leaved Paperbark	Native	Tree
Myrtaceae	*Melaleuca*	*decora*	`	Native	Tree
Oleaceae	*Ligustrum*	*lucidum*	Large-leaved Privet	Exotic	Shrub
Oleaceae	*Ligustrum*	*sinense*	Small-leaved Privet	Exotic	Shrub
Oleaceae	*Olea*	*europaea* subsp. *cuspidata*	African Olive	Exotic	Shrub
Orchidaceae	*Calochilus*	*paludosus*	Red Beard Orchid	Native	Forb
Phormiaceae	*Dianella*	*longifolia*	Blue Flax-Lily	Native	Rush
Phyllanthaceae	*Poranthera*	*microphylla*		Native	Forb
Phytolaccaceae	*Phytolacca*	*octandra*	Inkweed	Exotic	Forb
Pittosporaceae	*Bursaria*	*spinosa* subsp. *spinosa*	Blackthorn	Native	Shrub

Family	Genus	Species	Common name	Native/Exotic	Type
Pittosporaceae	*Pittosporum*	*undulatum*	Sweet Pittosporum	Native	Tree
Plantaginaceae	*Plantago*	*lanceolata*	Lamb's Tongue	Exotic	Forb
Plantaginaceae	*Veronica*	*plebeia*	Trailing Speedwell	Native	Forb
Poaceae	*Andropogon*	*virginicus*	Whisky Grass	Exotic	Grass
Poaceae	*Aristida*	*vagans*	Threeawn Speargrass	Native	Grass
Poaceae	*Austrostipa*	*pubescens*		Native	Grass
Poaceae	*Cynodon*	*dactylon*	Couch	Exotic	Grass
Poaceae	*Echinopogon*	*caespitosus*	Bushy Hedgehog-grass	Native	Grass
Poaceae	*Ehrharta*	*erecta*	Panic Veldtgrass	Exotic	Grass
Poaceae	*Entolasia*	*marginata*	Bordered Panic	Native	Grass
Poaceae	*Imperata*	*cylindrica*	Blady Grass	Native	Grass
Poaceae	*Microlaena*	*stipoides*	Weeping Grass	Native	Grass
Poaceae	*Paspalum*	*dilatatum*	Paspalum	Exotic	Grass
Poaceae	*Paspalum*	*distichum*	Water Couch	Native	Grass
Poaceae	*Setaria*	*parviflora*	Pigeon Grass	Exotic	Grass
Poaceae	*Themeda*	*triandra*	Kangaroo Grass	Native	Grass
Proteaceae	*Banksia*	*spinulosa*	Hairpin Banksia	Native	Shrub
Proteaceae	*Grevillea*	*parviflora* subsp. *parviflora*	Small-flower Grevillea	Native	Shrub
Proteaceae	*Hakea*	*sericea*	Needlebush	Native	Shrub
Proteaceae	*Persoonia*	*bargoensis*		Native	Shrub
Proteaceae	*Persoonia*	*linearis*	Narrow-leaved Geebung	Native	Shrub
Proteaceae	*Persoonia*	*lanceolata* x *linearis*		Native	Shrub
Pteridaceae	*Adiantum*	*aethiopicum*	Common Maidenhair	Native	Fern
Rosaceae	*Rubus*	*fruticosus*	Blackberry	Exotic	Scrambler
Rosaceae	*Rubus*	*parvifolius*	Native Raspberry	Native	Scrambler
Rubiaceae	*Richardia*	*brasiliensis*	White Eye	Exotic	Forb

Family	Genus	Species	Common name	Native/Exotic	Type
Santalaceae	*Exocarpos*	*strictus*	Dwarf Cherry	Native	Tree
Santalaceae	*Leptomeria*	*acida*	Native Currant	Native	Shrub
Solanaceae	*Solanum*	*nigrum*	Black-berry Nightshade	Exotic	Forb
Solanaceae	*Solanum*	*pseudocapsicum*	Madeira Winter	Exotic	Forb
Solanaceae	*Solanum*	*prinophyllum*	Forest Nightshade	Native	Forb
Thymelaeaceae	*Pimelea*	*linifolia*	Slender Rice Flower	Native	Shrub
Verbenaceae	*Verbena*	*bonariensis*	Purpletop	Exotic	Forb

Fauna

Class	Family	Scientific name	Common name	Native/ Exotic	Ecoplanning (13/01/17)
Aves	Acanthizidae	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Native	O
Aves	Acanthizidae	*Acanthiza nana*	Yellow Thornbill	Native	OW
Aves	Acanthizidae	*Gerygone albogularis*	White-throated Gerygone	Native	OW
Aves	Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	Native	W
Aves	Artamidae	*Cracticus tibicen*	Australian Magpie	Native	W
Aves	Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	Native	W
Aves	Cacatuidae	*Cacatua roseicapilla*	Galah	Native	OW
Aves	Cacatuidae	*Cacatua sanguinea*	Little Corella	Native	W
Aves	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Native	OW
Aves	Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	Native	W
Aves	Columbidae	*Phaps chalcoptera*	Common Bronzewing	Native	O
Aves	Coraciidae	*Eurystomus orientalis*	Dollar bird	Native	OW
Aves	Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	Native	W
Aves	Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	Native	OW
Aves	Halcyonidae	*Todiramphus macleayii*	Sacred Kingfisher	Native	O
Aves	Maluridae	*Malurus cyaneus*	Superb Fairy-wren	Native	OW
Aves	Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	Native	W
Aves	Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	Native	W
Aves	Meliphagidae	*Manorina melanocephala*	Noisy Miner	Native	W
Aves	Meliphagidae	*Manorina melanophrys*	Bell Miner	Native	W
Aves	Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	Native	OW
Aves	Monarchidae	*Grallina cyanoleuca*	Magpie-lark	Native	W
Aves	Monarchidae	*Myiagra rubecula*	Leaden Flycatcher	Native	W
Aves	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	Native	W
Aves	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	Native	W
Aves	Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	Native	W
Aves	Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	Native	W
Aves	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	Native	W
Aves	Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	Native	W
Aves	Sturnidae	*Sturnus tristis**	Common Myna*	Exotic	OW
Aves	Turdidae	*Turdus merula**	Common Blackbird*	Exotic	O

Class	Family	Scientific name	Common name	Native/ Exotic	Ecoplanning (13/01/17)
Mammalia	Canidae	*Vulpes vulpes**	European Red Fox*	Exotic	P
Mammalia	Leporidae	*Oryctolagus cuniculus**	Rabbit*	Exotic	O
Mammalia	Macropodidae	*Wallabia bicolor*	Swamp Wallaby	Native	O
Reptilia	Agamidae	*Physignathus lesueurii lesueurii*	Eastern Water Dragon	Native	O
Reptilia	Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	Native	O