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Ecological Constraints Assessment





Lot 1 // DP 996286
95 Great Southern Road, Bargo, NSW

Proposed Landuse Rezoning

Prepared for: Precise Planning Pty Ltd

9 May 2017

PROJECT NUMBER	2015-005		
PROJECT NAME	Ecological Constraints Assessment		
PROJECT ADDRESS	Lot 1 // DP 996286, 95 Great Southern Road, Bargo, NSW		
PREPARED FOR	Precise Planning Pty Ltd		
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REVIEW	Lucas McKinnon		
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Glossary and abbreviations

ABBR./TERM	DESCRIPTION
CAMBA	China and Australia Migratory Bird Agreement
CEEC	Critically endangered ecological community
DCP	Development Control Plan
DNG	Derived native grassland
EEC	Endangered ecological community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
JAMBA	Japan and Australia Migratory Bird Agreement
LEP	Local Environment Plan
LGA	Local Government Area
mm/cm/m/km	millimetres/centimetres/metres/kilometres
masl	metres above sea level
NRBL	Natural Resources Biodiversity Layer
TEC	Threatened Ecological community, listed as vulnerable, endangered or critically endangered under either the TSC and/or EPBC Acts
TSC Act	NSW *Threatened Species Conservation Act 1995*
WSC	Wollondilly Shire Council
*	Denotes exotic species

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1 Introduction

1.1 Purpose of report and legislative context

This ecological constraints assessment has been undertaken to accompany an application rezone Lot 1 // DP 996286, 95 Great Southern Road, Bargo NSW (the 'subject site') from the existing RU2 zoning to a combination of R2 and E2 zoning. This report outlines the ecological constraints and addresses the legislative context provided in below.

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)		
Threatened Species Conservation (TSC) Act 1995	Schedules 1, 1A, 2 and 3	Lists threatened species, populations, ecological communities and key threatening processes to be considered under Section 5A EP&A Act.
Native Vegetation (NV) Act 2003	Parts 3, 4 and Schedule 1	Object of the Act is to prevent broadscale clearing unless it 'improves or maintains' environmental outcomes. Schedule 1 outlines land that is excluded from the operations of the Act.
Noxious Weeds (NW) Act 1993	Part 3	Relates to the control of noxious weeds on land.
State Environmental Planning Policy 44	Koala Habitat Protection	Aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas
Fisheries Management Act 1994	Schedules 4, 4A and 5	Lists threatened species, populations, ecological communities and provides for key fish habitats to be considered under Section 5A EP&A Act.
Water Management (WM) Act 2000	Section 91	Controlled activity approval is required for activities in, on or under waterfront land.
Local		
Wollondilly Local Environmental Plan (WLEP) 2011	Clause 7.2	Biodiversity Protection: the objective of this clause is to maintain terrestrial and aquatic biodiversity. It applies to land identified on the 'Natural Resources – Biodiversity Map'.

INSTRUMENT	CONSIDERATIONS	CONTEXT
Wollondilly Local Environmental Plan (WLEP) 2011	Clause 7.3	The objective of this clause is to maintain the hydrological functions of riparian land, waterways and aquifers. This clause applies to land identified as "sensitive land" on the Natural Resources—Water Map.
Wollondilly Development Control Plan (WDCP) 2011	Clause 2.5	Biodiversity: provides additional requirements to be met on land identified under Cl. 7.2 of WLEP.
Wollondilly Development Control Plan (WDCP) 2011	Clause 2.6	Water Protection: applies to land identified under LEP clause 7.3 as 'Sensitive Land' on the Natural Resources – Water Map to the LEP. Land identified as sensitive land for Water Protection may also contain land identified as 'sensitive land' for Biodiversity as described under Clause 2.5 of the DCP.

1.2 Response to Council letter (21 October 2016) and email (3 May 2017)

Following the submission of an earlier version of this FFRA (V 1.0) (Ecoplanning 2016), a letter was received from Council (WSC 2016) requesting further details with regards to the matters outlined in **Table** 1.2. Accordingly, those concerns were addressed and provided in s revised version of this report (v 1.1). Additionally, a second request was made by Council (WSC 2017) to identify the associated Sections of the report that had been updated, accordingly this has been provided in **Table** 1.2 below.

Table 1.2: Council concerns as outlined in WSC 2016) and Ecoplanning response.

Council concern	Ecoplanning response	Relevant Section of report
Mapping and Classification of Native Grasslands: Approx. 20m in width directly to the west of the drainage line potentially satisfied the definition of derived native grasslands. It is therefore recommended that an updated ECA be provided which includes the following, additional survey; analysis of DNG, the results of the analysis in tabular format and mapping is updated	Additional transect surveys were undertaken to determine the extent of native grassland in the area directly west of the drainage line. Three 50 m transects were undertaken perpendicular to the Alluvial Woodland within the area mapped as 'Cleared land – pasture'. The grassland was determined to be predominantly exotic in this area. The area that was originally mapped as 'Cleared – exotic pasture' has been retained.	**Section 2.2.1**, **Figure 2.1**, **Section 3.2.1**, **Table 3.3**, and Error! Reference source not found.

Council concern	Ecoplanning response	Relevant Section of report
Conservation value of Alluvial Woodland: Council staff are of the view that the Alluvial Woodland would achieve a viable good condition following the removal of pressures from grazing and assisted management in the form of weed control. Further expansion of the (E2) zone may be necessary depending on the results of the additional grassland surveys above.	Whilst heavily impacted by grazing, the vast majority of the Alluvial Woodland has been recommended for retention as E2 with the remainder recommended as R5 Large Lot (5,000 m^2) zoning. Further, the entirety of the Alluvial Woodland has been recommended as Natural Resources – Biodiversity Layer (NRBL) under the WLEP 2009 (see below). As noted by WSC (2016), removal of grazing and assisted management of the corridor will improve the condition of this vegetation, and the application of the NRBL will allow for suitable offsets where protection of this vegetation cannot be achieved. As recommended and in accordance with NOW (DPI 2012) Guidelines, a VMP for any impact to 'waterfront land' will be required, and further assessment of appropriate areas for rehabilitation should be given consideration at the subdivision DA stage.	**Sections 4.2.1** and **4.3**
Conservation values of the Shale Sandstone transition Forest and its Protection: Councils Environmental Services Team was agreeable with the findings and mapped areas of the site related Shale Sandstone Transition Forest. It is recommended that the NRBL be applied over areas of Shale Sandstone Transition Forest on the site to ensure that its future removal is suitably offset.	Recommendations have been made to capture all mapped EEC and CCEC under the NRBL.	**Section 4.3**

Council concern	Ecoplanning response	Relevant Section of report
Management and Protection of Riparian Corridors: The application of the E2 zone to this corridor would be suitable for conservation requirements. Should the E2 zoned lands not be dedicated to Council, then it will be necessary to insert controls to the Councils DCP which require the submission of a Vegetation Management Plan as part of any future subdivision application applying to the E2 land.	It has been recommended that the E2 corridor is dedicated to a public authority (Council or otherwise) to ensure appropriate long term protection and management of this land. A VMP is a necessary component of any DA that will impact upon 'waterfront land' in accordance with the NOPW Guidelines (DPI 2012).	**Section 4.3**

1.3 Site description

1.3.1 Subject site and study area

The ***subject site***, 95 Great Southern Road, Bargo (Lot 1 //DP 996286), is located approximately 1.5 km to the north of the Bargo railway station in the Wollondilly Shire Local Government Area (LGA) (**Figure 1.1** and **Figure 1.2**).

The subject site is defined by the area 'directly impacted upon by the rezoning proposal', and includes the built, naturally vegetated and cleared grazing areas proposed for rezoning from the existing RU2 Rural Landscape land use zone.

The area of the subject site is 28.42 ha and is comprised of a parcel of land that has had a long history of agricultural uses. The subject site is predominantly cleared of vegetation and the majority of the site consists of a mixture of native and exotic grasses that have been subject to grazing uses.

The subject site is traversed by a second order, north to north easterly flowing, Un-named tributary of Dog Trap Creek (hereafter, 'Un-named Tributary') and another first order, west to east flowing, Un-named first order drainage line (hereafter, 'Un-named Drainage Line'), both of which ultimately flow to the Nepean River.

The ***study area*** includes the subject site and all areas that are potentially directly and indirectly impacted by the proposal and future landuse change. For the purposes of this report the subject site and study area are synonymous, as no substantial or significant indirect impacts have been identified. Adjacent land to the subject site were considered and (in part) inspected for consideration in this assessment. This was undertaken to provide a more comprehensive indication of the historical extent of native vegetation cover across the subject site and to assist with determining the significance of remnant vegetation and regenerating areas within the subject site.

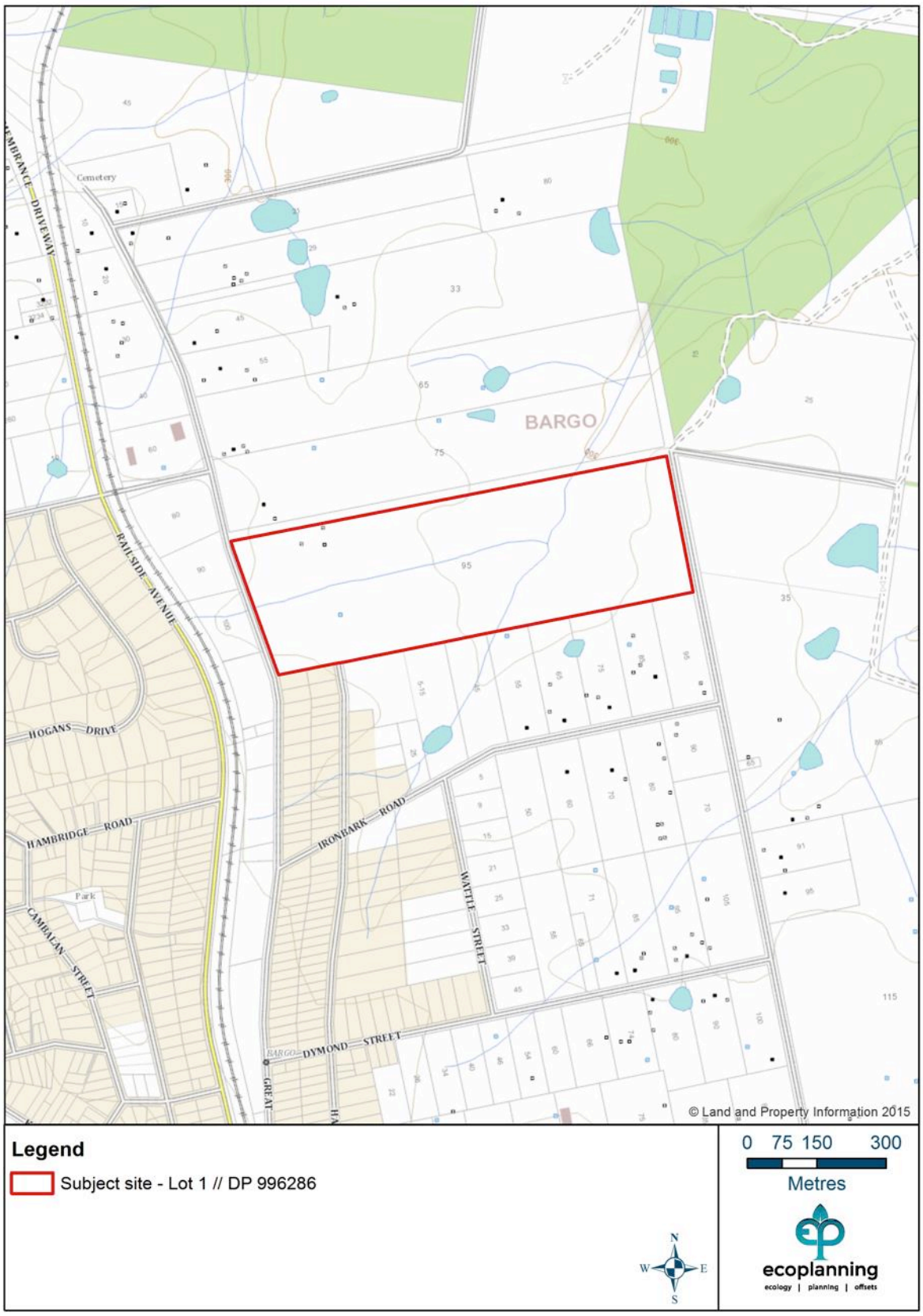

Figure 1.1: Subject site and study area.

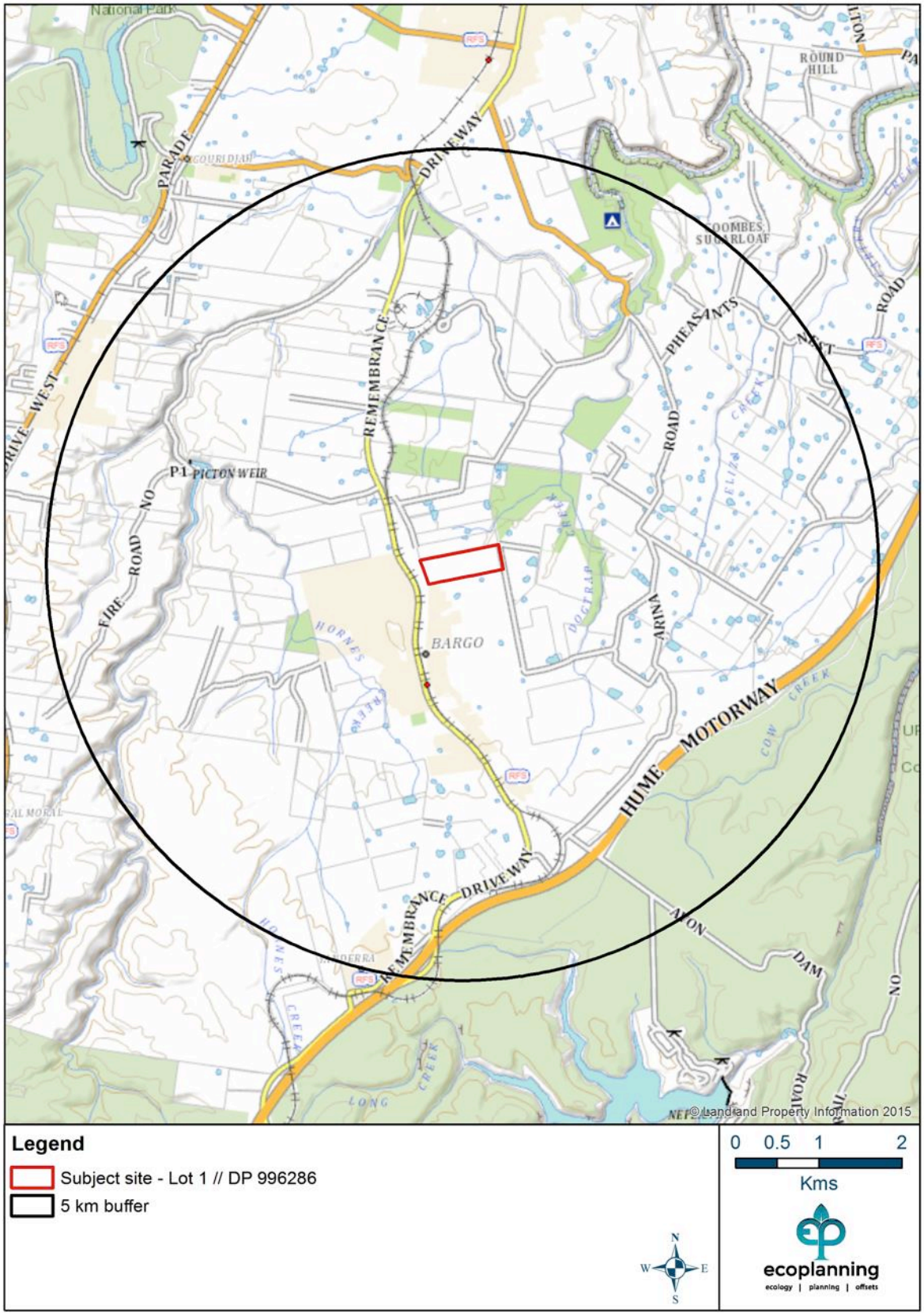

Figure 1.2: Locality map of subject site.

At present the subject site is a single rural residential allotment which has dual street frontage including, 95 Great Southern Road and 50 Government Road, Bargo. The subject site has an existing residential dwelling (farm house) and associated sheds, a silo and other farm structures with access fronting Great Southern Road

The existing farmhouse and surrounding home allotment with pioneer/colonial features, consists of the 'Old Coomeroo' Homestead, a Silo and Slab Shed, all of which have heritage listings. The home allotment and Great Southern Road frontage also have exotic landscape and garden plantings of various trees and shrubs, including an avenue of Radiata Pine trees.

Vegetation across the subject site is primarily exotic grassy ground cover with a patchy distribution of native grass species. A long history of heavy grazing across the subject site has limited the ability of native vegetation to regenerate. Some remnant native vegetation is present, however, this is restricted to the riparian zone and adjacent floodplain of the Un-named Tributary. Un-named Drainage Line is devoid of native vegetation. In addition, a retained native tree-line exists along the Government Road verge/reserve and a small number of retained paddock trees are present mainly along the eastern and southern boundary fence-line.

Regional vegetation mapping undertaken by NPWS (NPWS 2002) has mapped the vegetation on the subject site as Shale Sandstone Transition Forest (High Sandstone Influence MU2) and 'Unclassified' (TX condition, MU10999) (**Figure 1.3**). Conversely, Tozer et al. (2006 and 2010), has not mapped the vegetation on the subject site, but does however map the vegetation of the adjoining property as Sydney Hinterland Transition Woodland (DSF p146) (**Figure 1.4**).

The topography of the site is relatively flat with a gentle slope towards the dissecting drainage line. The site is approximately 300-320 metres above sea level (masl). Regional-scale soil mapping indicates the occurrence of shale soils of the Blacktown Soil Landscape Group in the western third of the site and the eastern two thirds of the site is mapped as Lucas Heights Soil Landscape derived from the lower Wianamatta Shale geological formations (Hazelton and Tille, 1990) (**Figure 1.5**).

The underlying surface geology for the subject site (Rose, 1966) is mapped as Wianamatta Shale, however along the dissecting creek-line exposed Hawkesbury sandstone is evident, particularly in the northern section of the sites creek-line (**Figure 1.6**). This is indicative of the shallowness of the shale lens coverage of the site and the likely sandstone influence on the remnant native vegetation. Downstream vegetation on adjoining properties is clearly influenced by its composition by the increased Hawkesbury Sandstone outcropping that occurs along the unnamed headwater drainage line to the north.

Figure 1.3: Mapped Vegetation in vicinity of subject site (NPWS, 2002).

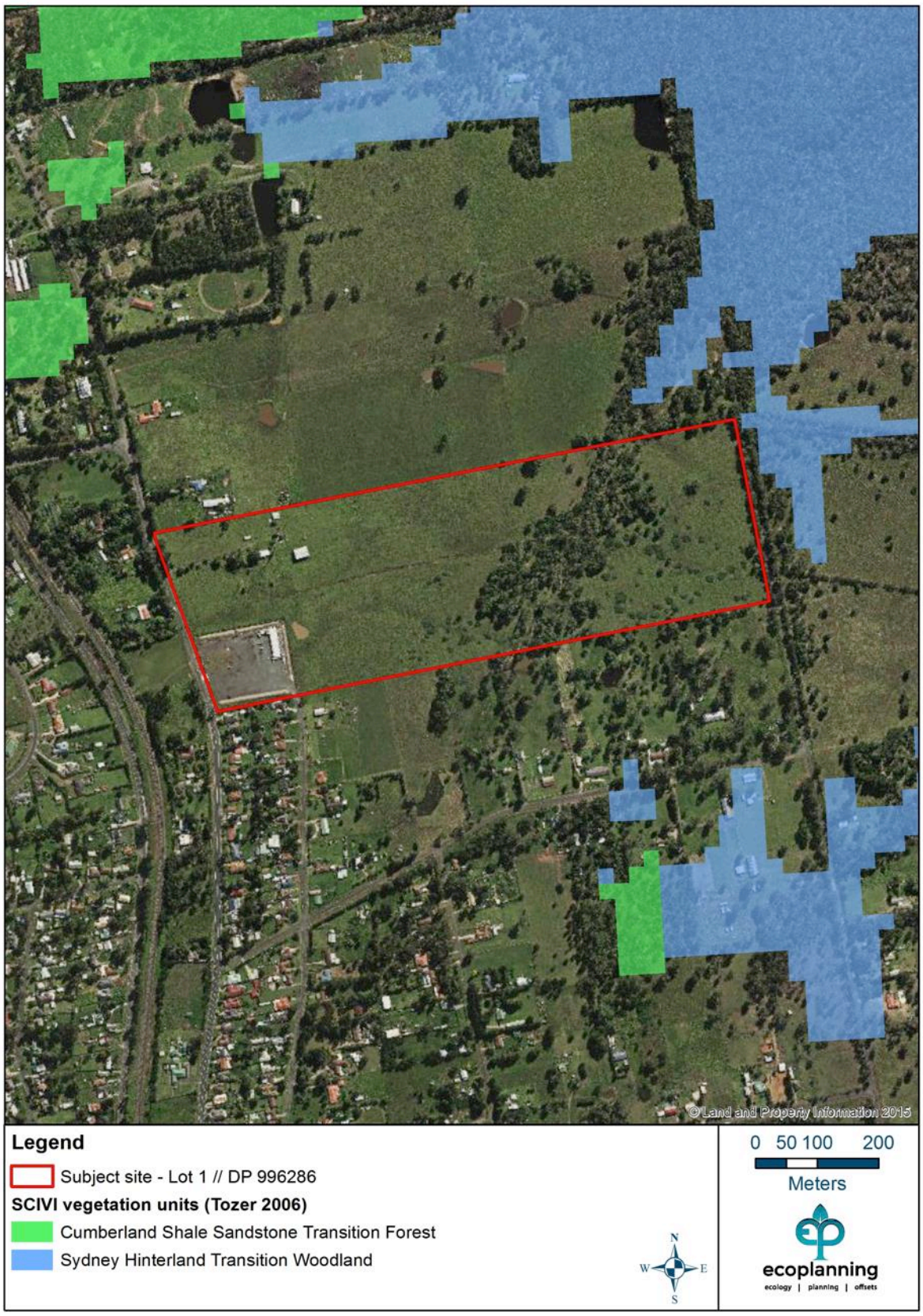

Figure 1.4: Mapped vegetation in vicinity of subject site (Tozer, et al. 2006/2010).

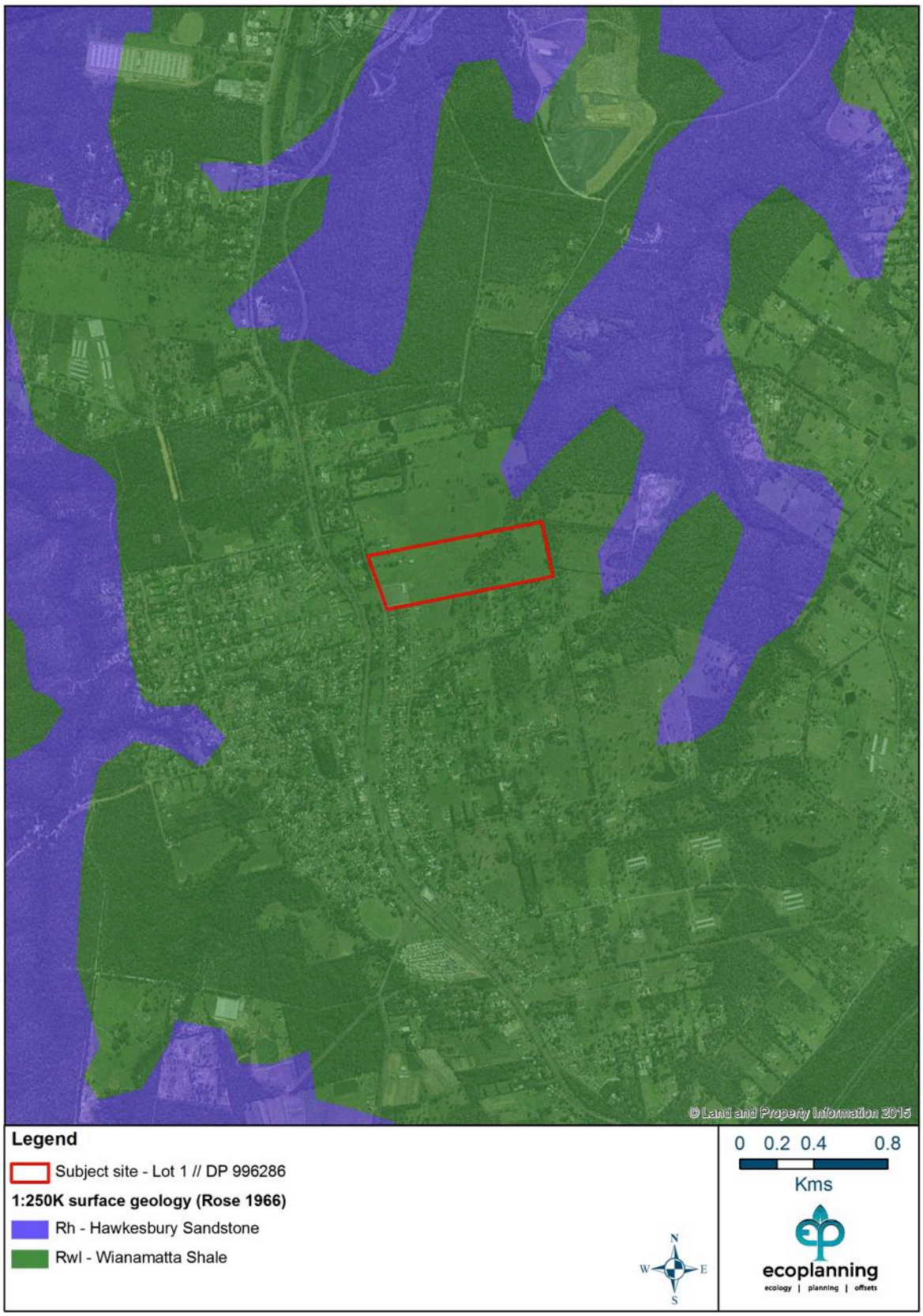

Figure 1.5: Surface Geology (Rose 1966).

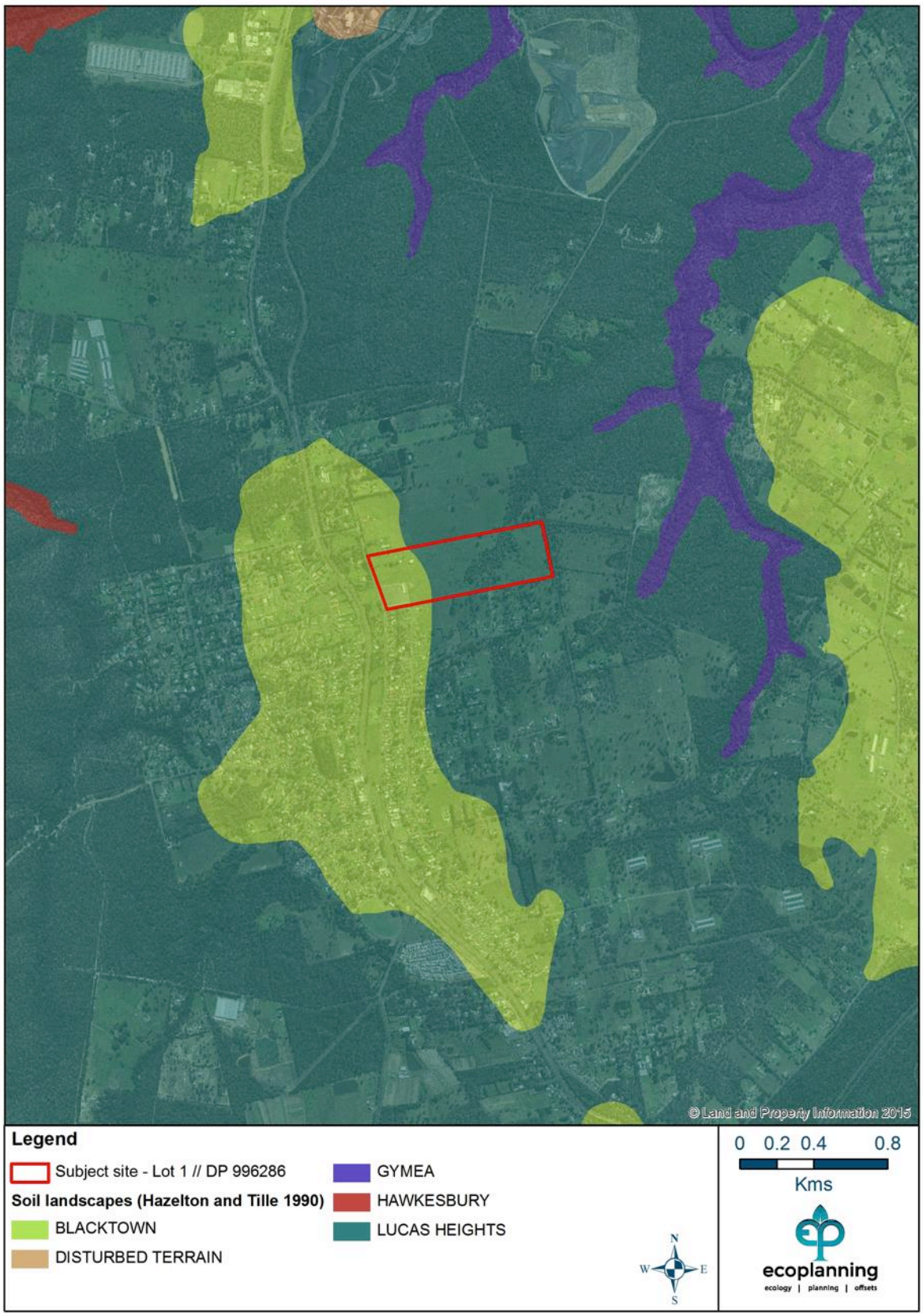

Figure 1.6: Soil Landscapes (Hazelton and Tille 1990).

1.3.2 Locality

Unless otherwise stated, the ***locality*** is described as the area within 5 km of the subject site. Much of the locality consists of areas that historically cleared and/or disturbed. However extensive areas of native vegetation remain on the outer margins of the locality. A significant amount of this is in high condition (NPWS 2002) and is found in either conservation estate or nearby water catchment areas (**Figure 1.7**).

1.4 Description of the proposal

Under the Wollondilly Local Environmental Plan (WLEP) (2011) the subject site is currently zoned RU2 – Rural Landscapes (**Figure 1.8**). At present the subject site is a small rural land holding, with a heritage listed farmhouse and ancillary structures fenced off as a 'home yard' within an otherwise largely cleared expanse of grazing land.

The proposal to rezone the subject site has received Gateway Determination, with suggested zoning a combination of R2 – Low Density Residential and R5 – Large Lot Residential (**Figure** 1.9).

However, further consideration of the interaction of the rezoning with the NSW *Threatened Species Conservation Act 1995* (TSC Act) and NSW *Native Vegetation Act 2003* (NV Act) has resulted in a recommendation to proceed with rezoning of R2 – Low Density Residential, R2 – Low Density Residential (with limited lot size) and E2 – Environmental Conservation, as is discussed further in **Sections 3** and **4**.

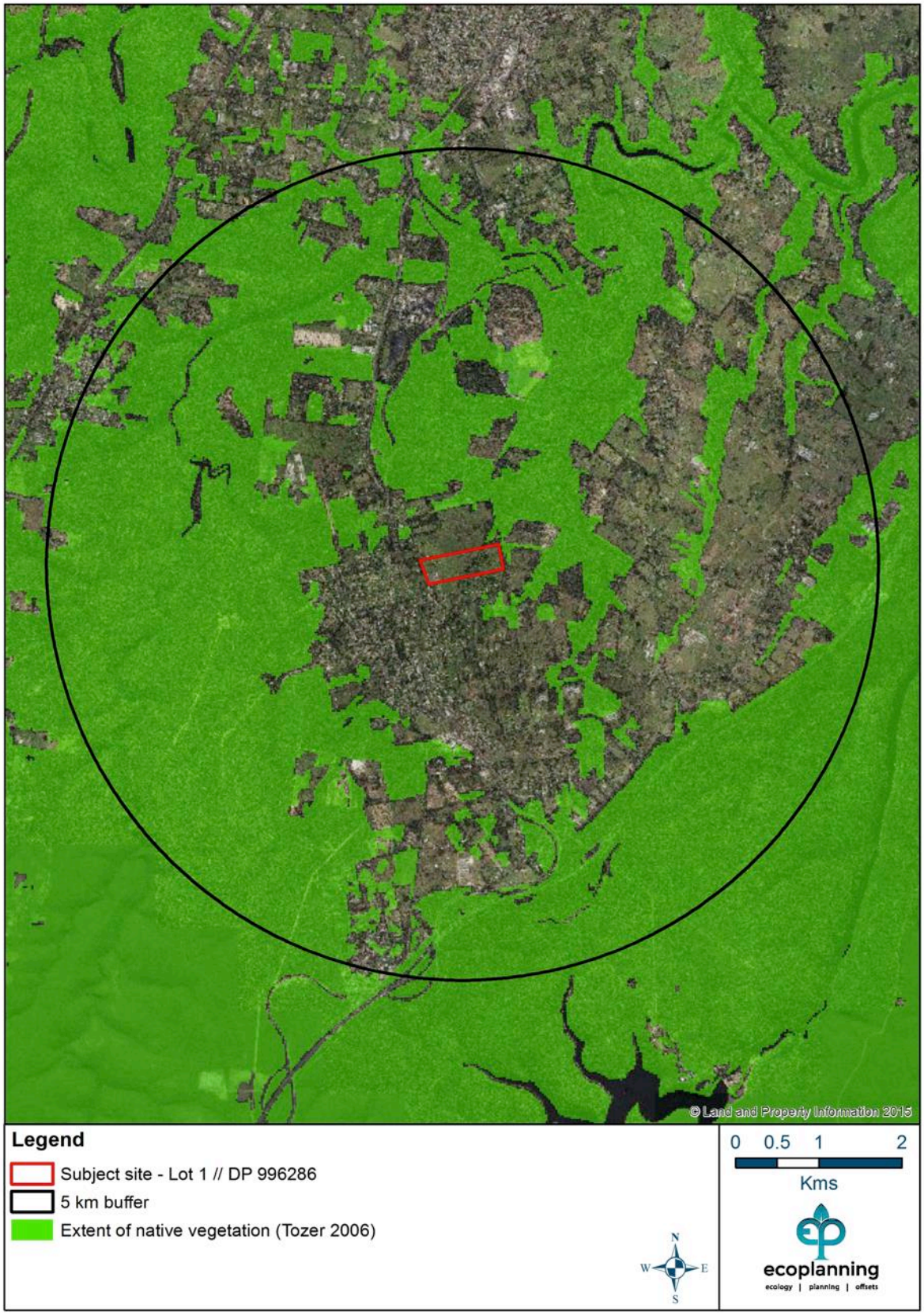

Figure 1.7: Locality of subject site and existing native vegetation.

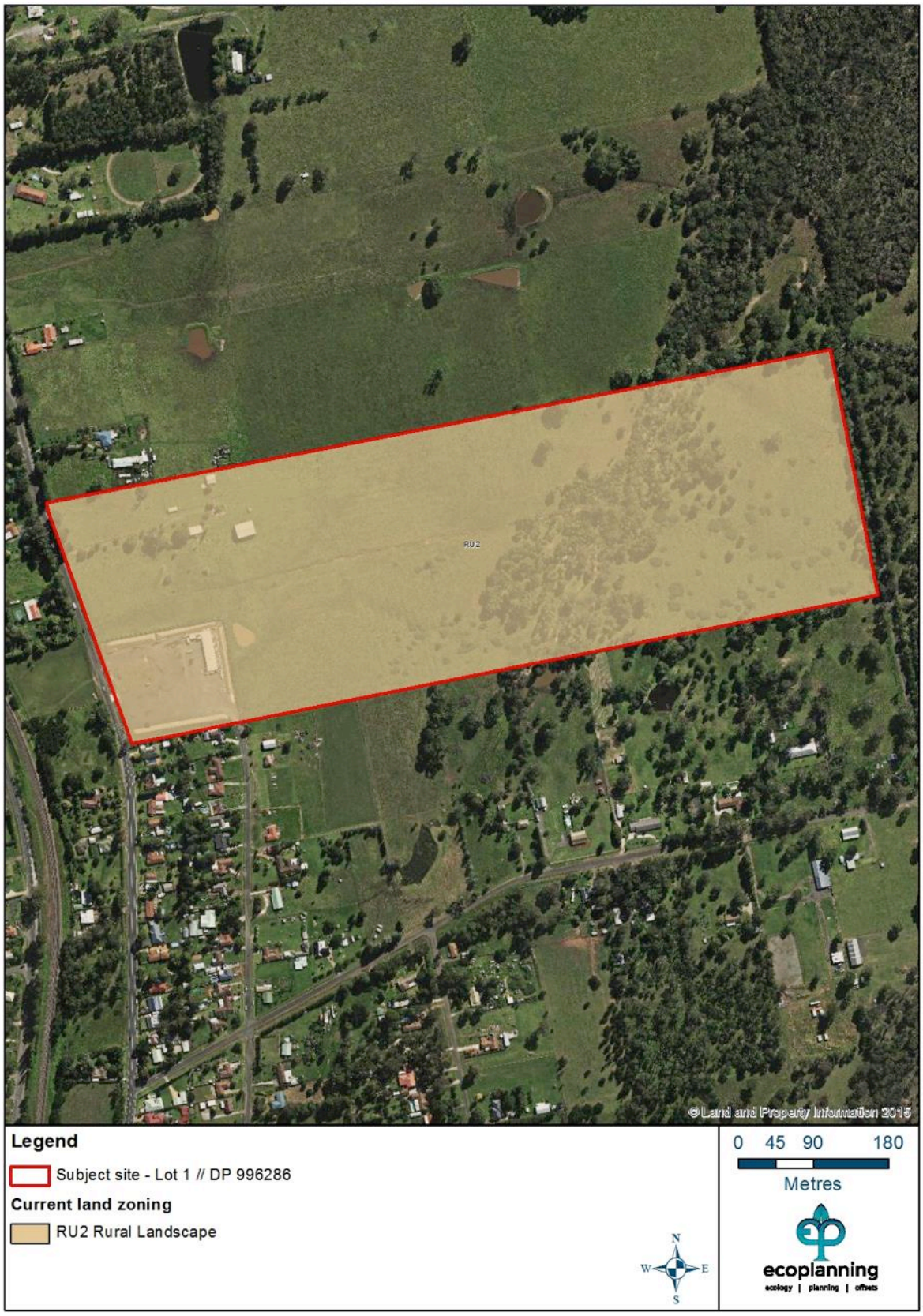

Figure 1.8: Current land zoning under Wollondilly LEP.

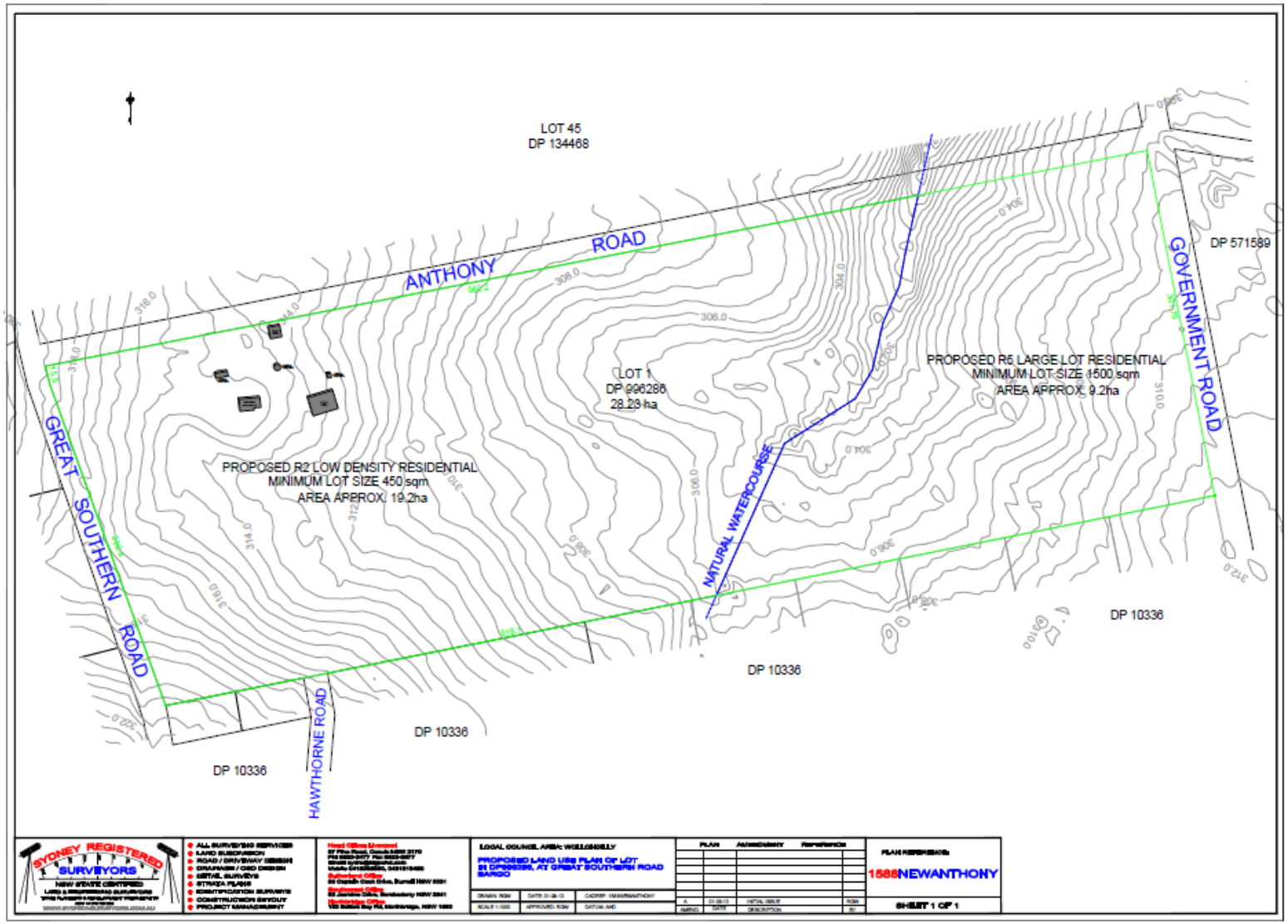

Figure 1.9: General Planning Proposal for rezoning following Gateway Determination.

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 mapping resources from the following sources:

- NSW Planning Viewer (NSW Dept. of Planning and Environment 2015)
- BioNet Atlas of NSW Wildlife (NSW Office of Environment and Heritage 2015)
- Protected Matters Search Tool (Commonwealth Dept. of the Environment 2015)
- Native vegetation of the Cumberland Plain (NPWS, 2002; Tozer, 2003)
- Native Vegetation of South East NSW (Tozer et al., 2006; 2010)
- Soil landscapes of the Wollongong-Port Hacking 1:100 000 mapsheet (Hazelton and Tille, 1990)
- Surface Geology of the Wollongong 1:250,000 Geological Series Map Sheet (Rose, 1966)
- SIX Maps (LPI 2015)
- Threatened and Protected Fish Species Records Viewer (NSW Department of Primary Industries 2016)
- Key Fish Habitat Mapping – Wollondilly (NSW Department of Primary Industries 2007)

Previous reports of relevance to the subject land reviewed include:

- Environmental Assessment (Flora and Fauna) for a Proposed Development at Anthony Road, Parish of Bargo, Bargo, NSW (Stone et al. 2012)
- Riparian Management Plan: Proposed Waste Recycling Facility, Anthony Street, Bargo, NSW (Martens 2012)
- Bargo and Buxton Wastewater Scheme REF – Addendum, Sydney Water – (GHD 2013)

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 and surrounding areas
- review of the scientific literature pertaining to each species and population
- applying expert knowledge of each species

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 subject site and 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 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

2.2 Field survey

Initial field survey was undertaken at the subject site on the day and evening of 6 and 7 May 2015 and again on 4 July 2016. Weather conditions on the days of survey were considered cool to mild, no rainfall was recorded in the 48 hours prior to the earliest survey. (**Table 2.1**).

Table 2.1: Daily weather observation at Moss Vale AWS [Station No. 068239]. (28.8 km).

DATE	TEMP (°C)		RAINFALL (MM) [1]	MAX WIND	
	Min	Max		Direction	Spd (km/h)
6/05/2015	6.0	12.6	0.0	W	63
7/05/2015	5.3	12.1	0.0	WSW	59
4/07/16	-1.1	12.4	0.2	SW	31

2.2.1 Vegetation communities and flora

Field survey of vegetation communities and flora species was undertaken by Lucas McKinnon (Principal Ecologist, Ecoplanning) and Gary Leonard (Senior Botanist, Ecoplanning), and involved undertaking a preliminary inspection of the subject site and accessible areas of the adjoining properties and road reserves to obtain an immediate local perspective. This was followed by undertaking traverses of the subject site and recording native and exotic flora species to validate vegetation types present, and determine condition and relative abundance of flora species. Nomenclature follows the Flora of NSW (Harden, 1993-2002) and updates provided in the PlantNET (RBGDT, 2015).

Field survey was undertaken to validate the regional vegetation mapping of NPWS (2002) and Tozer et al. (2006), with reference to Stone et al. (2012) and Martens (2012). Vegetation communities were then reconciled with described threatened ecological communities (TEC), listed under either the EPBC or TSC Acts that were predicted from database searches and regional vegetation mapping, to occur or had been previously mapped in the vicinity of the study area.

A follow up survey was undertaken by Lucas McKinnon on 18 October 2016, to assess potential for 'derived native grassland' (DNG) along the western edge of Dog Trap Creek, following a request from Council (WSC 2016). Three 50 m transects were surveyed perpendicularly to the forested vegetation of the creek, with the presence of native and exotics species recorded at 1 m intervals along the transect, to assess proportionate dominance of exotic pasture or DNG (**Figure 2.1**).

Targeted threatened flora survey was undertaken on the basis of potential threatened flora species indicated as being present in the near vicinity of the subject site or considered to have the potential to occur in the study area on the basis of indicated vegetation associations and habitat.

2.2.2 Fauna and fauna habitat

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.).

Fauna habitat searches were conducted for potential foraging, roosting, breeding or nesting habitat of nocturnal and diurnal species. This included 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 nomenclature includes: Christidis and Boles (2008) for birds; Van Dyck and Strahan (2008) for mammals; Cogger (2014) for reptiles and amphibians and the Australian Faunal Directory (AG, 2015) for relevant invertebrates.

Diurnal bird surveys

Opportunistic surveys of diurnal birds were undertaken which included recording avifauna concurrent with other observations such as general flora surveys, or other fauna surveys. Further, two 20-minute meandering avifauna searches were completed across the site by Lucas McKinnon on 6 and 7 May 2015, prior to nocturnal surveys discussed below.

Stag and hollow watches

Dusk observations were undertaken to record fauna exiting and entering hollows during dusk. Observations were undertaken by up to three observers over two nights (Lucas McKinnon, Ross Wellington [AES] and Carl Tippler [CT Environmental]) for approximately one hour during dusk and after nightfall (between approximately 17:00 and 19:00) on the nights of 6 and 7 May 2015 (**Figure 2.1**).

Call playback

Call playback was undertaken following stag watching using an amplified speaker system and digital recordings taken from Naturesound (Stewart 2007) and BOCA (2002). Calls were played for 5 minutes, followed by 10 minutes of listening. Following DEC (2004), one stratification unit was necessary due to the small size of the subject site, with call playback undertaken over two nights from various points across the subject site (6 and 7 May 2015).

A number of nocturnal birds and mammals were broadcast during the call playback sessions, in particular species credit species, *Phascolarctos cinereus* (Koala) and *Petaurus norfolcensis*

(Squirrel Glider). Other call played of ecosystem credit species and common fauna included, *P. breviceps* (Sugar Glider), *Ninox strenua* (Powerful Owl), *Tyto novaehollandiae* (Masked Owl) and *Aegotheles cristatus* (Australian Owlet-nightjar).

Spotlighting

Spotlighting was conducted by two people between the hours of 1800 and 1900 hours using a high powered hand held spotlight and headtorches (**Figure 2.1**).

Sound recording

A Songmeter SM3 was deployed for four nights (11-14 June 2015) and was set with two channels, one channel set to record audible sounds between 0-10 kHz to detect frogs and other nocturnal animals and the second channel set to collect ultrasonic calls between 10 kHz and 180 kHz. No species credit species were expected to occur (or recorded) at the subject site. The Songneter was placed in close proximity to hollow bearing trees (**Figure 2.1**).

Remote camera surveys

One remote cameras (Moultrie M-880) was deployed for 96 hours from 11 to 14 June aimed at the one of the hollow bearing trees identified during spotlighting as being occupied by a Glider (*Petaurus* sp.), in order to capture further evidence of the potential for Squirrel Glider to occupy the hollow (**Figure 2.1**).

2.2.3 Top of bank mapping

Top of bank (TOB) mapping on the Un-named Tributary and Un-named Drainage Line was conducted by Car Tippler, May 7 2015. Top of bank data was captured in the field using the mobile IOS mapping application iGIS Version 7.4.8. Data collected in the field was later exported and mapped using ArcMap V10.2.

2.2.4 Riparian vegetation and creek channel condition assessment

Riparian vegetation and creek channel condition was assessed by applying the Rapid Riparian Appraisal (RRA) method (Findlay et al 2011). This method was developed for use in coastal riparian zones of the Sydney basin, however modifications to the method have been made to suit the vegetation communities and conditions of waterways in the south western Sydney region.

Riparian vegetation and creek channel condition was assessed at three sites across the subject site. Assessment Site 1 is located at the northern extent of the property where the creek bed is sandstone bedrock and appears relatively stable. Assessment Site 2 is located at the southern extent of the property where the creek bed is erodible clay and shale, deeply incised and unstable. Assessment Site 3 is located in the Un-named Drainage Line at approximately the mid-way point between Great Southern Road and the confluence with Un-named Tributary of Dog Trap Creek.

At the time of assessment flow was low, however the floodplain of the upper reach of the Un-named Tributary of Dog Trap Creek and the lower reach of the Un-named Drainage Line flowing drainage line were waterlogged as a result recent rainfall.

2.2.5 Key Fish Habitat

To determine if waterways within the study were Key Fish Habitat, review of the Wollondilly Key Fish Habitat Map (NSW DPI 2007) was undertaken. Stream order was assigned using the Strahler method (Strahler 1952 in NSW DPI 2012b).

2.2.6 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, more 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 its condition onsite, and detect any threatened flora with the potential to occur.

A full fauna survey following *Threatened Species Survey and Assessment Guidelines* (OEH 2013) was not undertaken. However, the survey undertaken was considered preliminary but sufficient to be indicative of any further specialised targeted survey effort warranted. Habitat evaluation undertaken and the preliminary survey effort enabled the provision of recommendations for the undertaking of additional targeted survey for potential threatened and migratory species considered to have a strong likelihood of occurrence. The relatively small extent of the subject site with identified habitat values and its degraded but regenerating native vegetation state/condition has limited the threatened species warranting such additional targeted survey effort. As such, further detailed fauna survey is only considered necessary for the Squirrel Glider and several microbat species.

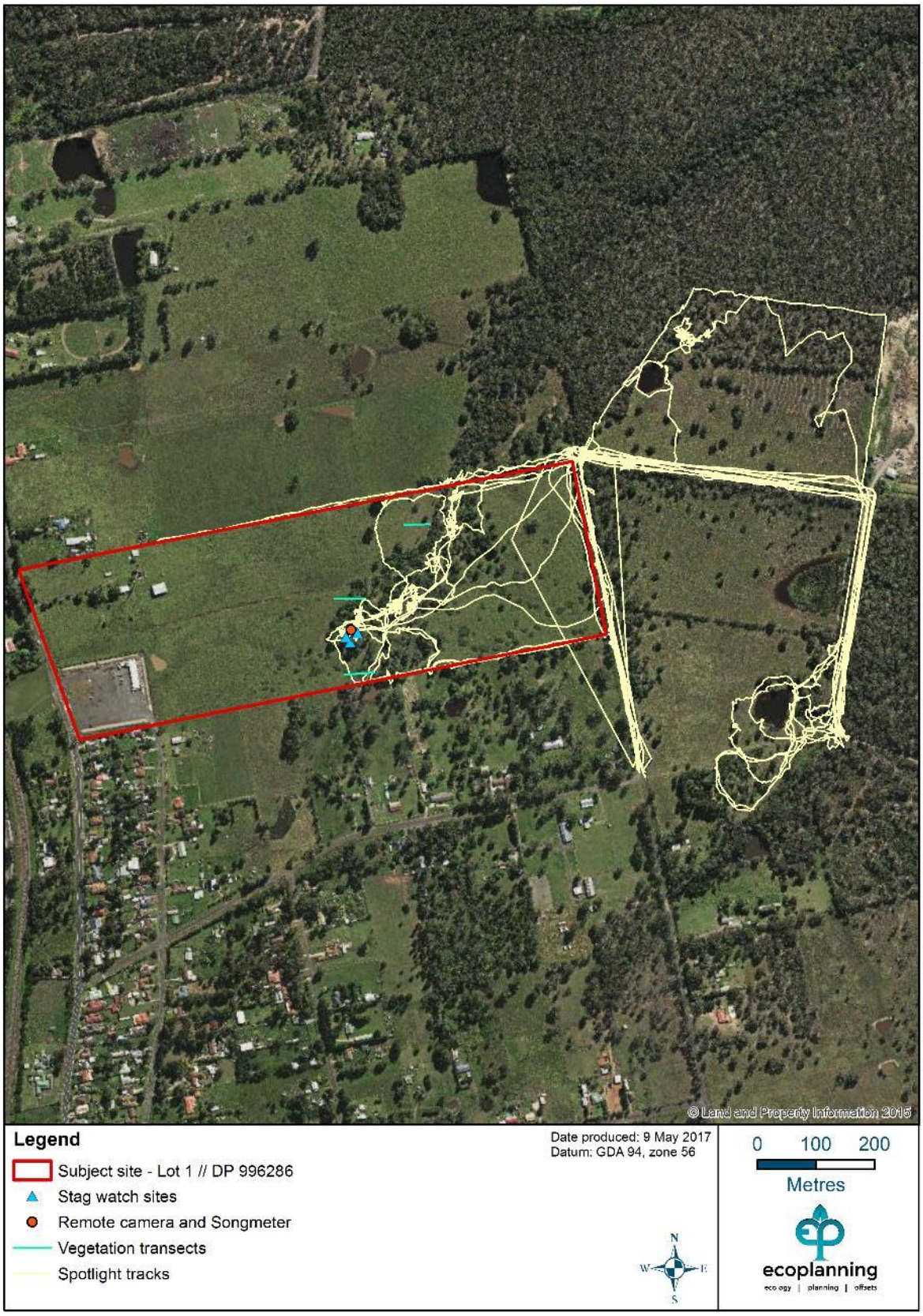

Figure 2.1: Survey effort map (does not include diurnal general survey and traverses).

3 Results

3.1 Literature and database review

3.1.1 Topography, drainage, and soils

The subject site is approximately 300-320 masl, predominantly flat with a gentle slope to the west and north from the eastern third of the subject lot towards the Unnamed Tributary of Dog Trap Creek, which flows north to north east. The western two thirds of the subject site drain more gradually to the Un-named Tributary via the Un-named Drainage Line, both of which are mapped as drainage features on statewide topographic maps (LPI 2015) (see **Figure 3.1**).

Regional surface geology mapping from the 1:250k map series (Rose, 1966), depicts the subject lot mapped as being entirely of the Wianamatta (Rwl) formation. With Hawkesbury Sandstone interdigitating as the exposed formation along the drainage lines of Dog Trap Creek, Horne's Creek and Teatree Hollow to the east, west and north respectively and all tributaries of the Bargo River (see **Figure 1.5**).

Regional scale soil landscape mapping by Hazelton and Tille (1990), indicate that the soils of the study area are derived from Wianamatta Group sediments of the Lucas Heights (lh) and Blacktown (bt) soil landscape groups with Gymea (gy) and Hawkesbury (ha) soil landscape groups present along the drainage lines (**Figure 1.6**). Soils of the Hawkesbury group present within the more deeply incised drainages and Gymea soils in the less incised streams or upper stream sections. 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…".

Hazelton and Tille (1990) provide the following relevant soil formation descriptions:

- Blacktown Soil Formation – bt: Soils derived from the Blacktown Group consist of Ashfield and Bringelly Shales of the Wianamatta Group and occur on undulating rises. Soils are shallow to moderately deep Red Podzolic Soils and Brown Podzolic Soils, with Yellow Podzolic soils and Soloths on lower slopes. Occur throughout most of Bargo and Thirlmere.
- Lucas Heights Soil Formation – lh: Soils of the Lucas Heights Group are derived from the Mittagong Formation and consist of interbedded shale, laminate and fine to medium-grained quartz sandstone. The layers are generally shallow and may be interspersed with Hawkesbury Sandstone and Ashfield Shale. Areas of ironstone also occur. Occur extensively between Bargo and Thirlmere.
- Gymea Soil Landscape – gy: Soils of the Gymea Group are derived from Hawkesbury Sandstone and consist of medium to coarse grained quartz sandstone with minor shale and laminate lenses. Occur on the banks and bed of the Bargo River.
- Hawkesbury Soil Landscape – ha Soils of the Hawkesbury Group are derived from Hawkesbury Sandstone and consist of medium-to coarse-grained quartz sandstone with minor shale and laminate lenses. Occur on the banks and bed of the Bargo

River in the upper areas. Extensive areas of soils derived from the Hawkesbury Group occur to the west of Wilson Road.

3.1.2 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Threatened Species Conservation Act 1995 (TSC Act)

Threatened and migratory fauna and flora species

A search of the relevant databases and literature, identified a potential total of 31 threatened species including: nine threatened flora species, 22 threatened fauna species (including one amphibian, 11 birds, 10 mammals [six of which are microbats]), that have been recorded within a 5 km radius of the subject land (see **Figure 3.2**).

The likelihood of occurrence analysis undertaken prior to field assessment reduced the primary list to three threatened fauna, four migratory fauna and three threatened flora that have a 'moderate', or 'high' potential to use the subject site and to be impacted by the proposed works (see **Appendix A**). These include:

- Threatened mammals
  - *Pteropus poliocephalus* (Grey-headed Flying-fox) (moderate)
- Threatened birds
  - *Climacteris picumnus victoriae* (Brown Treecreeper – eastern subspecies) (moderate)
  - *Daphoenositta chrysoptera* (Varied Sittella) (high)
- Migratory birds
  - *Merops ornatus* (Rainbow Bee-eater) (moderate)
  - *Myiagra cyanoleuca* (Satin Flycatcher) (moderate)
  - Myiagra cyanoleuca (White-bellied Sea-Eagle) (moderate)
  - *Ardea ibis* (Cattle Egret) (moderate)
- Threatened plants
  - *Epacris purpurascens* var. *purpurascens* (moderate)
  - *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea) (high)
  - *Persoonia bargoensis* (Bargo Geebung) (high)

Each threatened species is listed under the TSC Act, but only Grey-headed Flying Fox, the migratory birds and the three threatened plants are listed under the EPBC Act.

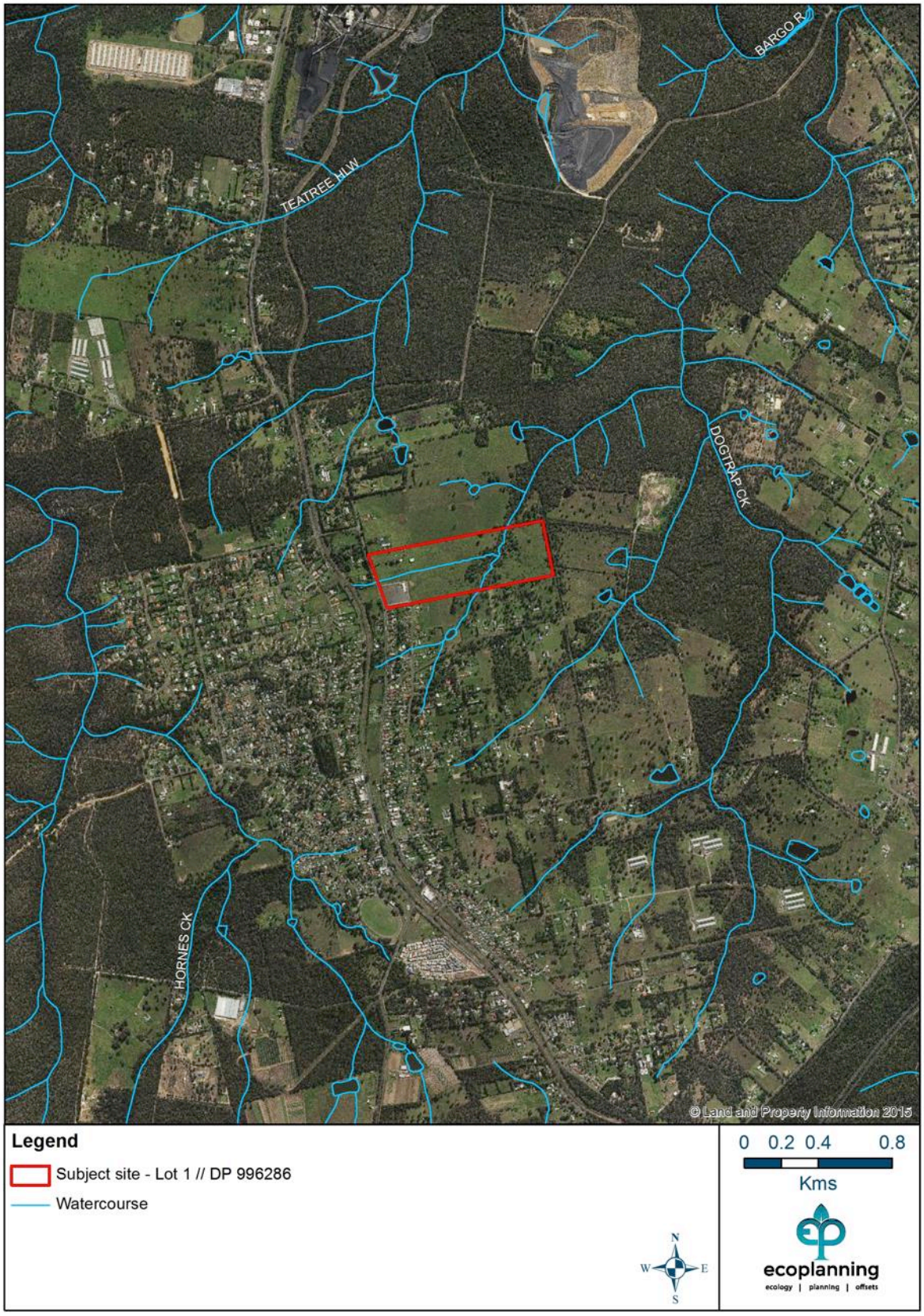

Figure 3.1: Locality Drainage Map.

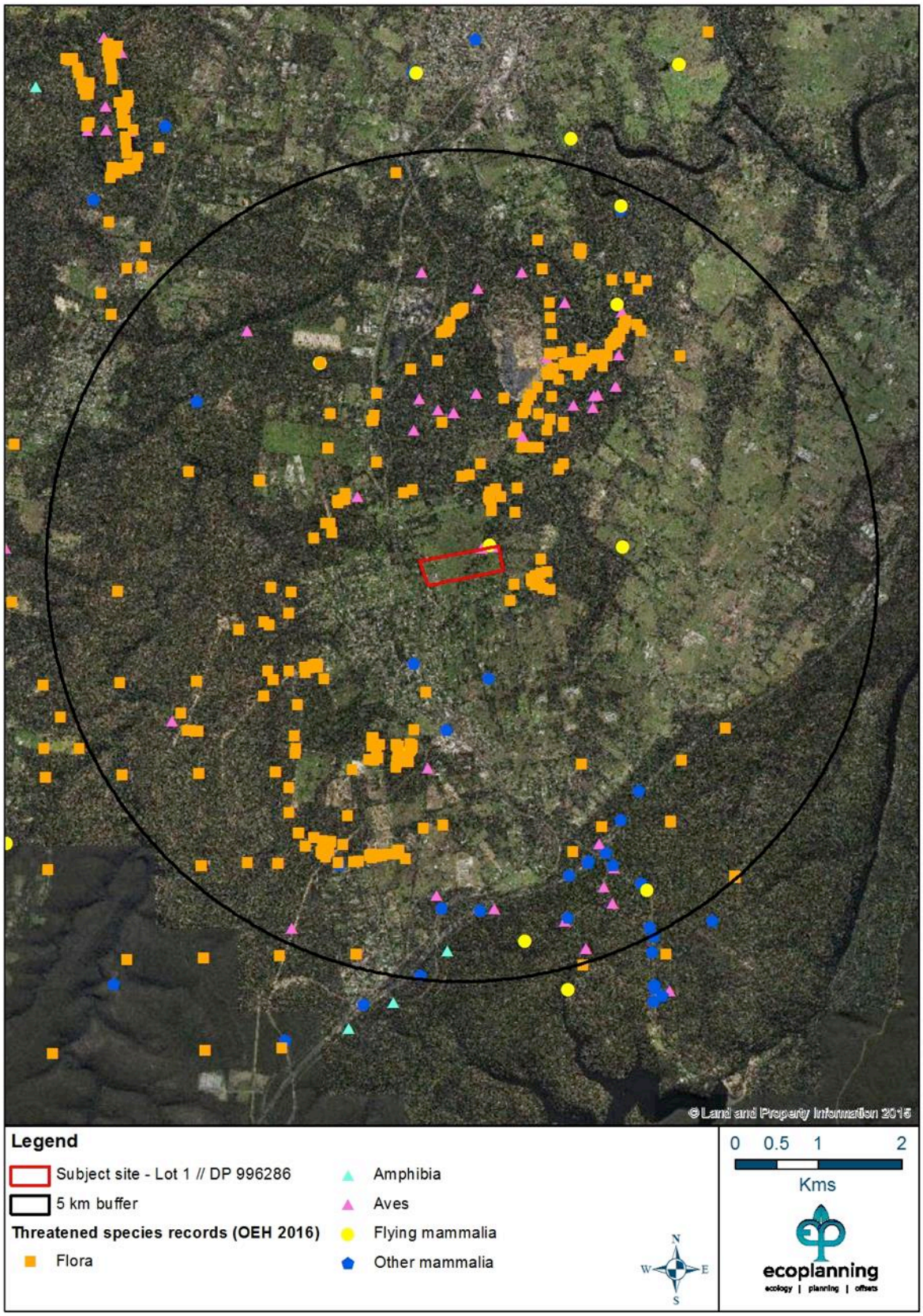

Figure 3.2: Threatened Species Records (OEH 2016).

Vegetation and threatened ecological communities

The desktop assessment determined that four vegetation types had previously been mapped on or in the vicinity of the study area by NPWS (2002) and Tozer et al (2006; 2010), these are:

- Shale Sandstone Transition Forest (Low Sandstone Influence MU1) (NPWS 2002)
- Shale Sandstone Transition Forest (High Sandstone Influence MU2) (NPWS 2002)
- Upper Georges River SS Woodland (MU 32) (NPWS 2002)
- Sydney Hinterland Transition Woodland (MU146), (Tozer et al 2010)
- Unclassified (NPWS 2002)

NPWS (2002) vegetation mapping does provide a classification of the vegetation on the subject site as well as that adjacent. This mapping identifies Shale Sandstone Transition Forest (High Sandstone Influence) and an 'Unclassified' unit on-site and Shale Sandstone Transition Forest (Low Sandstone Influence) and Upper Georges River Sandstone Woodland vegetation units immediately nearby (**Figure 1.3**). Vegetation mapping of Tozer et al. (2006; 2010) does not extend to include the on-site vegetation but maps the adjacent vegetation as Sydney Hinterland Transition Woodland and Cumberland Shale Sandstone Transition Forest (**Figure 1.4**).

Vegetation mapping has previously been validated by Stone et al. (2012) during investigations for adjoining properties to the north.

Shale Sandstone Transition Forest (in both 'high' and 'low' sandstone influence forms) is listed as a critically endangered ecological community (CEEC), under the TSC Act (NSW SC 2014) and the EPBC Act (TSSC 2014). The association between each vegetation type description is shown in **Table 3.1**.

Table 3.1: Vegetation community nomenclature of patches mapped in proximity to the study area.

Vegetation communities	Threatened Ecological Communities	Recorded at subject site		
		Tozer 2006; 2010	NPWS 2002	This Study
Shale Sandstone Transition Forest – Low sandstone influence (MU1)[1]	Shale Sandstone Transition Forest (Critically Endangered – TSC and EPBC Acts)	N	N	Y
Shale Sandstone Transition Forest – High sandstone influence (MU2)[1]	Shale Sandstone Transition Forest (Critically Endangered – TSC and EPBC Acts)	N	Y	N
Sydney Hinterland Transition Woodland (DSF p146)[2]	Not listed	Y	N	N

[1] NPWS (2002); [2] Tozer et al (2010).

3.1.3 Native Vegetation Act 2003 (NV Act)

The Wollondilly Shire is not an 'excluded' LGA under Schedule 1 of the NV Act. R2 zoning is excluded from the operations of the Act, but R5 zoning is not. Where the NV Act applies,

clearing of vegetation must be undertaken in accordance with a Property Vegetation Plan (PVP) or as a Routine Agricultural Management Activity (see *Native Vegetation Regulation 2013*). PVP's

3.1.4 State Environmental Planning Policy No.44 (SEPP 44) – Koala Habitat Protection

Wollondilly LGA is listed under Schedule 1 of SEPP 44 and therefore this proposal is subject to SEPP 44 assessment.

One of the tree species *Eucalyptus tereticornis* outlined in Schedule 2 as a feed tree does occur within the subject site, with one other feed tree species *E. punctata* occurring just outside of the subject site. There are very few *E. tereticornis* within the subject, and as such they do not make up 15% of the total number of trees present and thus the site does constitute 'potential Koala habitat' under SEPP 44.

Within the last ten years the closest recording of a Koala was 1.2 km (2006). The most recent recording of a Koala was in 2016, 4.1km from the subject site. No koala scats were recorded during this site visit, or any scratches characteristic of koala climbing scratches. Thus it is concluded that the site is unlikely to provide 'core Koala habitat'.

3.1.5 Water Management Act 2000 (WM Act)

Creek channel classification

The site contains two mapped drainage lines and a desktop assessment of each of these drainage lines was undertaken. Drainage features identified on the 1:25,000 topographic map were reviewed and Strahler stream order determined as outlined in **Figure 3.3**.

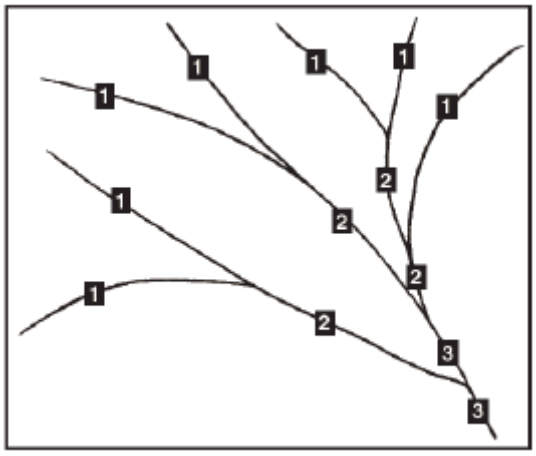

Figure 3.3: Determining Strahler stream order (from DPI 2012a).

Results show the Un-named Tributary of Dog Trap Creek, which flows south to north through the subject site is classified as a Second Order stream. In addition, the small west to east flowing drainage line which confluences with the Un-named Drainage Line is a First Order stream.

Riparian corridors

Consistent with the *Guidelines for Riparian Corridors on Waterfront Land* (DPI 2012a) the riparian corridors, or 'buffers', required for each creek were determined based on Strahler Stream Order, as required by the WM Act. This system requires increasing riparian vegetation

buffers on creek banks as Strahler Stream Order increases. Riparian corridor buffer widths as recommended by DPI (2012a) are summarised in **Table 3.2**.

Table 3.2: Riparian corridors recommended by Guidelines for Riparian Corridors on Waterfront Land (DPI 2012a).

Strahler Stream Order	Corridor Width on Each Bank	Total Riparian Corridor Width
1st order	10 metres	20 metres + channel width
2nd order	20 metres	40 metres + channel width

A 20 m riparian corridor on each bank (total 40 m riparian corridor width), as required by *Guidelines for Riparian Corridors on Waterfront Land* (DPI 2012a), has been applied to the unnamed tributary of Dog Trap Creek and a 10 m riparian corridor (total 20 m riparian corridor width) has been applied to the small west to east flowing drainage line. (**Figure 3.4**).

3.1.6 Fisheries Management Act 1994

Key Fish Habitat

Review of the NSW Key Fish Habitat (KFH) Map for Wollondilly LGA (NSW Department of Primary Industries 2007) shows no waterways within the subject site are classed as Key Fish Habitat. Review of the NSW Threatened and Protected Species Record Viewer (NSW Department of Primary Industries 2015) shows no threatened fish records for the subject site.

3.1.7 Wollondilly Local Environment Plan (Part 7)

The subject site is also identified under Clause 7.3 and identified on the Natural Resources Water Maps of the Wollondilly LEP (NRW-008). These maps depict the Unnamed Tributary of Dog Trap Creek traversing the lot as requiring a 10 m buffer for purposes further detailed under Clause 2.6 of the Wollondilly DCP.

The subject site has not been mapped on the *Natural Resources – Biodiversity map* of the Wollondilly LEP (Cl. 7.2).

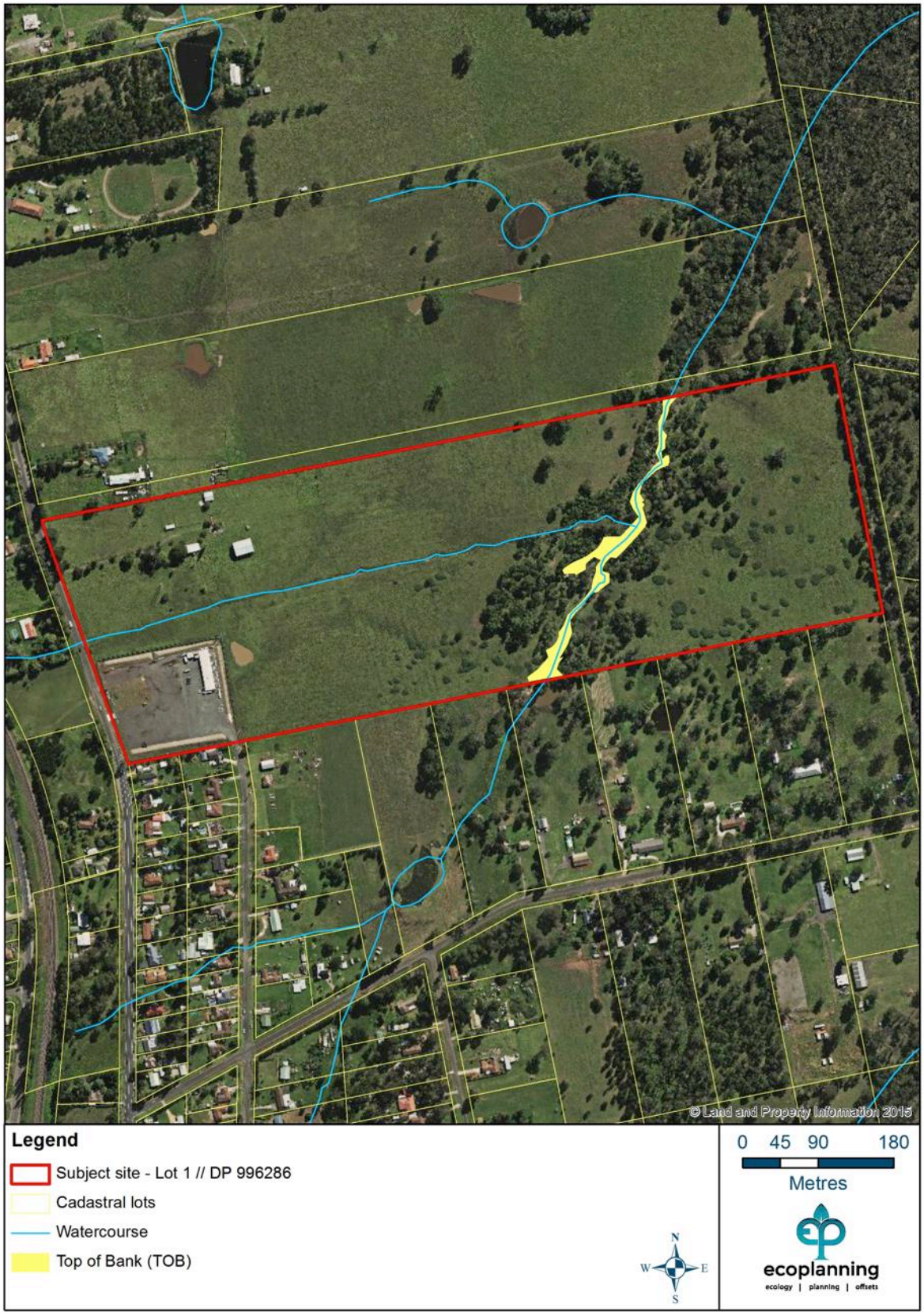

Figure 3.4: Watercourse's within subject site showing Top of Bank.

3.2 Field survey

3.2.1 Vegetation communities and flora species

The subject site has been heavily modified through previous clearing and ongoing management by grazing (Error! Reference source not found.). The majority of the vegetation is cleared pastureland with some scattered paddock trees (**Figure 3.6** to **Figure 3.8**). This pastureland is a mixture of native and exotic grasses and forbs. Where native species predominate, some of the more common species include, *Themeda triandra* (Kangaroo Grass), *Microlaena stipoides* var. *stipoides* (Weeping grass), *Eragrostis benthamii*, *E. leptostachya* (Paddock Lovegrass) and *Sporobolus creber* (Western Rat-tail Grass). In some of the more heavily grazed sections of this pastureland some of the most common species include, *Pennisetum clandestinum** (Kikuyu), *Andropogon virginicus** (Whisky Grass), *Setaria parviflora** (Pigeon Grass), *Hypochaeris radicata** (Catsear), *Plantago lanceolata** (Lamb's Tongue) and *Paspalum dilatatum** (Paspalum). Two of the three 50 m transects undertaken to assess presence of DNG along the western boundary of the forested vegetation of Dog Trap Creek were assessed to be predominately exotic (>50%), with native dominance decreasing in the transects further to the south (**Table 3.3**). The area is not considered to be DNG, rather it was predominantly exotic pasture with some native resilience in the pasture further to the north.

Table 3.3: Native and exotic dominance assessed across three 50 m transects.

Transect	% Native	% Exotic	Proportion Native
1	79	40	66%
2	34	72	32%
3	1	100	0.01%

Vegetation mapping was refined by the stretch of vegetation along the main creekline determined to be Alluvial Woodland (MU11) (**Figure 3.9** and **Figure 3.10**). The main canopy component within this section is, *Eucalyptus amplifolia* (Cabbage Gum). The midstorey was generally absent, most likely due to ongoing grazing of the subject site. The few native species that are present include, *Bursaria spinosa* subsp. *spinosa* (Blackthorn), *Acacia decurrens* (Black Wattle) and *Melaleuca linariifolia* (Flax-leaved Paperbark). Some exotic shrub species were also present including, *Rubus* spp. aggr. * (Blackberry), *Ligustrum sinense** (Small-leaved Privet) and *Gomphocarpus fruticosus** (Narrow-leaved Cotton Bush). The groundcover is a mix of predominantly native grasses, interspersed with exotic and native forbs and ferns. The natives include *Microlaena stipoides* var. *stipoides*, *Cynodon dactylon* (Couch), *Dichondra repens* (Kidney Weed), *Dianella revoluta* (Blueberry Lily) and *Pellaea falcata* (Sickle Fern). The main exotic forbs included *Ranunculus repens** (Creeping Buttercup), *Cirsium vulgare** (Spear Thistle) and *Conyza bonariensis** (Flaxleaf Fleabane).

At the eastern end of the subject site there are a few isolated patches of vegetation identified as Shale Sandstone Transition Forest (MU1), these patches differ to the patch of Alluvial Woodland in that the canopy is dominated by *Eucalyptus crebra* and *E. fibrosa* (Red Ironbark). There are also two small patches of Shale Plains Woodland (MU10) mapped to occur on the west of the main creekline, which includes two mature specimens of *E. tereticornis* and *E. eugenioides*.

At the western end of the subject site near the old sheds there is a small patch of planted ornamentals (**Figure 3.14** and **Figure 3.15**). Vegetation community nomenclature and conservation status under the EPBC and TSC Act's is provided in

Table 3.4.

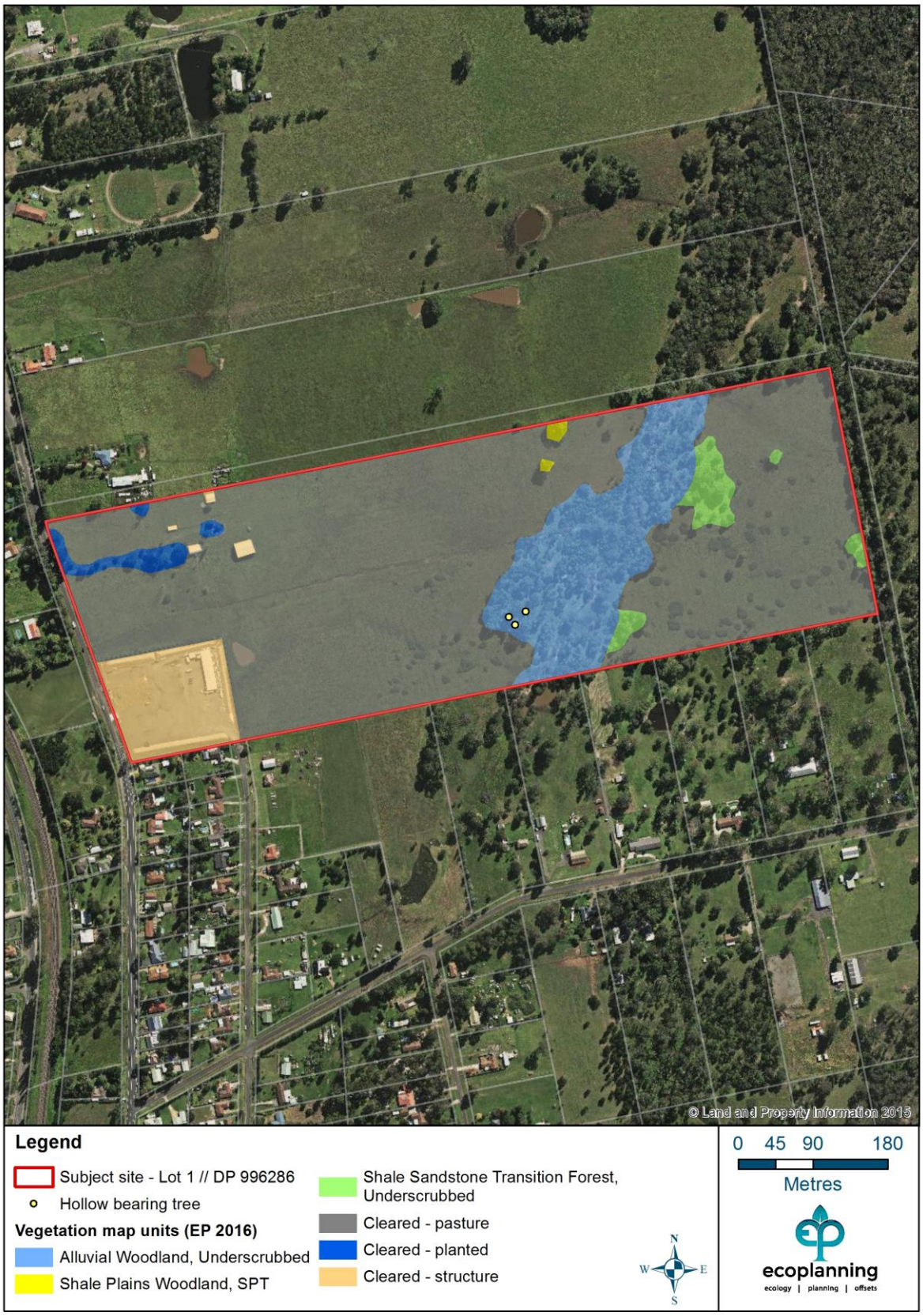

Figure 3.5: Validated vegetation at subject site (Ecoplanning 2016).

Table 3.4: Vegetation types found on the subject site showing the condition and area.

Vegetation type (NPWS 2002)	Vegetation zone (condition class)	TSC Act	EPBC Act	Description	Area (ha)
Shale Sandstone Transition Forest	Underscrubbed	CE	CE	Sparse overstorey and absent midstorey with a groundcover repetitively managed through grazing.	0.7
Alluvial Woodland	Underscrubbed	E	-	Sparse overstorey and generally absent midstorey with a groundcover repetitively managed through grazing.	4.0
Shale Plains Woodland	Scattered Paddock Trees (SPT)	CE	CE	Sparse overstorey and absent midstorey with a groundcover repetitively managed through grazing	0.1
Cleared	Planted	-	-	Ornamental and horticultural plantings of exotic and introduced non indigenous Australian native plants.	0.4
	Pasture	-	-	Predominantly native grassland	21.3
	Structure	-	-	Dwellings, sheds, paddocks and lawns	1.9
				Total	***28.4****

* Total area of vegetation subject to rounding errors and some boundary patches extending slightly beyond allotment boundary; CE = critically endangered; E = endangered.

Figure 3.6: Boundary view to the west along northern boundary and Anthony Road, 'Road Reserve'. Remnant Shale Plains Woodland – scattered paddock trees (SPT) seen on the left of picture.

Figure 3.7: View south west from the northern boundary fence of the subject site.

Figure 3.8: View north along inside boundary Government Road frontage. Remnant underscrubbed Shale Sandstone Transition Forest can be seen inside the boundary fence o the subject site.

Figure 3.9: Underscrubbed Alluvial Woodland in the riparian zone near northern boundary.

Figure 3.10: Underscrubbed Alluvial Woodland in the riparian zone viewed northward.

Flora species

A total of 50 flora species were identified within the study area during field investigations, of which 19 are exotic species (**Appendix B**). Three noxious weeds listed under the NSW *Noxious Weeds Act 1993,* were recorded, two of which are recognised as weeds of national significance (see **Table 3.5**).

Table 3.5: Noxious weeds and Weeds of National Significance (WONS).

Common name	Scientific name	WONS	Class	Requirement
Blackberry	*Rubus fruticosus* species aggregate	Y	4	Locally Controlled Weed *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*.
Fireweed	*Senecio madagascariensis*	Y	4	As above
Giant Parramatta Grass	*Sporobolus fertilis*	-	3	Regionally Controlled Weed *The plant must be fully and continuously suppressed and destroyed.*

Searches were conducted for the threatened shrub species *Grevillea parviflora* var. *parviflora* (Small-flowered grevillea), *Epacris purpurascens* subsp. *purpurascens* and *Persoonia bargoensis* (Bargo Geebung), which all have the potential to occur on site. No individuals were recorded in the study area from these surveys.

3.2.2 Fauna habitat

A minimal range of fauna habitat features are present throughout the site and include:

- Woodland
- Grassland
- Hollow bearing trees (x3)
- Stag tree
- Creek line and ephemeral drainage line
- Anthropogenic structures and materials (e.g. horse sheds; derelict house, tin and timber)

Habitat within the wider study area of adjoining allotments provides potential foraging, roosting, breeding and nesting resources however the subject site itself provides only minimal foraging habitat for a range of species that prefer open grassy areas. A single stag tree, three hollow bearing trees, dilapidated sheds, house and the silo may provide shelter habitat for some fauna species. Anthropogenic ground covers and a few of the planted ornamentals may also provide some foraging opportunities for some species that are habituated to human activity or take advantage of ornamental species for occasional foraging. Habitat features relevant to each fauna group with potential to occur are identified in **Table 3.6**, and shown in **Figure 3.11** to **Figure 3.15**.

Table 3.6: Key fauna habitat features present across the subject land.

Habitat features	Fauna species
Woodland	Diurnal and nocturnal birds, arboreal mammals and microchiropteran bats
Dead Stag tree	Birds (roosting) and microchiropteran bats (refuge)
Creek line and ephemeral drainage depression	Amphibians; birds, microbats, reptiles and mammals
Grassland	Birds, microchiropteran bats and reptiles
Artificial ground cover	Foraging and refuge for reptiles, gastropods and birds
Man-made Structures	Birds, Microbats and other mammals

Figure 3.11: Boundary view to the south showing grassland habitat.

Figure 3.12: Storage shed and old farmhouse, potentially providing roosting/sheltering habitat for some fauna including microbats.

Figure 3.13: Creek line at northern end of subject site provides a valuable water resource to a number of fauna guilds.

Figure 3.14: Heritage silo on Great Southern Road frontage.

Figure 3.15: Storage shed and hut near Great Southern Road frontage.

3.2.3 Fauna species

Fauna species previously recorded by Stone et al (2012) for the subject site and immediately adjoining allotments included, seven frogs, three reptiles, 39 bird species (including one exotic), seven mammals (including one exotic). Surveys undertaken for this report provided two additional frog species and eight additional bird species and one additional mammal (see **Appendix B**).

Two threatened fauna and three migratory species were recorded in the previous surveys by Stone et al (2012), Rainbow Bee-eater, Satin Flycatcher, White-bellied Sea-Eagle. Whilst not observed during survey the Cattle Egret is also highly likely to utilise the pasture whilst grazing persists.

One potential threatened species (Squirrel Glider) was detected during the current surveys (**Figure 3.16**). It is notable that the individual seen in the picture has a white tail spot, which is generally indicative of Sugar Glider (see for example, Menkhorst and Knight 2009), although some individuals observed and not photographed were noted to be distinctly larger in appearance and/or tail dimensions than a Sugar Glider. The **Figure 3.16** and other less clear images were circulated amongst fauna experts for further determination, but the opinions were to contrary suggesting further survey is required. As noted, a *Petaurus* sp. glider was observed utilising a hollow in the riparian corridor and an attempt should be made to capture some individuals to provide a more definitive identification.

Figure 3.16: Glider (*Petaurus* sp.) observed along Government Road reserve tree-line during spotlighting.

3.2.4 Riparian vegetation, creek channel and key fish habitat

Riparian vegetation

The vegetation community of the riparian corridor is predominantly underscrubbed Alluvial Woodland with remnant *E. amplifolia* and some *E. tereticornis*). The extent of Alluvial Woodland perpendicular to the stream channel ranges from 10-100 m.

Native ground cover throughout the riparian corridor and beyond the extent of Alluvial Woodland includes *Rytidosperma* spp. (Wallaby Grasses), *Themeda triandra* and *Microlaena stipoides* var. *stipoides* (Weeping Grass).

Exotic ground cover species found throughout the riparian corridor and beyond the extent of Alluvial Woodland includes, *Rubus fruticosus* spp. aggr.*, *Conyza* spp.* (Fleabane) and *Pennisetum clandestinum**.

Riparian vegetation and creek channel condition assessment

Assessment of riparian vegetation and creek channel condition is presented in **Figure 3.17**. *Assessment Site 1:* shows condition of the lower reach of the unnamed tributary of Dog Trap Creek is 'fair'. This result reflects a moderate departure from a natural, unmodified creek with undisturbed riparian and floodplain vegetation communities. The 'fair' condition of the lower reach of Un-named Tributary of Dog Trap Creek is reflected by a narrow strip of approximately 5 – 20 m of Alluvial Woodland with an understory of mixed exotic and native ground cover species (**Figure 3.18**).

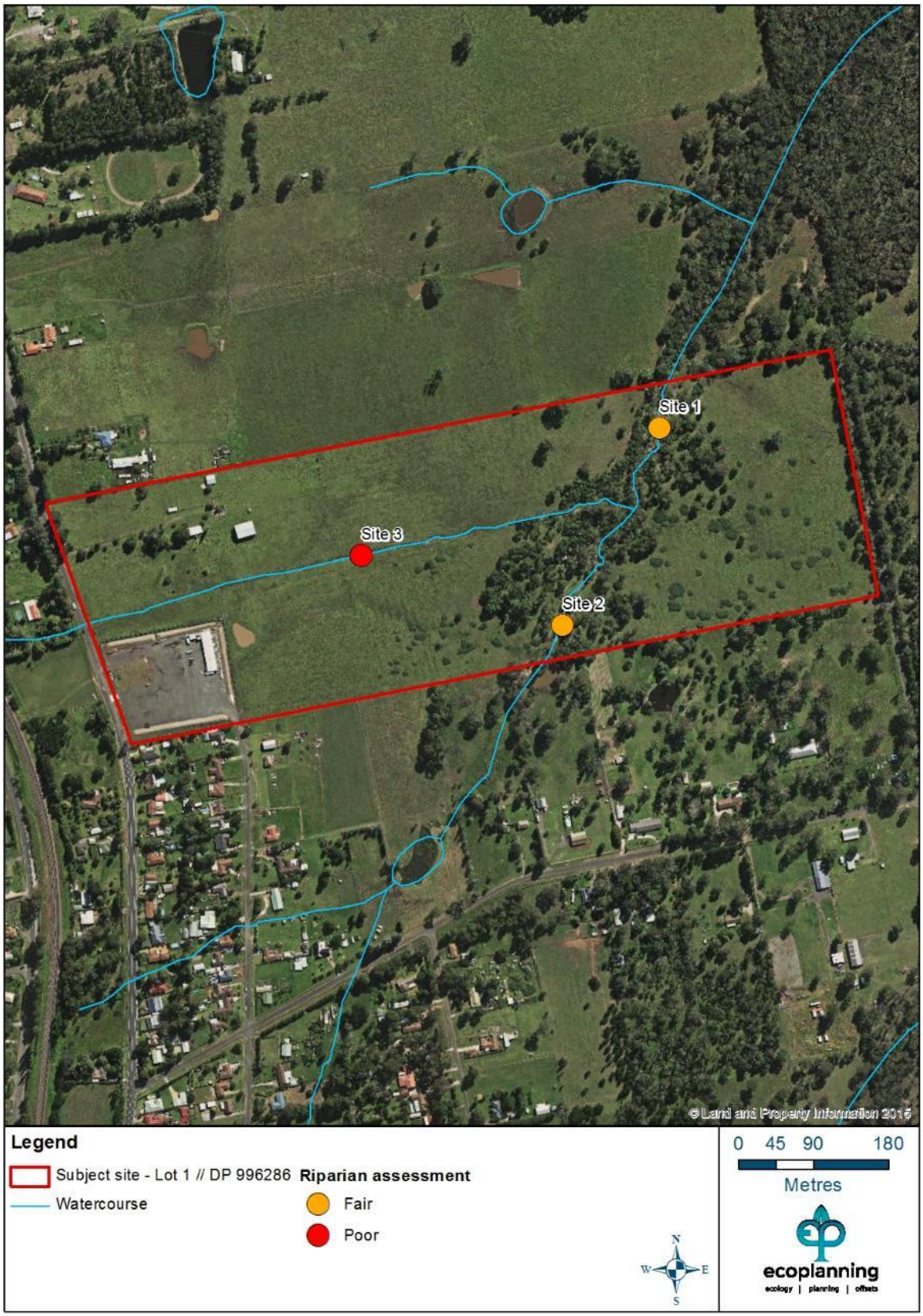

Figure 3.17: Riparian vegetation and creek channel condition assessment site locations and results.

Although much of the bedding material in the lower reach of the creek is sandstone and is therefore stable, in parts the creek channel presents as widened and infilled. In addition, bank undercutting, bank slump, rill erosion and un-supported knick points were observed (**Figure 3.18**).

Figure 3.18: Assessment Site 1 looking upstream from the northern boundary of subject site.

Assessment Site 2: Riparian vegetation and creek channel condition at Assessment Site 2 was 'fair' (**Figure 3.17**). This result reflects a moderate departure from a natural, unmodified creek with undisturbed riparian and floodplain vegetation communities.

When compared to Assessment Site 1, the extent of Alluvial Woodland is wider in the upper reach of unnamed tributary of Dog Trap Creek and ranged from 20 – 50 m. The understorey and groundcover in the riparian zone comprised of mixed exotic and native ground cover species including dense patches of *R. fruticosus* spp. aggr.*.

Bedding material in the upper reach of the creek is clay and in parts erosional processes have exposed shale bedrock. Severe erosion has degraded much of the bed and bank within this reach and bank undercutting, bank slump and gully and rill erosion is common.

Past grazing and stock movement through the riparian corridor and creek channel is likely to have triggered much of the erosion which is exacerbated by overflows from an upstream dam which has caused deep scouring of the creek bed which in places is up to 1.5 m deep (**Figure** 3.19).

Figure 3.19: Assessment Site 2 looking upstream toward southern boundary of subject site.

Assessment Site 3: Riparian vegetation and creek channel condition at Assessment Site 3 was 'poor' (**Figure 3.17**). This result reflects a significant departure from a natural, unmodified creek with undisturbed riparian and floodplain vegetation communities.

Along the length of the channel significant erosion is evident with bed scouring, undercutting, bank slump and a number of knick points/headcuts present. In addition, degradation to bed and bank as a result of stock watering is evident and deep pugging can be seen along the length of the channel.

With exception of the area within the confluence with the Un-named Tributary of Dog Trap Creek, vegetation has been cleared and exotic pasture grasses such as *P. clandestinum** dominate the adjacent banks and floodplain (**Figure 3.20**). See **Appendix C** for detailed results of riparian and creek channel assessment.

Figure 3.20: Assessment Site 3 looking downstream towards confluence with the unnamed tributary of Dog Trap Creek.

4 Ecological Constraints

The ecological survey of the subject site has found some high-moderate ecological constraints, however they are predominantly limited to the creek corridor and riparian zone of the Un-named tributary of Dog Trap Creek, and to a lesser extent the Un-named Drainage Line, which that flows from west to east and has been identified as first order. A summary of the ecological constraints and recommendations for zoning are provided below.

4.1 Ecological assessment

4.1.1 Vegetation communities

This study has confirmed the presence of several degraded areas of native vegetation within the study area, including Alluvial Woodland (MU11), and Shale Sandstone Transition Forest (MU1) and Shale Plains Woodland (MU10) (NPWS 2002), all of which are component of TEC listed under the TSC and/or EPBC Act's.

Alluvial Woodland is a component of the endangered ecological community (EEC), *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, listed under the NSW TSC Act.

Shale Sandstone Transition Forest is a component of the critically endangered ecological community (CEEC), listed under the TSC Act. Of the remnants surveyed during this assessment, the vegetation is degraded to such an extent (only underscrubbed vegetation is present) that it would not meet the condition criteria to be considered a CEEC under the EPBC Act.

Shale Plains Woodland is also a component of the CEEC, *Cumberland Plain Woodland in the Sydney Basin Bioregion*, listed on the TSC Act. As with the patch of Shale Sandstone Transition Forest, the vegetation on site is in a degraded condition, existing only as a small patch of scattered paddock trees, and as such it would not meet the condition criteria to be considered a CEEC under the EPBC Act.

In total the area of mapped native vegetation is 4.8 ha, or ~17% of the site. The dominant native vegetation type is Alluvial Woodland, totalling 4.0 ha of the 4.8 ha of native vegetation mapped. Shale Plains Woodland occupies 0.1 ha of the subject site and Shale Sandstone Transition Forest 0.7 ha. The remainder of the site is classified as cleared, covering pasture, planted ornamentals and structures. It totals 23.6 ha, or ~83% of the site.

4.1.2 Threatened and migratory species

Three migratory bird species listed under the EPBC Act have previously been recorded in close proximity to the subject site (Stone et al 2012), and one is likely to occur whilst grazing persists. These species, Rainbow Bee-eater, Satin Flycatcher, White-bellied Sea-Eagle and Cattle Egret respectively. All highly mobile so it is unlikely that the proposed land use changes will impact significantly on them.

Three threatened fauna species were found to have a moderate to high likelihood of utilising the subject site prior to field assessment. Two of these species were recorded by Stone et al (2012)

in close proximity to the subject site, these being the Varied Sittella and Grey-headed Flying-fox. The subject site may provide foraging habitat for both these species, and possible roosting/nesting habitat for Varied Sittella. Surveys undertaken for this report identified a potential Squirrel Glider utilising one of the hollows in Alluvial Woodland

Three threatened flora species were deemed to have a moderate to high likelihood of occurring within the subject site prior to field assessment, however no specimens were found during any of the surveys.

There is a moderate likelihood that some threatened species may utilise the subject site including a number of migratory birds and threatened fauna. Due to the degraded condition of the subject site it is unlikely nesting/roosting habitat is present however the there is potential for the remaining vegetation to be used for foraging.

The Wollondilly LGA is listed under Schedule 1 of SEPP44, but vegetation at the subject site was assessed as neither 'core' nor 'potential' Koala habitat and thus no further assessment would be required under SEPP44.

4.2 Key Fish Habitat, riparian vegetation and creek channel condition assessment

4.2.1 Key Fish Habitat

Although the waterways across the subject site are not mapped as Key Fish Habitat, it is noted that KFH attributes of riffle and pool habitat and large woody debris are present throughout the study area.

Due to this, any proposed construction, crossing or alteration to the creek bed, banks or riparian vegetation community should follow the recommended approach outlined by Policy and Guidelines for Fish Habitat Conservation and Management (NSWDPI 2013) and in particular those outlined by Chapter 3.3.2 "*Standard Precautions and Mitigation Measures*".

The NSW Office of Water Guidelines for Vegetation Management Plans on Waterfront Land (NSWDPI 2012b) present a number of recommendations to minimise the impacts to both instream habitat and the riparian vegetation community.

4.2.2 Riparian corridors

Creek channel and riparian vegetation condition across the subject site ranged from poor to fair. Consistent with the *Guidelines for Riparian Corridors on Waterfront Land* (DPI 2012a) the riparian corridors, or 'buffers', required for each creek were determined based on Strahler Stream Order. Riparian corridor buffer widths as recommended by DPI (2012a) are summarised in **Section 2**.

4.3 Recommendation

As discussed throughout this report, the ecological and riparian issues considered do not constrain the subject site to a significant extent. Due to the property being managed for grazing over many years, the native vegetation that remains onsite is found as disturbed and isolated patches, surrounded by cleared and pasture improved paddocks.

The majority of the vegetation within the study area exists as a corridor along the Un-named Tributary of Dog Trap Creek, which is predominantly Alluvial Woodland, a component of the River-flat Eucalypt Forest on Coastal Floodplains EEC. This is also the location of the hollow bearing trees which were observed to be utilised by both native birds and mammals, potentially a threatened species (Squirrel Glider).

Similarly, the riparian corridors are found in a modified and fair to poor condition. It is recommended a vegetation riparian zone (VRZ) of 20 m from top of bank on either side of the Un-named tributary of Dog Trap Creek be created and maintained should future rezoning and development occur at the site. This is the minimum width for the riparian corridor of a second order stream in accordance with NSW Office of Water (NOW) Guidelines for Riparian Corridors on Water Front Land (DPI 2012).

Assessment of the Unnamed Drainage Line showed this waterway is in poor condition. As a result, the drainage line has little biodiversity significance and correspondence has been initiated with NOW to seek approval to pipe this drainage line. No formal response has been received due to the perceived preliminary nature of the lot and road layout at this rezoning stage, it is therefore recommended dialogue with NOW is resumed on this matter at the Development Application stage (see **Appendix D** for email correspondence).

It is recommended that this area of the subject site be rezoned to E2 – Environmental Conservation, consolidating the areas with the highest biodiversity value (EEC, riparian zone and hollow bearing trees) with the recommended VRZ. This E2 corridor should be dedicated to a public authority with dedicated funding to ensure ongoing management for conservation purposes. In accordance with NOW Guidelines (DPI 2012), a Vegetation Management Plan (VMP) will be necessary for any impacts to this 'waterfront land', and no stormwater drainage (detention basins etc) or allowance for Asset Protection Zones should be permitted within the E2 corridor.

Whilst there is vegetation outside of the proposed E2 corridor is listed CEEC, it is accepted that due to the highly disturbed nature of vegetation that some residential zoning can be achieved without significant impact on the CEEC onsite. The recommended zoning of R2 – Low density residential zoning to the west of the Un-named Tributary to Dog Trap Creek will potentially impact on 0.1 ha of Cumberland Plain Woodland CEEC, this is 0.1 ha is reflective of 3-4 trees which in are in a young – early mature stage, and ultimately a very minor impact within the locality.

To the east of the Un-named Tributary to Dog Trap Creek, approximately 0.7 ha of Shale Sandstone Transition Forest CEEC persists, albeit in the form of underscrubbed and partly isolated vegetation. Whilst the recommended zoning of R5 – Large Lot Residential should allow for the retention of the majority of this vegetation, due to this zoning interacting with the NV Act in the Wollondilly LGA, a PVP is required for clearing of native vegetation, and as the vegetation

is CEEC it is considered a 'red light' and consequently a PVP will not allow for any clearing of this vegetation. It is recommended that the zoning of the eastern side of the Un-named Tributary should be reconsidered to R2 – Low Density Residential, but with limited lot sizing and a possible overlay in the WLEP to limit dual occupancy under this zoning. This will allow for retention of the majority of the CEEC east of the Un-named Tributary to Dog Trap Creek, whilst still permitting some limited vegetation clearing if necessary.

As a final recommendation, as all native vegetation has been identified as either EEC or CEEC, the application of Clause 7.2 – Natural Resources Biodiversity Layer of the WLEP should be considered for placement over these parcels to ensure that any vegetation clearing that does take place in these area is given due consideration by Council at DA stage.

Subject to the ecological constraints outlined by this study, the proposed rezoning of the subject site from RU2 – Rural Landscapes to R2 – Low density residential, R2 – Low density residential (limited lot size), E2 environmental protection with a Natural Resources –Biodiversity Layer overlay (in addition to the Riparian Layer that already exists) is considered appropriate. The proposed zoning taking account of the above recommendations is provided in **Figure 4.1**.

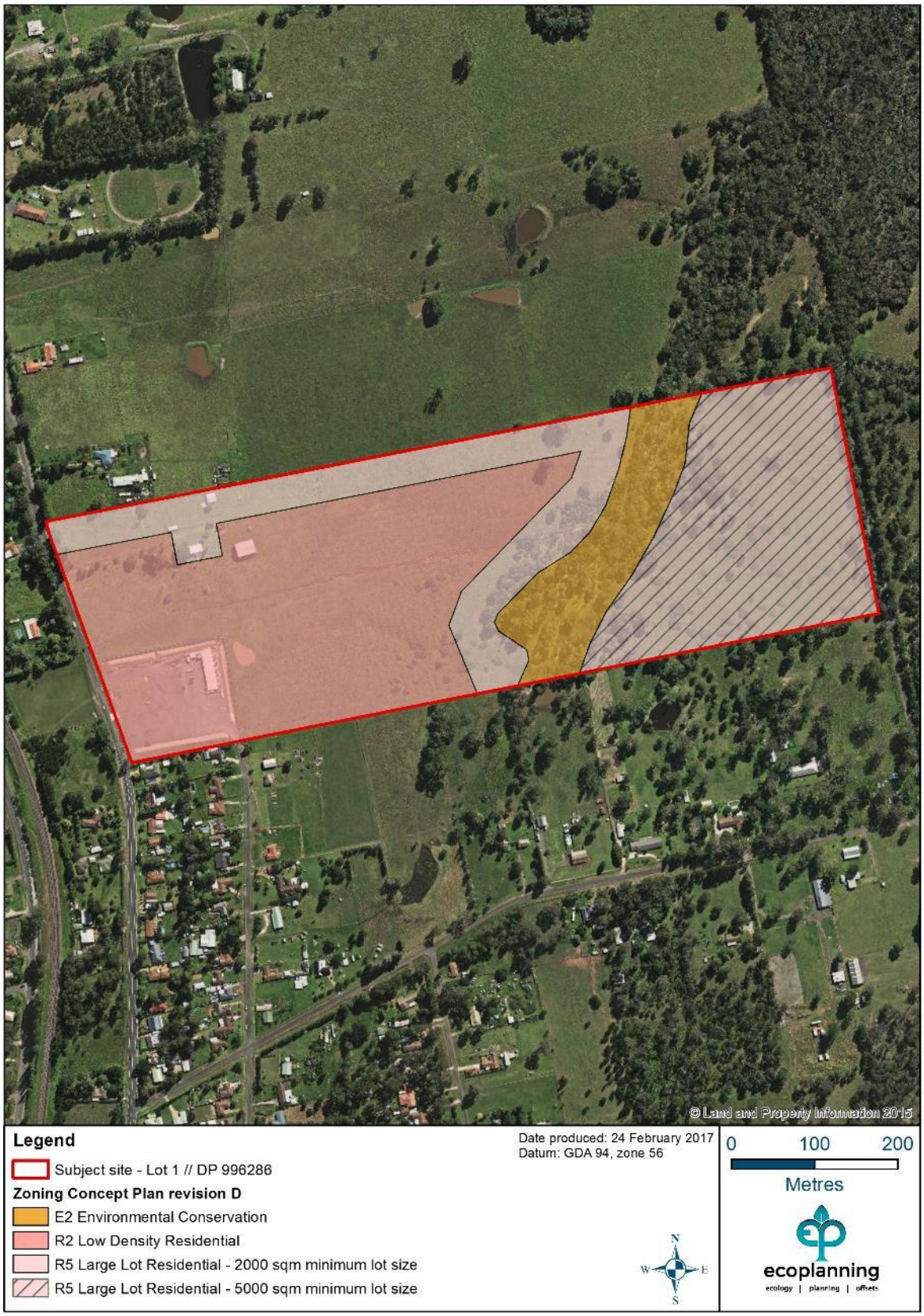

Figure 4.1: Proposed rezoning.

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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 subject site and study area, the potential for species to utilise the site and be affected directly or indirectly by the proposed action 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 proximity and date	Most recent* and proximity	Likelihood of occurrence	
					Before survey	After survey
KINGDOM: Animalia; CLASS: Amphibia						
Pseudophryne australis (Red-crowned Toadlet)	TSC Act = V EPBC Act = not listed	1	4.4km (2016)	2016 (4.4km)	Low	Not present
KINGDOM: Animalia; CLASS: Aves						
Burhinus grallarius (Bush Stone-curlew)	TSC Act = E1 EPBC Act = not listed	1	3.4km (1991)	1991 (3.4km)	Low	Low
Callocephalon fimbriatum (Gang-gang Cockatoo)	TSC Act = V EPBC Act = not listed	2	4.7km (2012)	2012 (4.7km)	Low	Low
Calyptorhynchus lathami (Glossy Black-Cockatoo)	TSC Act = V EPBC Act = not listed	1	2.5km (2014)	2014 (2.5km)	Low	Not present
Climacteris picumnus victoriae (Brown Treecreeper (eastern subspecies))	TSC Act = V EPBC Act = not listed	14	1.6km (2003)	2006 (1.9km)	Mod	Low
Daphoenositta chrysoptera (Varied Sittella)	TSC Act = V EPBC Act = not listed	10	0.0009km (2011)	2015 (4.4km)	High	Mod
Haliaeetus leucogaster (White-bellied Sea-Eagle)	TSC Act = EPBC Act = marine	1	0.40km (2011)	0.40km (2011)	Low	Low
Hieraaetus morphnoides (Little Eagle)	TSC Act = V EPBC Act = not listed	4	3.5km (2013)	2015 (4.4km)	Low	Low
Merops ornatus (Rainbow Bee-eater)	TSC Act = EPBC Act = marine	1	0.40km (2011)	0.40km (2011)	Low	Low
Melithreptus gularis gularis (Black-chinned Honeyeater (eastern subspecies))	TSC Act = V EPBC Act = not listed	5	1.7km (2006)	2006 (1.7km)	Low	Low
Ninox strenua (Powerful Owl)	TSC Act = V EPBC Act = not listed	2	1.9km (1996)	1997 (2.2km)	Low	Low

Onychoprion fuscata (Sooty Tern)	TSC Act = V EPBC Act = not listed	1	0.9km (1996)	1996 (0.9km)	Not present	Not present
Petroica boodang (Scarlet Robin)	TSC Act = V EPBC Act = not listed	6	2.4km (2006)	2015 (4.4km)	Low	Low
Stagonopleura guttata (Diamond Firetail)	TSC Act = V EPBC Act = not listed	3	1.8km (2006)	2006 (1.8km)	Low	Low
KINGDOM: Animalia; CLASS: Mammalia						
Cercartetus nanus Eastern Pygmy-possum)	TSC Act = V EPBC Act = not listed	1	3.2km (1996)	1996 (3.2km)	Low	Not present
Chalinolobus dwyeri (Large-eared Pied Bat)	TSC Act = V EPBC Act = V	2	2.7km (2008)	2008 (2.7km)	Low	Low
Dasyurus maculatus (Spotted-tailed Quoll)	TSC Act = V EPBC Act = E	1	4.3km (2006)	2006 (4.3km)	Low	Low
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	TSC Act = V EPBC Act = not listed	1	2.0km (2008)	2008 (2.0km)	Low	Low
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	TSC Act = V EPBC Act = not listed	1	2.0km (2008)	2008 (2.0km)	Low	Low
Mormopterus norfolkensis (Eastern Freetail-bat)	TSC Act = V EPBC Act = not listed	2	2.7km (2008)	2008 (2.7km)	Low	Low
Myotis macropus (Southern Myotis)	TSC Act = V EPBC Act = not listed	3	1.5km (2015)	2015 (1.5km)	Low	Not present
Phascolarctos cinereus (Koala)	TSC Act = V EPBC Act = V	20	1.0km (1995)	2016 (4.1km)	Low	Low
Pteropus poliocephalus (Grey-headed Flying-fox)	TSC Act = V EPBC Act = V	1	0.03km (2011)	2011 (0.03km)	Mod	Low
Scoteanax rueppellii (Greater Broad-nosed Bat)	TSC Act = V EPBC Act = not listed	3	2.0km (2008)	2010 (4.2km)	Low	Low

KINGDOM: Plantae						
Acacia bynoeana (Bynoe's Wattle)	TSC Act = E1 EPBC Act = V	1	4.8km (2012)	2012 (4.8km)	Low	Not recorded during this survey
Epacris purpurascens var. purpurascens	TSC Act = E1 EPBC Act = E	11	0.4km (2015)	2015 (0.4km)	Mod	Not recorded during this survey
Genoplesium baueri (Bauer's Midge Orchid)	TSC Act = E1 EPBC Act = E	1	2.5km (1992)	1992 (2.5km)	Low	Not recorded during this survey
Grevillea parviflora subsp. parviflora (Small-flower Grevillea)	TSC Act = V EPBC Act = V	39	0.4km (2010)	2013 (4.6km)	High	Not recorded during this survey
Leucopogon exolasius (Woronora Beard-heath)	TSC Act = V EPBC Act = V	1	4.9km (2003)	2003 (4.9km)	Low	Not recorded during this survey
Persoonia bargoensis (Bargo Geebung)	TSC Act = E1 EPBC Act = V	231	0.2km (2010)	2015 (0.4km)	High	Not recorded during this survey
Persoonia glaucescens (Mittagong Geebung)	TSC Act = E1 EPBC Act = V	41	0.5km (2005)	2013 (5.0km)	High	Not recorded during this survey
Persoonia hirsuta (Hairy Geebung)	TSC Act = E1 EPBC Act = E	219	1.2km (1997)	2013 (3.4km)	Mod	Not recorded during this survey
Pomaderris brunnea (Brown Pomaderris)	TSC Act = E1 EPBC Act = V	9	1.2km (2005)	2008 (1.6km)	Low	Not recorded during this survey

Appendix B: Flora and fauna species inventories

Flora

Family	*Genus*	*Species*	Common Name	Native/ Exotic	Type
Apiaceae	*Centella*	*asiatica*	Indian Pennywort	Native	Forb
Apocynaceae	*Gomphocarpus*	*fruticosus*	Narrow-leaved Cotton Bush	Exotic	Shrub
Asphodelaceae	*Asphodelus*	*fistulosus*	Onion Weed	Exotic	Herb
Asteraceae	*Chrysocephalum*	*apiculatum*	Common Everlasting	Native	Forb
Asteraceae	*Cirsium*	*vulgare*	Spear Thistle	Exotic	Forb
Asteraceae	*Conyza*	*bonariensis*	Flaxleaf Fleabane	Native	Forb
Asteraceae	*Euchiton*	*sphaericus*		Native	Forb
Asteraceae	*Hypochaeris*	*radicata*	Catsear	Exotic	Forb
Asteraceae	*Senecio*	*madagascariensis*	Fireweed	Exotic	Forb
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed	Native	Forb
Cyperaceae	*Cyperus*	*eragrostis*	Umbrella Sedge	Exotic	Sedge
Cyperaceae	*Cyperus*	*sanguinolentus*		Native	Sedge
Fabaceae - Mimosoideae	*Acacia*	*decurrens*	Black Wattle	Native	Tree
Juncaceae	*Juncus*	*usitatus*		Native	Rush
Malaceae	*Pyracantha*	*crenatoserrata*		Exotic	Shrub
Malvaceae	*Sida*	*rhombifolia*	Paddy's Lucerne	Exotic	Shrub
Myrtaceae	*Angophora*	*floribunda*	Rough Barked Apple	Native	Tree
Myrtaceae	*Eucalyptus*	*amplifolia*	Cabbage Gum	Native	Tree
Myrtaceae	*Eucalyptus*	*crebra*	Narrow-leaved Ironbark	Native	Tree
Myrtaceae	*Eucalyptus*	*fibrosa*	Red Ironbark	Native	Tree
Myrtaceae	*Eucalyptus*	*globoidea*	White Stringybark	Native	Tree
Myrtaceae	*Eucalyptus*	*tereticornis*	Forest Red Gum	Native	Tree
Myrtaceae	*Melaleuca*	*linariifolia*	Flax-leaved Paperbark	Native	Shrub/ tree
Oleaceae	*Ligustrum*	*sinense*	Small-leaved Privet	Exotic	Shrub
Oxalidaceae	*Oxalis*	*perennans*		Native	Forb
Phormiaceae	*Dianella*	*revoluta*	Blueberry Lily	Native	Forb
Pittosporaceae	*Bursaria*	*spinosa*	Blackthorn	Native	Shrub/ tree
Plantaginaceae	*Plantago*	*lanceolata*	Lamb's Tongue	Exotic	Forb
Pteridaceae	*Pellaea*	*falcata*	Sickle Fern	Native	Fern
Poaceae	*Andropogon*	*virginicus*	Whisky Grass	Exotic	Grass
Poaceae	*Chloris*	*gayana*	Rhodes Grass	Exotic	Grass
Poaceae	*Cynodon*	*dactylon*	Couch	Native	Grass

Family	*Genus*	*Species*	Common Name	Native/ Exotic	Type
Poaceae	*Dichelachne*	*micrantha*	Shorthair Plumegrass	Native	Grass
Poaceae	*Entolasia*	*stricta*	Wiry Panic	Native	Grass
Poaceae	*Eragrostis*	*benthami*		Native	Grass
Poaceae	*Eragrostis*	*leptostachya*	Paddock Lovegrass	Native	Grass
Poaceae	*Microlaena*	*stipoides var. stipoides*	Weeping Grass	Native	Grass
Poaceae	*Paspalum*	*dilatum*	Paspalum	Exotic	Grass
Poaceae	*Pennisetum*	*clandestinum*	Kikuyu	Exotic	Grass
Poaceae	*Poa*	*affinis*		Native	Grass
Poaceae	*Poa*	*labillardierei*	Tussock	Native	Grass
Poaceae	*Rytidosperma*	*racemosum*	Wallaby Grass	Native	Grass
Poaceae	*Setaria*	*parviflora*	Pigeon Grass	Exotic	Grass
Poaceae	*Sporobolus*	*creber*	Western Rat-tail Grass	Native	Grass
Poaceae	*Sporobolus*	*fertilis*	Giant Parramatta Grass	Exotic	Grass
Poaceae	*Themeda*	*triandra*	Kangaroo Grass	Native	Grass
Ranunculaceae	*Ranunculus*	*repens*	Creeping Buttercup	Exotic	Forb
Rosaceae	*Rubus*	*anglocandicans*	Blackberry	Exotic	Shrub
Solanaceae	*Solanum*	*prinophyllum*	Forest Nightshade	Native	Forb
Verbenaceae	*Verbena*	*bonariensis*	Purpletop	Exotic	Forb

Fauna

Class	Family	*Genus*	*Species*	Common name	Native/ Exotic	EP (2016)	Stone (2012)
Amphibia	Hylidae	*Litoria*	*dentata*	Bleating Tree Frog	Native		W
Amphibia	Hylidae	*Litoria*	*fallax*	Eastern Dwarf Tree Frog	Native		W
Amphibia	Hylidae	*Litoria*	*peronii*	Person's Tree Frog	Native		W
Amphibia	Hylidae	*Litoria*	*verreauxii*	Verreaux's Tree Frog	Native		W
Amphibia	Myobatrachidae	*Crinia*	*signifera*	Common Eastern Froglet	Native		W
Amphibia	Myobatrachidae	*Limnodynastes*	*tasmaniensis*	Spotted Marsh Frog	Native		W
Amphibia	Myobatrachidae	*Uperoleia*	*laevigata*	Smooth Toadlet	Native		W
Aves	Acanthizidae	*Acanthiza*	*chrysorrha*	Yellow-rumped Thornbill	Native		OW
Aves	Acanthizidae	*Acanthiza*	*lineata*	Striated Thornbill	Native		OW
Aves	Acanthizidae	*Acanthiza*	*nana*	Yellow Thornbill	Native		OW
Aves	Acanthizidae	*Acanthiza*	*reguloides*	Buff-rumped Thornbill	Native		OW
Aves	Acanthizidae	*Acanthiza*	*spp.*		Native	O	
Aves	Acanthizidae	*Gerygone*	*albogularis*	White-throated Gerygone	Native		W
Aves	Acanthizidae	*Smicrornis*	*brevirostris*	Weebill	Native		OW
Aves	Accipitridae	*Accipiter*	*fasciatus*	Brown Goshawk	Native		OW
Aves	Accipitridae	*Haliaeetus*	*leucogaster*	White-bellied Sea-Eagle	Native		O
Aves	Anatidae	*Chenonetta*	*jubata*	Australian Wood Duck	Native	O	
Aves	Ardeidae	*Ardea*	*pacifica*	White-necked Heron	Native		O
Aves	Artamidae	*Cracticus*	*tibicen*	Australian Magpie	Native	O	OW
Aves	Artamidae	*Cracticus*	*torquatus*	Grey Butcherbird	Native		W
Aves	Artamidae	Strepera	*graculina*	Pied Currawong	Native		W
Aves	Cacatuidae	*Cacatua*	*galerita*	Sulphur-crested Cockatoo	Native		OW
Aves	Cacatuidae	*Eolophus*	*roseicapillus*	Galah	Native	O	
Aves	Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-shrike	Native		OW
Aves	Climacteridae	*Cormobates*	*leucophaea*	White-throated Treecreeper	Native	W	OW

Class	Family	*Genus*	*Species*	Common name	Native/ Exotic	EP (2016)	Stone (2012)
Aves	Corvidae	*Corvus*	*coronoides*	Australian Raven	Native	OW	OW
Aves	Cuculidae	*Cacomantis*	*pallidus*	Pallid Cuckoo	Native		W
Aves	Cuculidae	*Chalcites*	*lucidus*	Shining Bronze-Cuckoo	Native		O
Aves	Cuculidae	*Eudynamys*	*orientalis*	Eastern Koel	Native		W
Aves	Halcyonidae	*Dacelo*	*novaeguineae*	Laughing Kookaburra	Native		OW
Aves	Halcyonidae	*Todiramphus*	*sanctus*	Scared Kingfisher	Native		W
Aves	Hirundinidae	*Hirundo*	*neoxena*	Welcome Swallow	Native		OW
Aves	Maluridae	*Malurus*	*cyaneus*	Superb Fairy-wren	Native		OW
Aves	Meliphagidae	*Acanthorhynchus*	*tenuirostris*	Eastern Spinebill	Native		OW
Aves	Meliphagidae	*Anthochaera*	*chrysoptera*	Little Wattlebird	Native	O	
Aves	Meliphagidae	*Lichenostomus*	*chrysops*	Yellow-faced Honeyeater	Native		OW
Aves	Meliphagidae	*Manorina*	*melanocelphala*	Noisy Miner	Native	OW	OW
Aves	Meliphagidae	*Myzomela*	*sanguinolenta*	Scarlet Honeyeater	Native		W
Aves	Meliphagidae	*Philemon*	*corniculatus*	Noisy Friarbird	Native		W
Aves	Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater	Native		W
Aves	Monarchidae	*Grallina*	*cyanoleuca*	Magpie-lark	Native	O	
Aves	Monarchidae	*Myiagra*	*cyanoleuca*	Satin Flycatcher	Native		OW
Aves	Neosittidae	*Daphoenositta*	*chrysoptera*	Varied Sittella	Native		OW
Aves	Pachycephalidae	*Pachycephala*	*rufiventris*	Rufous Whistler	Native		OW
Aves	Pardalotidae	*Pardalotus*	*punctatus*	Spotted Pardalote	Native	O	W
Aves	Petroicidae	*Microeca*	*fascinans*	Jacky Winter	Native		OW
Aves	Phalacrocoracidae	*Microcarbo*	*melanoleucos*	Little Black Cormorant	Native		O
Aves	Psittacidae	*Platycercus*	*eximius*	Eastern Rosella	Native	O	O
Aves	Psittacidae	*Trichoglossus*	*haematodus*	Rainbow Lorikeet	Native	O	
Aves	Rhipiduridae	*Rhipidura*	*albiscapa*	Grey Fantail	Native	O	OW
Aves	Rhipiduridae	*Rhipidura*	*leucophrys*	Willie Wagtail	Native		OW
Aves	Sturnidae	*Sturnus*	*tristis*	Common Myna	Exotic		W

Class	Family	*Genus*	*Species*	Common name	Native/ Exotic	EP (2016)	Stone (2012)
Aves	Sturnidae	*Sturnus*	*vulgaris*	Common Starling	Native	O	
Aves	Timaliidae	*Zosterops*	*lateralis*	Silvereye	Native	O	
Mammalia	Bovidae	*Bos*	*taurus*	Cow	Exotic	O	
Mammalia	Macropodidae	*Macropus*	*robustus*	Common Wallaroo	Native		S
Mammalia	Molossidae	*Tadarida*	*australis*	White-striped Freetail-bat	Native		W
Mammalia	Muridae	*Rattus*	*rattus*	Black Rat	Native		O
Mammalia	Petauridae	*Petaurus*	*breviceps*	Sugar Glider	Native	O	O, W, S
Mammalia	Phalangeridae	*Trichosurus*	*vulpecula*	Common Brushtail Possum	Native	P	O, W, S
Mammalia	Pseudocheiridae	*Pseudocheirus*	*peregrinus*	Common Ringtail Possum	Native		O, S
Mammalia	Pteropodidae	*Pteropus*	*poliocephalus*	Grey-headed Flyinf-fox	Native		O
Reptilia	Chelidae	*Chelodina*	*longicollis*	Eastern Long-necked Turtle	Native		O
Reptilia	Scincidae	*Eulamprus*	*quoyii*	Eastern Water Skink	Native		O
Reptilia	Scincidae	*Lampropholis*	*delicata*	Delicate Skink	Native		O

Herpetological likelihood assessment (prepared by Ross Wellington)

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
				Amphibia					
Limnodynastidae	*Heleioporus australiacus*	Giant Burrowing Frog	V,P	V	*	+			The habitat for this species is not present on-site.
	Limnodynastes dumerilii grayi	Eastern Banjo Frog	P		*	*			Potentially present in and around naturalised farm dams; conditions not suitable for calling.
	Limnodynastes peronii	Brown-striped Marsh Frog	P		*	*		*	Present around streamline soaks and farm dams.
	Limnodynastes tasmaniensis	Spotted Marsh Frog	P		*	*	*	*	Present in soaks around streamlines and around farm dams.
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		*	*	*	*	Present around farm dams and soaks around streamlines.
	Mixophyes balbus	Stuttering Frog	E1,P,2	V	*				The habitat for this species is not present on-site nor in the near vicinity.
	Paracrinia haswelli	Haswell's Frog	P		*	*			Unlikely present on the basis of habitat present; conditions and seasonally suitable to detect calling
	Pseudophryne australis	Red-crowned Toadlet	V,P		*	+			The habitat for this species is not present on-site.
	Pseudophryne bibronii	Bibron's Toadlet	P		*	*		*	Present in soaks and ephemeral seeps adjacent to streamlines.
	Uperoleia laevigata	Smooth Toadlet	P		*	*	*		Potentially present conditions not ideal for calling; previously detected in studies of adjacent property.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
Pelodryadidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	*				Historically may have been present, likely locally extirpated; no records for more than 20 years.
	Litoria caerulea	Green Tree Frog	P		*				Potentially present but conditions and seasonality not ideal for detection; has declined to a patchy distribution south of Sydney.
	Litoria citropa	Blue Mountains Tree Frog	P		*	*			The habitat for this species is not present on-site.
	Litoria dentata	Bleating Tree Frog	P		*	*	*		Potentially present conditions and seasonality unsuitable for detection by call; Previously detected in studies of adjoining property
	Litoria fallax	Eastern Dwarf Tree Frog	P		*	*	*		Likely present in an around farm dams; seasonality unsuitable for detection.
	Litoria freycineti	Freycinet's Frog	P		*				The habitat for this species is not present on-site.
	Litoria jervisiensis	Jervis Bay Tree Frog	P		*	*			
	Litoria latopalmata	Broad-palmed Frog	P		*				Potentially present around farm dams; conditions unsuitable for activity or detection by call.
	Litoria lesueurii	Lesueur's Tree Frog			*	*			Has some potential for detection down stream and just off site; conditions unsuitable for activity during survey though detected active not far north of subject site on previous day on a warmer evening.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
	Litoria littlejohni	Littlejohn's Tree Frog	V,P	V	*				The habitat for this species is not present on-site.
	Litoria peronii	Peron's Tree Frog	P		*	*	*		Likely present around farm dams and previously detected during surveys on adjacent site.
	Litoria phyllochroa	Leaf-green Tree Frog	P		*	*			The habitat for this species is not present on-site.
	Litoria tyleri	Tyler's Tree Frog	P		*	*			Potentially present around farm dams; conditions unsuitable for detection.
	Litoria verreauxii	Verreaux's Frog	P		*	*	*	*	Present in damp grassy areas surrounding headwaters of streams.
Reptilia									
Chelidae	*Chelodina longicollis*	Long Necked Turtle	P		*	*	*		Conditions unsuitable for detection; previously detected during surveys of adjoining property; likely present in farm dams;
	Emydura macquarii dharuk	Nepean Short-necked Turtle	P		*				The habitat for this species is not present on-site.
Carphodactylidae	*Phyllurus platurus*	Broad-tailed Gecko	P		*	*			The habitat for this species is not present on-site.
	Underwoodisaurus milii	Thick-tailed Gecko	P		*				The habitat for this species is not present on-site.
Diplodactylidae	*Amalosia lesueurii*	Lesueur's Velvet Gecko	P		*	*			The habitat for this species is not present on-site.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
	Diplodactylus vittatus	Wood Gecko	P		*				This species may have previously occurred on the subject site prior to agricultural activities; insufficient habitat extent and ground covers to be likely still present.
Pygopodidae	*Lialis burtonis*	Burton's Snake-lizard	P		*				May have previously occurred; locally extirpated across most of the Cumberland Plain
	Pygopus lepidopodus	Common Scaly-foot	P		*				May have occurred previously; heath layer on the subject site is too degraded to support the species on the site; extirpated across much of the Cumberland Plain and surrounds.
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P		*	*			The habitat for this species is not present on-site.
	Concinnia tenuis	Barred-sided Skink	P		*	*			Potentially still present along drainage/riparian zone; difficult to detect and conditions unsuitable for detection
	Cryptoblepharus pulcher	Elegant snake-eyed Skink	P		*	*			Likely present conditions unsuitable for detection
	Ctenotus robustus	Robust Striped-skink	P		*				Potentially present in vicinity and of subject site but paucity of ground covers restricts the species; may be detected around fence-lines and under human refuse in the locality generally.
	Ctenotus taeniolatus	Copper-tailed Skink	P		*	*			The habitat for this species is not present on-site.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
	Cyclodomorphus michaeli	She-oak Skink	P		*				Patchily distributed and with some potential to occur but equivocal as to whether it is likely to persist, habitat marginal.
	Egernia cunninghami krefftii	Cunningham's Skink	P		*	*			The habitat for this species is not present on-site.
	Eulamprus quoyii	Eastern Water-skink	P		*	*	*	*	Riparian zone specialist and highly adaptable.
	Lampropholis delicata	Dark-flecked Garden Sunskink	P		*	*	*	*	Common species that prefers damper areas
	Lampropholis guichenoti	Pale-flecked Garden Sunskink	P		*	*			Likely present around dryer ridgelines and human structyres/habitations.
	Liopholis whitii	White's Skink	P		*	*			The habitat for this species is not present on-site.
	Lygisaurus foliorum	Tree-base Litter-skink	P		*				May have previously existed but likely extirpated; extent of heath remaining and undisturbed condition reduces this likelihood though may be still present in nearby less disturbed localities.
	Saiphos equalis	Three-toed Skink	P		*				Potentially present in areas with dense leaf litter, perhaps downstream of the subject site where this occurs.
	Saproscincus mustelinus	Weasel Skink	P		*				The habitat for this species is not present on-site.
	Tiliqua scincoides	Eastern Blue-tongue	P		*	*	*		Previously detected in adjacent study during favourable conditions.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P		*	*			May have previously occurred, heath layer and understorey in too poor condition and extent to persist on-site.
	Intellagama lesueurii	Eastern Water Dragon	P		*	*	*		Likely present downstream of the subject site where stream/riparian conditions and flow regime higher in water flow frequency. Detected by previous studies adjacent during more favourable conditions.
	Pogona barbata	Bearded Dragon	P		*	*			Likely previously present habitat condition and extent unlikely to support the species any longer.
	Rankinia diemensis boylani	Mountain Dragon	P		*	*			The habitat for this species is not present on-site.
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V,P		*				The habitat for this species is not present on-site.
	Varanus varius	Lace Monitor	P		*				Likely present particularly downstream and more heavily timbered adjoining properties; conditions unsuitable for detection.
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		*	*			Potentially present; subterranean existence difficult to survey and only detectable when flushed to surface after extended rain or under deeply embedded cover (rocks) able to be searched
Boidae	*Morelia spilota*	Diamond Pythons	P		*	*			Potentially present in downstream riparian areas, although the species will frequent agricultural structures.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
Colubridae	*Boiga irregularis*	Brown Tree Snake	P		*				The habitat for this species is not present on-site.
	Dendrelaphis punctulatus	Common Tree Snake	P		*				Potentially present in downstream more heavily wooded riparian areas; conditions unsuitable for detection.
Elapidae	*Acanthophis antarcticus*	Common Death Adder	P		*				The habitat for this species is not present on-site.
	Cacophis squamulosus		P		*				The habitat for this species is not present on-site.
	Cryptophis nigrescens	Eastern Small-eyed Snake	P		*	*			The habitat for this species is not present on-site.
	Demansia psammophis	Yellow-faced Whip Snake	P		*				The habitat for this species is not present on-site.
	Drysdalia rhodogaster	Mustard-bellied Snake	P		*				The habitat for this species is not present on-site.
	Furina diadema	Red-naped Snake	P		*				May have previously existed condition and extent of habitat unlikely to any longer support the species.
	Hemiaspis signata	Black-bellied Swamp Snake	P		*				May occur but conditions unsuitable for detection and minimal ground cover habitat present. May be detected around damp soaks in the vicinity of farm dams.
	Hoplocephalus bungaroides	Broad-headed Snake	E1,P,2	V	*	+			The habitat for this species is not present on-site.
	Notechis scutatus	Tiger Snake	P		*	*			The habitat for this species is not present on-site.

Family	Scientific Name	Common Name	NSW Status	C' wealth Status	Predicted on basis of locality and known dist.	Bionet Records within the Locality	Previous Study	This Study	Comment
	Pseudechis porphyriacus	Red-bellied Black Snake	P		*		*		Likely present and detected during studies of adjoining properties.
	Pseudonaja textilis	Eastern Brown Snake	P		*				Likely present; conditions unsuitable for detecting active individuals and minimal ground cover; will almost certainly be detected around human habitation areas and where rubbish occurs in rural residential yards.
	Vermicella annulata	Bandy-bandy	P		*				Enigmatic species difficult to predict occurrence; subterranean existence makes detection difficult; presence unlikely.

Appendix C: Results of Riparian Vegetation and Creek Channel Assessment

CTENVIRONMENTAL SITE ASSESSMENT

Type Regular Date 7/05/2015 Time 4:00 PM Assessor Carl

Site Condition and Score: fair 25.1

Unnamed - Dog Trap

or catchment area

Assessment Site 1

2 stream order

notes

The site is in fair condition, with a score of 25.1 overall.

Site located approx 50 upstream of northern boundary

landuse

Within the 50 metre assessment radius, left bank land use is 10% bushland, 90% pasture, approximately. Right bank land use is 40% bushland, 60% pasture, approximately. This is included in the site features score.

vegetation

Within the 50 metre assessment radius, left bank vegetation structure is 20% under-scrubbed forest/ woodland, 40% pasture grassland, 40% derived native grassland, approximately. Right bank vegetation structure is 40% under-scrubbed forest/ woodland, 40% derived native grassland, 20% pasture grassland, approximately. This is reflected in the vegetation structure subtotal.

upstream

downstream

extraction	absent	
excavation	absent	
litter	absent	
sewer/stormwater	absent	
odour	normal/none	
turbidity	low	
Land Use	Subtotal	9.5
Site Features	Total	9.5
channel shape	widened/infilled	
pool riffle sequence	present	
meanders	unconfined yes	
large woody debris	high >10	
woody debris size	> 300 mm dia and 3 m	
overhanging vegetation	mod <30>60%	
natural bed detritus	present	
natural gravel bed	not visible	
natural rock in-stream	natural > 500 mm	
native macrophyte	not visible	
mapped Key Fish Habitat	no	
KFH riparian buffer zone		
Aquatic Habitat	Total	8
benches	present unconstricted	
islands	absent	
channel bars	absent	
Deposition	Total	1
bedrock/clay exposure	natural	
undercutting	severe >30% bank	
bank slumps	severe >30% bank	
knick point	unsupported	
bank erosion	gully/rill	
Erosion	Total	-12
total riparian corridor WMAct	40	
riparian buffer width left	over 40m	
riparian buffer width right	over 40m	
Riparian Vegetation	Subtotal	20
Vegetation Structure	Subtotal	7.6
weed density left bank	moderate 40-70%	
weed density right bank	light up to 40%	
Weeds	Subtotal	-9
Vegetation	Total	18.6

CTENVIRONMENTAL SITE ASSESSMENT

Type Regular Date 7/05/2015 Time 4:30 PM Assessor Carl

Site Condition and Score: fair 23.0

Unnamed - Dog Trap

or catchment area

Assessment Site 2

2 stream order

notes

The site is in fair condition, with a score of 23 overall.

Site located approx 50 downstream of southern boundary

landuse

Within the 50 metre assessment radius, left bank land use is 100% bushland, approximately. Right bank land use is 40% bushland, 60% pasture, approximately. This is included in the site features score.

vegetation

Within the 50 metre assessment radius, left bank vegetation structure is 20% under-scrubbed forest/ woodland, 40% pasture grassland, 40% derived native grassland, approximately. Right bank vegetation structure is 40% under-scrubbed forest/ woodland, 40% derived native grassland, 20% pasture grassland, approximately. This is reflected in the vegetation structure subtotal.

upstream

downstream

extraction	absent	
excavation	absent	
litter	med 6-20	
sewer/stormwater	absent	
odour	normal/none	
turbidity	low	
Land Use	Subtotal	15.4
Site Features	Total	15.4
channel shape	straighened/deepened	
pool riffle sequence	absent	
meanders	unconfined yes	
large woody debris	high >10	
woody debris size	> 300 mm dia and 3 m	
overhanging vegetation	low <30%	
natural bed detritus	present	
natural gravel bed	not visible	
natural rock in-stream	small debris	
native macrophyte	not visible	
mapped Key Fish Habitat	no	
KFH riparian buffer zone		
Aquatic Habitat	Total	5
benches	absent	
islands	absent	
channel bars	absent	
Deposition	Total	0
bedrock/clay exposure	from incision	
undercutting	moderate 10-30%	
bank slumps	severe >30% bank	
knick point	unsupported	
bank erosion	gully/rill	
Erosion	Total	-13
total riparian corridor WMAct	40	
riparian buffer width left	over 40m	
riparian buffer width right	over 40m	
Riparian Vegetation	Subtotal	20
Vegetation Structure	Subtotal	7.6
weed density left bank	moderate 40-70%	
weed density right bank	moderate 40-70%	
Weeds	Subtotal	-12
Vegetation	Total	15.6

CTENVIRONMENTAL SITE ASSESSMENT

Type Regular Date 7/05/2015 Time 4:30 PM Assessor Carl

Site Condition and Score: poor -15.6

Unnamed - Dog Trap

or catchment area

Assessment Site 3

1 stream order

notes

The site is in poor condition, with a score of -15.6 overall.

Ephemeral drainage line that runs west to east across subject site.

landuse

Within the 50 metre assessment radius, left bank land use is 10% bushland, 90% pasture, approximately. Right bank land use is 20% bushland, 10% commercial, 70% pasture, approximately. This is included in the site features score.

vegetation

Within the 50 metre assessment radius, left bank vegetation structure is 10% under-scrubbed forest/ woodland, 90% pasture grassland, approximately. Right bank vegetation structure is 20% under-scrubbed forest/woodland, 80% pasture grassland, approximately. This is reflected in the vegetation structure subtotal.

upstream

downstream

extraction	absent	
excavation	absent	
litter	low 1-5	
sewer/stormwater	present	
odour	normal/none	
turbidity	medium	
Land Use	Subtotal	-4
Site Features	Total	-4
channel shape	straighened/deepened	
pool riffle sequence	absent	
meanders	unconfined no	
large woody debris	high >10	
woody debris size	absent	
overhanging vegetation	absent	
natural bed detritus	absent	
natural gravel bed	absent	
natural rock in-stream	absent	
native macrophyte	not visible	
mapped Key Fish Habitat	no	
KFH riparian buffer zone		
Aquatic Habitat	Total	-5
benches	absent	
islands	absent	
channel bars	no restriction	
Deposition	Total	1
bedrock/clay exposure	absent	
undercutting	severe >30% bank	
bank slumps	severe >30% bank	
knick point	unsupported	
bank erosion	gully/rill	
Erosion	Total	-12
total riparian corridor WMAct	20	
riparian buffer width left	over 40m	
riparian buffer width right	over 40m	
Riparian Vegetation	Subtotal	20
Vegetation Structure	Subtotal	4.4
weed density left bank	severe over 70%	
weed density right bank	severe over 70%	
Weeds	Subtotal	-20
Vegetation	Total	4.4

Appendix D: Email correspondence with NOW regarding west-east draining line

Additional material for request for approval to pipe drainage line at 95 Great Southern Rd, Bargo.

carl tippler <carl@ctenvironmental.com.au>

9/03/15

to jeremy.morice,

Hi Jeremy,

Following on from our conservation regarding approval to pipe the drainage line which dissects 95 Great Southern Rd, Bargo, Lot1 DP996286, we have provided additional material for consideration (see below and attached).

- The 1927 Army survey topographical series mapped the watercourse as a 'non-perenial waterway' (i.e a waterway that occasionally contains water). The drainage line can be found on Figure 1 (circled in red) of the supporting attachments just below the road running E-W below the word 'Dogtrap'. Figure 2 contains the map legend which correspondents to the 1927 topographic map.

Figure 1. The 1927 Army survey topographical series mapped the watercourse as a 'non-perenial waterway' (i.e a waterway that occasionally contains water). The drainage line can be found on

Figure 1 (circled in red) of the supporting attachments just below the road running E-W below the word 'Dogtrap'

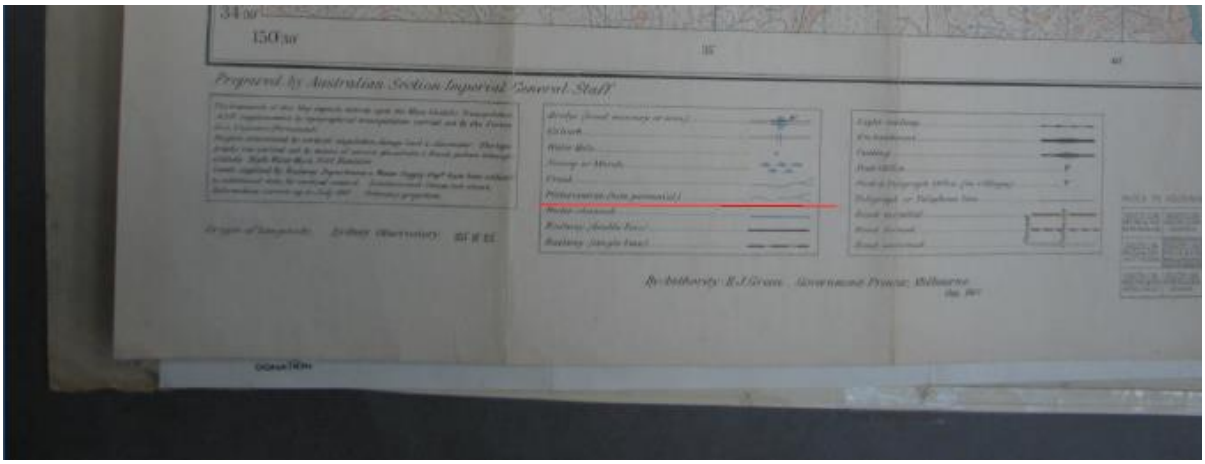

Figure 2. Map legend which correspondents to the 1927 topographic map.

- The channel is approximately 600 m in length, is of first order, and is predominantly without native vegetation having been historically cleared for grazing which has resulted in a pasture grass dominated riparian zone and floodplain (see Figure 3 - aerial photo).

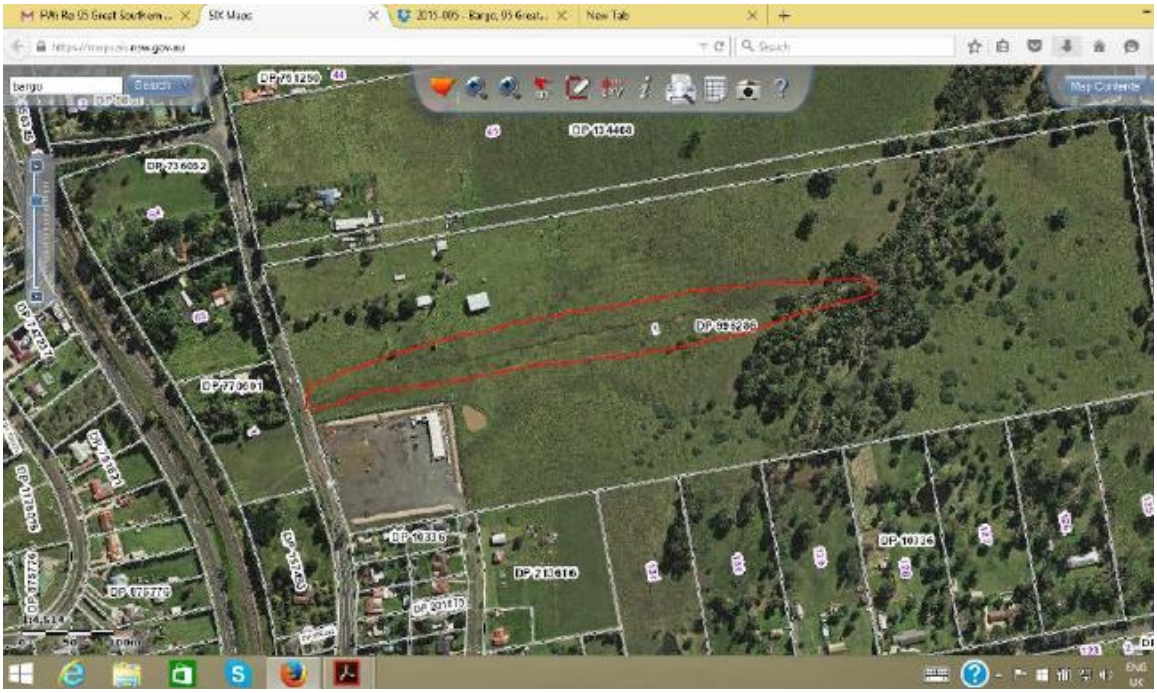

Figure 3. Aerial photo of drainage line. Circled in red.

- The final 120 m of the channel has remnant native vegetation which will remain as is and be contained in the Vegetation Management Zone of the proposed future development.

- A desktop assessment of the condition of the channel and riparian vegetation using the Rapid Riparian Appraisal (Findlay *et al* 2011) shows the condition of the waterway as 'poor' (Figure 4).

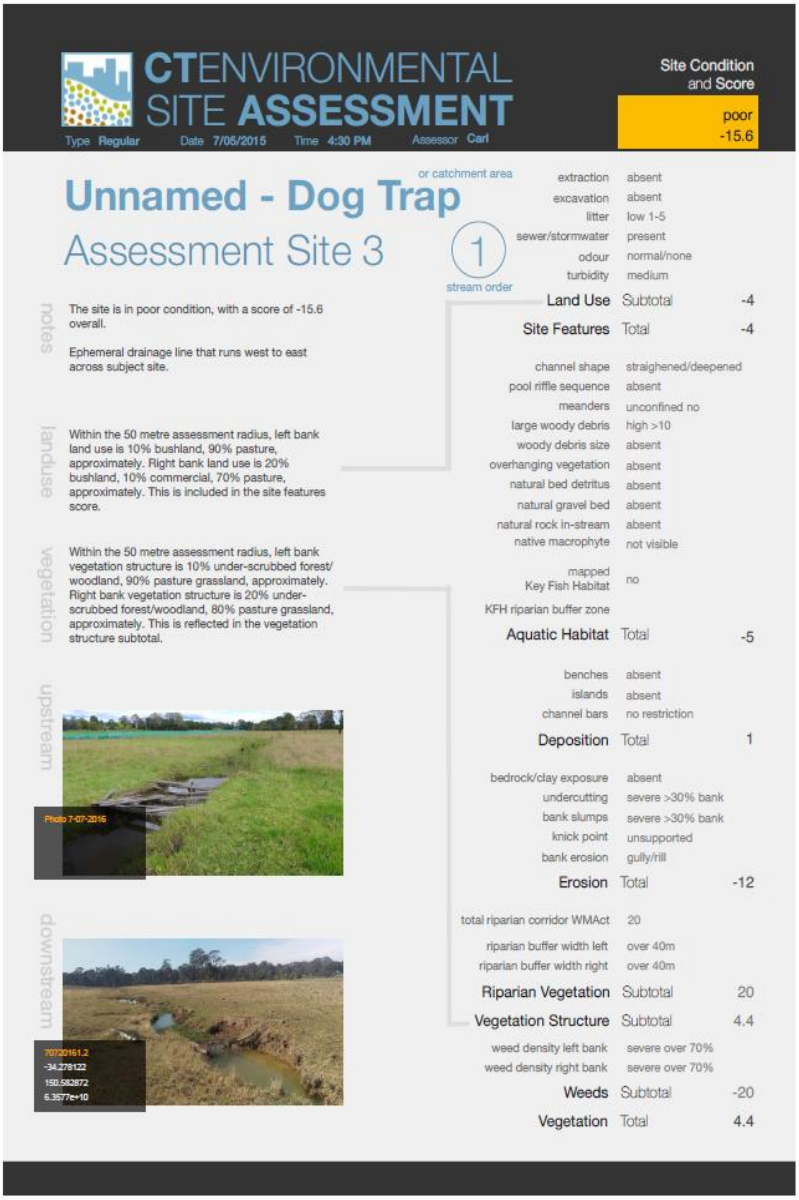

Figure 4. Rapid Riparian Appraisal report (RRA), unnamed trib 95 Great Southern Road Bargo.

- Along the length of the channel significant erosion is evident with bed scouring, undercutting, bank slump and a number of knick points/headcuts present. In addition, degradation to bed and bank as a result of stock watering is evident and deep pugging can be seen along the length of the channel (see Figures 5,6,7,8,9).

Figure 5. Bank undercutting and slump, lower end of channel

Figure 6. Bank undercutting lower end of trib in remnant bushland patch

Figure 7. Significant knickpoint and bankslump

Figure 8. Deepened channel, bank undercutting and cattle pugging

Figure 9. Deepened pool and cattle pugging

- The waterway in it's present form provides no significant water quality function, is prone to high, flashy flows during rain events, has very limited habitat value and is significantly modified from it's original form.

- Future development of Lot 1 will direct run-off from the upslope catchment through the Site via a pipe/culvert system with piped flows discharged in a controlled manner adjacent to the riparian zone of the North/South aligned creek in the eastern portion of the Site.

- Discharge control structures such as energy dissipaters and soft engineered armoured level spreaders will be used to mimic current overland flow conditions downslope of the proposed development. In addition, site generated stormwater quality and quantity will be managed separately through a series of bioretention and OSD basins.

- The proposed stormwater treatment will provide significant improvement to the receiving creek which runs North/South through the Lot by controlling the flashiness of flow which in turn will reduce erosion, reduce nutrient and sediment pollution and provide additional native wetland habitat.

Given the additional information/material can you please provide advice as to whether consent could be granted to pipe this channel.

Kind regards,

Carl Tippler

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