

# Appendix I

## Ecological Assessment

Kellyville Station Precinct



Planning &  
Environment





## Kellyville Priority Precinct Plan

### Ecological Constraints Assessment – Final

Prepared for  
**NSW Department of Planning and Environment**

August 2015



**DOCUMENT TRACKING**

Item	Detail
Project Name	Kellyville Precinct – Ecological Constraints Assessment
Project Number	14SYDECO-0115
Project Manager	Matthew Dowle (02) 8536 8670 Level 6, 299 Sussex Street Sydney NSW 2000
Prepared by	Matthew Dowle
Reviewed by	Steven Ward
Approved by	Steven Ward
Status	FINAL
Version Number	V5
Last saved on	1 September 2015
Cover photo	River-flat Eucalypt Forest (ELA 2008)

This report should be cited as 'Eco Logical Australia 2014. *Kellyville Precinct – Ecological Constraints Assessment*. Prepared for NSW Department of Planning and Environment.'

**ACKNOWLEDGEMENTS**

This document has been prepared by Eco Logical Australia Pty Ltd with support from AVER, The Hills Shire Council and NSW Department of Planning and Environment.

**Disclaimer**

*This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and NSW Department of Planning and Environment. The scope of services was defined in consultation with NSW Department of Planning and Environment, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.*

*Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.*

---

Template 08/05/2014

# Contents

<b>Executive Summary .....</b>	<b>7</b>
<b>1 Introduction.....</b>	<b>8</b>
1.1 Description of project.....	8
1.3 Study area .....	8
<b>2 Statutory planning context.....</b>	<b>10</b>
2.1 Overview.....	10
<b>3 Methods .....</b>	<b>12</b>
3.1 Literature review – terrestrial and aquatic values.....	12
3.1.1 North West Rail Link Ecological Assessment.....	12
3.1.2 The Hills Shire Council vegetation mapping.....	13
3.1.3 Likelihood of occurrence.....	13
3.1.4 Cumberland Plain Recovery Plan .....	13
3.2 Terrestrial ecology assessment.....	14
3.3 Aquatic and riparian assessment .....	14
3.4 Assessment limitations .....	15
<b>4 Description of existing biodiversity values .....</b>	<b>17</b>
4.1 Vegetation communities .....	17
4.1.1 Cumberland Plain Woodland.....	17
4.1.2 River-Flat Eucalypt Forest .....	19
4.1.3 Planted and modified vegetation .....	19
4.1.4 Threatened ecological communities area calculations.....	20
4.2 Flora and fauna species .....	22
4.2.1 Threatened flora .....	22
4.2.2 Threatened fauna .....	22
4.3 Aquatic habitat and riparian corridors.....	23
4.3.1 Riparian corridors .....	23
4.3.2 Aquatic fauna habitat.....	23
4.4 Noxious weeds .....	23
<b>5 Ecological constraints .....</b>	<b>25</b>
5.1 Ecological constraints assessment .....	25
5.1.1 High ecological value.....	25
5.1.2 Moderate ecological value.....	25
5.1.3 Low ecological value .....	25
5.1.4 Discussion of Outcomes.....	25



<b>6</b>	<b>Outcomes and recommendations .....</b>	<b>28</b>
6.1	Zoning outcomes .....	28
6.2	Impact assessment.....	28
6.3	Recommendations.....	32
6.3.1	Opportunity sites.....	32
6.3.2	Outside opportunity sites .....	32
6.3.3	Land ownership .....	33
6.3.4	Riparian corridors .....	33
	<b>References .....</b>	<b>36</b>
	<b>Appendix A - Likelihood of occurrence .....</b>	<b>37</b>
	<b>Appendix B – NSW 7-part test Assessment of Significance .....</b>	<b>67</b>

## List of figures

Figure 1: Kellyville Precinct .....	9
Figure 2: Assessment locations within Kellyville Precinct .....	16
Figure 3: Vegetation communities .....	21
Figure 4: Strahler stream order and corresponding riparian corridors .....	24
Figure 5: Mapped ecological constraints .....	27
Figure 6: Opportunity sites and vegetation communities .....	30
Figure 7: Opportunity sites and riparian corridors .....	31
Figure 8: Averaging Rule (Source NOW Controlled Activity Riparian Corridor Guidelines) .....	35

## List of tables

Table 1: Relevant legislation and policy .....	10
Table 2: NOW riparian categories and buffer specifications .....	14
Table 3: EPBC categories and thresholds for Cumberland Plain Woodland. ....	18
Table 4: Vegetation communities and their likely condition within Kellyville Precinct .....	20
Table 5: Threatened flora with a potential or likely occurrence within the precinct.....	22
Table 6: Threatened fauna with a potential or likely occurrence within the precinct.....	22
Table 7: Opportunity sites and impact areas .....	29
Table 8: NOW riparian corridor matrix.....	35
Table 9: Cumberland Plain Woodland .....	68
Table 10: River-flat Eucalypt Forest .....	72

# Abbreviations

Abbreviation	Description
CEEC	<i>Critically Endangered Ecological Community</i>
the Council (only where there is no confusion)	The Hills Shire Council
the Council (only where there is no confusion)	Blacktown City Council
DotE	Department of the Environment
the Department	NSW Department of Planning and Environment
EECs	Endangered Ecological Communities
ELA	Eco Logical Australia Pty Ltd
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP&A Act	Environmental Planning and Assessment Act 1979
FM Act	<i>Fisheries Management Act 1994</i>
the Hills DCP 2012	The Hills Development Control Plan 2012
the Hills LEP 2012	The Hills Local Environment Plan 2012
the Hills LGA	The Hills Local Government Area
NES	National Environmental Significance
NOW	NSW Office of Water
NPWS	NSW National Parks and Wildlife Service
NWRL	North West Rail Link
NWRL Corridor Strategy	North West Rail Link Corridor Strategy
OEH	Office of Environment and Heritage
the Precinct	Kellyville Precinct
the Structure Plan	Kellyville Precinct Structure Plan
TSC Act	<i>Threatened Species Conservation Act 1995</i>
WM Act	<i>Water Management Act 2000</i>



# Executive Summary

Eco Logical Australia was engaged by NSW Department of Planning and Environment (the Department) to assess the biodiversity and riparian values of the Kellyville Precinct as a component of the broader precinct planning/rezoning process that is being coordinated by the Department.

The purpose of this desktop assessment was to identify the key biodiversity and riparian constraints of the precinct and to provide recommendations on how those values could be appropriately considered in the planning, rezoning and ultimately, future urban development within the precinct.

A key consideration in this process was the identification of threatened species, ecological communities and/or their habitat listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Kellyville Precinct is approximately 440 ha in size and contains two listed ecological communities listed under the TSC Act and / or EPBC Act:

- *Cumberland Plain Woodland*, which is listed as a critically endangered ecological community under both the TSC Act and EPBC Act.
- *River-flat Eucalypt Forest* – is listed as endangered under the TSC Act.

The desktop assessment identified an indicative 7.48 ha of Cumberland Plain Woodland (TSC Act) and 34.48 ha of River-flat Eucalypt Forest to occur within the Precinct. These communities are a potential constraint to development in the areas where they occur.

Five threatened fauna species listed under the TSC Act and/or EPBC Act were identified as having recent records within the precinct (NSW Wildlife Atlas):

- Cattle Egret (*Ardea ibis*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail Bat (*Mormopterus norfolkensis*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*)

A further twelve threatened fauna species were also identified as being likely to occur, or potentially occurring. There were no recent threatened flora records for the Precinct, though seven species could potentially occur.

A number of watercourses and minor tributaries, associated with Caddies Creek, Elizabeth Macarthur Creek and Strangers Creek were identified from 1:25000 mapping within the Precinct, ranging from first to fourth order streams. Overall the conditions of the streams are mostly likely to be degraded due to historical disturbances, with high occurrences of exotic weeds and previous clearing. Riparian corridors have been mapped accordingly to stream order and may provide a constraint to potential development. It is noted that the riparian corridor mapping is indicative, and the actual extent and location of the riparian corridors will need to be confirmed.

It is recommended that listed ecological communities and riparian corridors be validated where required and considered in context with relevant legislation.

# 1 Introduction

## 1.1 Description of project

This report has been prepared by Eco Logical Australia and provides a desktop assessment of ecological and riparian constraints relating to the proposed rezoning of the Kellyville Precinct.

The Kellyville Precinct was announced by the NSW Government in August 2014. The Precinct is one of number of Priority Precincts which aim to provide for more homes, jobs and improved public spaces close to transport and services. One of the key goals for Priority Precincts is to increase housing choice and affordability by delivering increased housing supply in an environmentally, socially and economically sustainable manner.

The Kellyville Precinct is located in The Hills Shire Local Government Area and Blacktown City Local Government Area and covers approximately 440 hectares. The boundary of the Precinct is generally based on the road boundary within a radius of 800 metres from the proposed Kellyville station, which is normally considered to reflect a 10 minute walk. The boundary also takes in to account predominant land uses, built form and natural features.

The vision for the Kellyville Precinct is for a vibrant, mixed use centre comprising a mixture of offices, shops, community facilities, recreational, cultural and leisure activities, education, and a mix of housing types within walking distance of the new station.

The Kellyville Precinct is a long term project that will be delivered over the next 25 years.

## 1.2 Project aim

The aim of this report is to identify and assess the key ecological constraints and riparian features of the Precinct and to provide recommendations with respect to terrestrial and aquatic ecosystem management.

## 1.3 Study area

The Kellyville Precinct study area is shown in **Figure 1** and referred to in this report as the 'Precinct'.





Figure 1: Kellyville Precinct



## 2 Statutory planning context

### 2.1 Overview

A substantial array of legislation, policies and guidelines apply to the assessment, planning and management of biodiversity values within the Kellyville Precinct. The following table provides an overview of the relevance of the legislation and policy to this report and identifies the stages when the legislation applies (**Table 1**).

**Table 1: Relevant legislation and policy**

Name	Relevance to the project
<b>Commonwealth</b>	
<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Matters of National Environmental Significance have been identified on or near the site in this report. Whilst a rezoning is not defined as an 'action' under the EPBC Act, and therefore a referral to the Commonwealth Department of Environment does not need to occur for the proposed rezoning, subsequent development will need to consider whether a referral is required due to a potential significant impact on Matters of National Environmental Significance.
<b>State</b>	
<i>Environmental Planning and Assessment Act 1979</i> (EP&A Act)	The EP&A Act 1979 provides the statutory basis for a rezoning assessment, and requires assessment of impacts to threatened species and endangered ecological communities. This report identifies native vegetation communities and threatened species listed under the TSC Act, as well as indicative riparian corridor areas, so as to inform the rezoning process for the Precinct as to potential ecological constraints. Information is also provided on the potential ecological impact of the proposed rezoning.
<i>Threatened Species Conservation Act 1995</i> (TSC Act)	The land on which the rezoning is proposed is not biodiversity certified under s126 of the TSC Act and therefore consideration of impacts to threatened species and endangered ecological communities listed under the TSC Act are required.
<i>Fisheries Management Act 1994</i> (FM Act)	The Fisheries Management Act aims to protect fish habitat and threatened species via requiring assessment and approvals of impacts to habitat at the development application stage. Protection of fish habitat is a consideration during the precinct planning or Development Application phase.
<i>Native Vegetation Act 2003</i> (NV Act)	The Native Vegetation Act does not apply in The Hills Local Government Area and therefore is not relevant to the rezoning.
<i>Water Management Act 2000</i> (WM Act)	The Water Management Act aims to protect water resources. Development on waterfront land (land within 40m of a river) will require a Controlled Activity Approval at the development stage unless the works are undertaken by or on behalf of a public authority. The Water Management Act makes provision for strategic approvals on waterfront land, however these have not generally been utilised in precincts other than Turner Road in the South West Growth Centre. Consideration of aquatic habitat values and stability of watercourses is required by the precinct planning process.
<b>Planning</b>	

Instruments	
<i>SEPP 14 Coastal Wetlands</i>	No SEPP 14 wetlands are located within the Precinct.
<i>SEPP 26 – Littoral Rainforests</i>	No SEPP 26 littoral rainforest areas are located within the Precinct.
<i>SEPP 44 Koala Habitat</i>	SEPP 44 does not apply to The Hills or Blacktown local government areas.
<i>The Hills Local Environmental Plan 2012 (Hills LEP)</i>	The Local Environment Plan identifies the currently permitted uses, and that the consent authority must consider potential adverse impacts from proposed development on biodiversity values.
<i>Blacktown Local Environment Plan 2013</i>	The Local Environment Plan identifies the currently permitted uses, and that the consent authority must consider potential adverse impacts from proposed development on biodiversity values.
<i>Cumberland Plain Recovery Plan</i>	This document is a plan prepared under the TSC Act 1995 to address multiple endangered ecological communities and species found within the Cumberland Plain. No Priority Conservation Areas have been identified within the Precinct. The Recovery Plan also has as a principle that where impacts on threatened species, populations and ecological communities cannot be avoided, that they should be offset using appropriate means.

## 3 Methods

### 3.1 Literature review – terrestrial and aquatic values

A desktop literature review was conducted to determine the location and extent of previous known field surveys, to identify the known constraints within the precinct and evaluate the presence and likelihood of occurrence of threatened species, populations and ecological communities listed under both the TSC Act and EPBC Act within the precinct. The following documentation and data was reviewed;

- Topographic maps, digital elevation models and aerial photography of the study area.
- Database searches of NSW OEH Wildlife Atlas and EPBC online Protected Matters.
- Western Sydney Vegetation Mapping (NPWS 2002a) and Western Sydney Condition and Conservation Significance Mapping (NPWS 2002b).
- The Hills Shire Council vegetation mapping (THSC 2012).
- Cumberland Plain Recovery Plan (DECCW 2011).
- North West Rail Link Ecological Assessment (ELA 2012).
- North West Rail Link Kellyville Draft Structure Plan (2014).
- Relevant 1:25,000 topographic maps.

#### 3.1.1 North West Rail Link Ecological Assessment

Terrestrial and aquatic ecological assessment reports were conducted for the North West Rail Link (NWRL) to inform two Environmental Impact Statements. The assessments involved both desktop and field investigations of terrestrial and riparian ecological values within the study area. The reports assessed the direct impacts (all native vegetation within the construction footprint), and indirect impacts (e.g. light, noise) within the study area that were likely to occur as a result of the proposed works. The NWRL study area included areas within and outside the North West Growth Centres. The study area of the NWRL report that is relevant to this assessment is overlaid on the Final Structure Plain and shown in **Figure 2**.

A total of 30.87 ha (12.16 ha within the North West Growth Centres) of direct impacts on vegetation communities were identified from the NWRL project, including impacts to five listed ecological communities:

- Blue Gum High Forest
- Cumberland Plain Woodland
- River Flat Eucalypt Forest
- Shale Sandstone Transition Forest
- Sydney Turpentine-Ironbark Forest.

Two of the listed ecological communities, Cumberland Plain Woodland (6.32 ha) and River-flat Eucalypt Forest (7.09 ha) were identified within the Kellyville Precinct.

A number of threatened and migratory fauna were identified as potentially occurring, and impacts on these species were assessed. The majority of these fauna utilise native vegetation as habitat. However, potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) and Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) includes man-made features such as dams, ponds and culverts.

An offset strategy was prepared to offset the loss of native vegetation (endangered ecological communities) and threatened species habitat which could not be avoided or mitigated.

### 3.1.2 The Hills Shire Council vegetation mapping

The 2012 version of The Hills Shire Council vegetation mapping (THSC 2012) has been supplied for this project and used to inform the ecological constraints assessment. This mapping has been updated from the original 2005 vegetation mapping and is supported by a report prepared by AES Environmental Consultancy (AES 2001).

The vegetation mapping is a project that represents the second phase of The Hills Shire Council Natural Asset Assessment Program. This Program is aimed at addressing the ecologically sustainable development provisions and legislative requirements. The project seeks to identify the plant communities occurring in the Shire and their distribution with particular reference to threatened ecological communities listed under the TSC Act.

The Hills Shire Council vegetation mapping incorporates aerial photography, vegetation/bushland cover and field survey work. The mapping identifies a variety of vegetation types across the Hills Shire, including endangered ecological communities.

### 3.1.3 Likelihood of occurrence

**Appendix A** identifies the threatened species returned by the NSW OEH Bionet Atlas database and EPBC online Protected Matters database searches (based on a 10 km radius from the Precinct) together with an assessment of the likelihood of occurrence for each species.

Each species likely occurrence was informed through a desktop assessment by incorporating the number of records for the species in the area, habitat availability based on previous vegetation mapping, knowledge of the species' ecology and professional judgement. The likelihood of occurrence was conducted using a conservative approach in the absence of being able to validate the presence of habitat types within the Precinct. Therefore, habitat was assumed to be present if habitat features were likely to occur within the mapped vegetation community.

Five terms for the likelihood of occurrence of species are used in this report. The terms for likelihood of occurrence are defined below:

- “known or recorded” = the species has been observed on the site or a data point from the NSW Wildlife Atlas data exists within the Precinct.
- “likely” = a medium to high probability that a species uses the site.
- “potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur.
- “unlikely” = a very low to low probability that a species uses the site.
- “no” = habitat on site and in the vicinity is unsuitable for the species.

### 3.1.4 Cumberland Plain Recovery Plan

The Cumberland Plain Recovery Plan has been developed to provide for the long-term survival and protection of the threatened biodiversity of the Cumberland Plain (DECCW 2011). The document defines a number of ‘priority conservation lands’ that are to be actively managed for conservation. No priority conservation lands have been mapped within the precinct (DECCW 2011). To be consistent with the Cumberland Plain Recovery Plan, any ecological offsets that may be required for impacts associated with the Precinct re-zoning, should be provided within priority conservation areas.



### 3.2 Terrestrial ecology assessment

Field surveys were undertaken as part of the North West Rail Link Ecological Assessment to validate part of the vegetation mapping within the Kellyville Precinct. This represents approximately 53.3 ha of the Precinct and is identified in **Figure 2**. No other site inspections have been undertaken.

Existing vegetation mapping has been used to determine the presence and extent of the vegetation communities within the remainder of the Precinct (outside of the North West Rail Link study area).

Therefore, the vegetation mapping used to inform this report in priority order includes:

- North West Rail Link Ecological Assessment (ELA 2012).
- The Hills Shire Council Vegetation Mapping (THSC 2012).
- Western Sydney vegetation mapping of the Cumberland Plain (NPWS 2002).

### 3.3 Aquatic and riparian assessment

The riparian categorisation and corridor mapping has been carried out in accordance with the Strahler stream order methodology. This was conducted using the field validated riparian assessment for the North West Rail Link study area, and as a desktop assessment of existing streams for the remainder of the Precinct. The desktop assessment component was based on all 'blue lines' appearing on the 1:25,000 topographic map series. Drainage lines that were not classified in this assessment are deemed to be of limited riparian value, or do not meet the definition of a river, and are therefore suitable for engineered drainage solutions.

The key outcome of this assessment is to classify watercourses within the Precinct and to identify the required riparian corridor widths. Riparian corridor requirements in accordance with the NSW Office of Water (NOW) controlled activity guidelines for Riparian Corridors are outlined below in **Table 2**.

**Table 2: NOW riparian categories and buffer specifications**

Watercourse type	Vegetation Riparian Zone width (each side of watercourse)	Total riparian corridor width (minimum indicative width)
1 <sup>st</sup> order	10 metres	20 m + channel width (where available)
2 <sup>nd</sup> order	20 metres	40 m + channel width (where available)
3 <sup>rd</sup> order	30 metres	60 m + channel width (where available)
4 <sup>th</sup> order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width (where available)

The guidelines require the riparian corridor to incorporate the Vegetation Riparian Zone measured from the Top of Bank, plus the width of the channel. The Vegetated Riparian Zone contains the areas formerly referred to as the core riparian zone and the vegetated buffer. Top of Bank data and field surveys have only been conducted within the North West Rail Link study area. Thus, the calculated riparian corridor provided in **Table 2** was designated using the middle of the channel for the majority of

the Precinct (outside of North West Rail Link study area), and should be considered only as an indicative minimum width.

### **3.4 Assessment limitations**

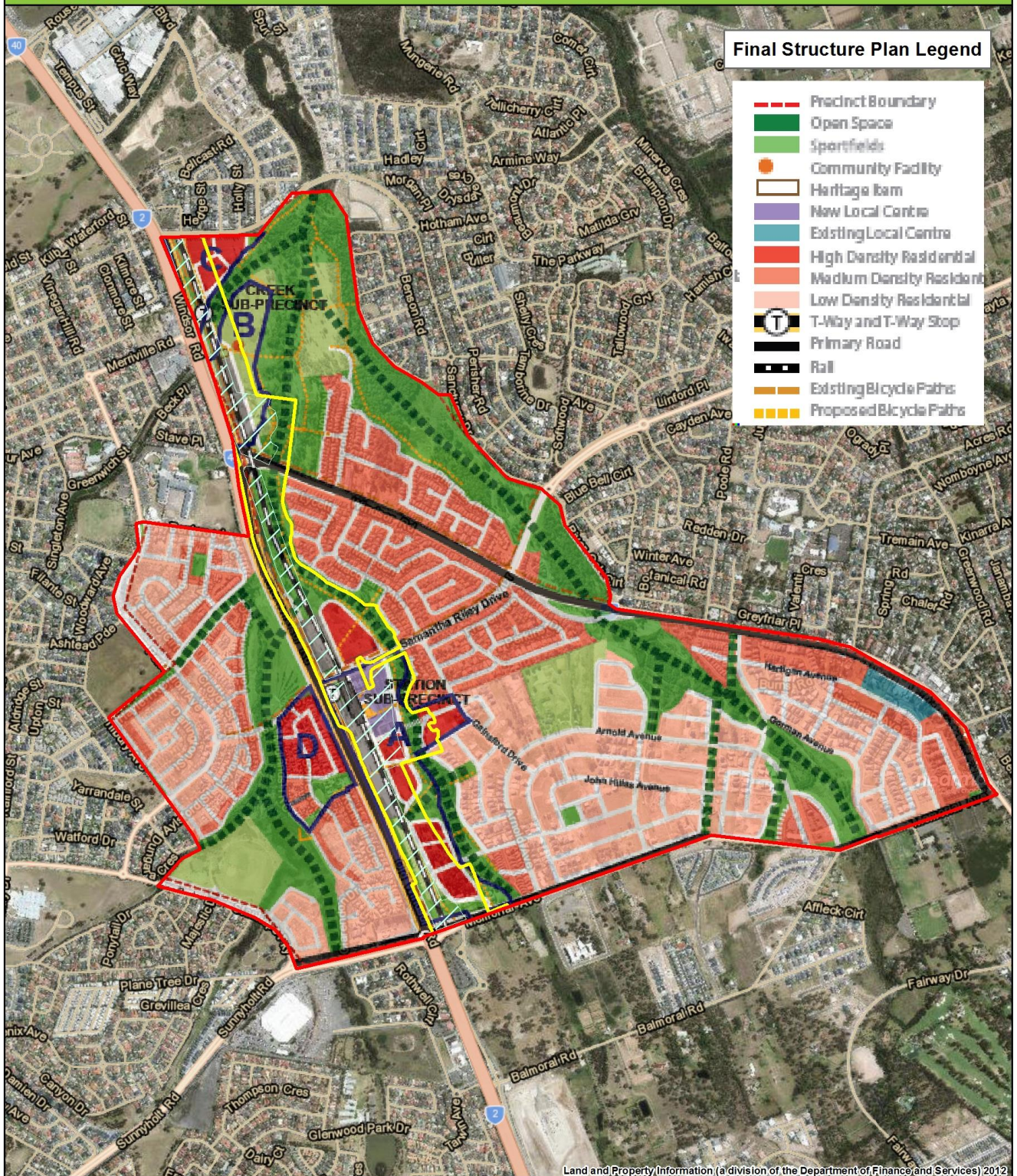
As noted above, only part of the study has been field validated. No field investigations were undertaken as part of this study (refer to **Section 3.2**). Therefore, the assessments used to inform this report were conducted using a combination of previous vegetation mapping, GIS techniques, site inspections, knowledge of previous surveys and professional judgement.

Ecological communities identified to be present within the precinct occur across the Cumberland Plain and regularly intergrade into one another, creating an ecotone between adjacent communities. The ability to determine where one community finishes and the other community starts can be very difficult. This difficulty is increased in disturbed areas, such as those dominated by exotic grasses, where grazing is present and where clearing of overstorey species has occurred (clearing of overstorey may have been selective). For the purposes of this report, the boundaries defined by the previous vegetation mapping were predominately used to determine the extent of the communities when they occurred adjacent to one another, unless obvious changes were observed.

Threatened ecological communities were mapped where appropriate, according to both TSC Act and EPBC Act definitions, as these definitions can differ under each Act. For Cumberland Plain Woodland, some areas of vegetation that meet the TSC Act definitions may not meet EPBC Act definitions due to patch size, vegetation condition or native / exotic understorey dominance. The EPBC Act definition of Cumberland Plain Woodland also includes Shale Gravel Transition Forest. It contains more stringent criteria to meet the listing definition and requires field validation, such as patch size requirements, minimum project foliage cover, the dominance (or near dominance) of native perennial vegetation in the understorey.



## Final Structure Plan



### Legend

- Kellyville Precinct
- North West Rail Link Study Area (ELA)
- North West Rail Link Footprint
- Opportunity Sites

0 200 400 800  
Metres  
Datum/Projection:  
GDA 1994 MGA Zone 56

N  
**eco logical**  
AUSTRALIA  
www.ecoaus.com.au  
Prepared by: MW Date: 01/09/2015

Figure 2: Assessment locations within Kellyville Precinct



## 4 Description of existing biodiversity values

### 4.1 Vegetation communities

The Precinct is currently dominated by a combination of residential, employment and open space zones. Remnant vegetation is primarily associated with the riparian corridors and open space areas in the north and east of the Precinct.

A total of three vegetation community types have been mapped within the Precinct. Of these, two are listed under the *NSW Threatened Species Conservation Act* (TSC Act) and/or *Commonwealth Environment Protection and Biodiversity Conservation Act* (EPBC Act). The typical characteristics and extent of the vegetation communities within the Precinct are presented in **Figure 3** and summarised in **Table 4**.

#### 4.1.1 Cumberland Plain Woodland

Cumberland Plain Woodland is a Critically Endangered Ecological Community listed under both the TSC and EPBC Acts. There are two sub-communities of Cumberland Plain Woodland, being Shale Plains Woodland and Shale Hills Woodland. The species compositions of both sub-communities are similar, and it is their position in landscape that predominantly determines whether an area is classified as Shale *Plains* or Shale *Hills* Woodland. Both sub-communities are equally protected under legislation and are referred to as Cumberland Plain Woodland in this report.

Cumberland Plain Woodland occurs on soils derived from Wianamatta Shale throughout the driest part of the Sydney Basin. Good examples can be seen at Scheyville National Park and Mulgoa Nature Reserve. The typical dominant canopy trees of Cumberland Plain Woodland are *Eucalyptus moluccana* (Grey Box) and *Eucalyptus tereticornis* (Forest Red Gum), with *Eucalyptus crebra* (Narrow-leaved Ironbark), *Corymbia maculata* (Spotted Gum), and *Eucalyptus eugenioides* (Thin-leaved Stringybark) occurring less frequently. The shrub layer is dominated by *Bursaria spinosa* (Blackthorn), and it is common to find abundant grasses such as *Themeda australis* (Kangaroo Grass) and *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass) (DECC 2005).

Cumberland Plain Woodland is the most widely distributed community on the Cumberland Plain, predominantly occurring on soils derived from Wianamatta Shale. It is listed as a Critically Endangered Ecological Community as most of the vegetation has either been cleared, or is disturbed and heavily impacted. The majority of Cumberland Plain Woodland within the precinct is likely to be in a poor condition with a scattered overstorey present and an understorey dominated by weeds and/or exotic grasses. However, some larger stands of Cumberland Plain Woodland representing good quality native vegetation maybe present and may meet the EPBC listing criteria for Cumberland Plain Woodland.

The NSW (TSC Act) and Commonwealth (EPBC Act) criteria of what vegetation and condition categories meet the respective definitions have substantial differences. The EPBC Act listing includes two vegetation types, Cumberland Plain Woodland and Shale Gravel Transition Forest, which are listed as separate entities under the TSC Act. However the EPBC Act listing has much stricter condition criteria than the TSC Act, which includes a very broad range of condition states.

A total of 7.48 ha of Cumberland Plain Woodland listed under the TSC Act have been indicatively mapped within the Kellyville Precinct (**Figure 3**). No EPBC Act Cumberland Plain Woodland has been confirmed within the Precinct.

EPBC Act Cumberland Plain Woodland Condition Criteria

Under the EPBC Act, vegetation characteristics and the assigning of condition classes based on quantitative information were introduced to the listing criteria (Table 3). With regard to the EPBC Act criteria, the amount of Cumberland Plain Woodland could not be confirmed within the Kellyville NWRL study area, as no field validation has been undertaken (**Figure 3**).

**Table 3: EPBC categories and thresholds for Cumberland Plain Woodland.**

Category and Rationale	Thresholds
A. Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.	Minimum patch <sup>1</sup> size is $\geq 0.5$ ha; <b>AND</b> $\geq 50\%$ of the perennial understorey vegetation cover <sup>2</sup> is made up of native species.
<b>OR</b>	
B. Larger patches which are inherently valuable due to their rarity.	The patch size is $\geq 5$ ha; <b>AND</b> $\geq 30\%$ of the perennial understorey vegetation cover is made up of native species.
<b>OR</b>	
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is $\geq 0.5$ ha; <b>AND</b> $\geq 30\%$ of the perennial understorey vegetation cover is made up of native species; <b>AND</b> The patch is contiguous <sup>3</sup> with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is $\geq 5$ ha in area.
<b>OR</b>	
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is $\geq 0.5$ ha in size; <b>AND</b> $\geq 30\%$ of the perennial understorey vegetation cover is made up of native species; <b>AND</b> The patch has at least one tree with hollows per hectare or at least one large tree ( $\geq 80$ cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A.

<sup>1</sup> A *patch* is defined as a discrete and continuous area that comprises the ecological community, outlined in the Description. Patches should be assessed at a scale of 0.04 ha or equivalent (e.g. 20m x 20m plot). The number of plots (or quadrats or survey transects) per patch must take into consideration the size, shape and condition across the site. Permanent man-made structures, such as roads and buildings, are typically excluded from a patch but a patch may include small-scale disturbances, such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community, for instance the easy movement of wildlife or dispersal of spores, seeds and other plant propagules.

<sup>2</sup> Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers (as outlined in the Description and Appendix A) with a life-cycle of more than two growing seasons (Australian Biological Resources Study, 2007). Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, leaf litter or exposed soil (although these are included in a patch of the ecological community when they do not alter functionality as per footnote 3 and the Description and Condition Thresholds are met).

<sup>3</sup> Contiguous means the woodland patch is continuous with, or in close proximity (within 100 m), of another patch of vegetation that is dominated by native species in each vegetation layer present.

**Source:** DEWHA (2009a) Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on an Amendment to the List of Threatened Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

### TSC Act Cumberland Plain Woodland Condition Criteria

Cumberland Plain Woodland under the TSC Act includes patches that are dominated by introduced species if a native canopy is present (containing characteristic species), or have identified minimum thresholds for the cover of native perennial understorey vegetation. Under the TSC Act, 'Derived Native Grassland' is also included as a component of the listed community. This means that areas of native grassland that were likely to have been Cumberland Plain Woodland in the past, but currently exist in the absence of an overstorey, are part of the community.

With regard to the TSC Act criteria, derived native grasslands could not be confirmed within the precinct.

#### **4.1.2 River-Flat Eucalypt Forest**

*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and Southeast Corner Bioregions* (River-Flat Eucalypt Forest) is listed as an endangered ecological community under TSC Act. River-Flat Eucalypt Forest is not listed under the EPBC Act.

The vegetation community has a tall open tree layer of eucalypts, which may exceed 40m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. It generally occurs on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (OEH 2014b).

The composition of species within the community can vary considerably. However, the most widespread and abundant canopy species trees include *Eucalyptus tereticornis*, *Eucalyptus amplifolia* (cabbage gum), *Angophora floribunda* (Rough-barked Apple) and *Angophora subvelutina* (broad-leaved apple). A layer of small trees and shrubs may be present in a typical good condition stand, including *Melaleuca decora*, *Melaleuca styphelioides* (Prickly-leaved Teatree) species, *Backhousia myrtifolia* (Grey Myrtle), *Melia azedarach* (White Cedar), *Casuarina cunninghamiana* (River Oak), and *Casuarina glauca* (Swamp Oak), *Bursaria spinosa*, *Breynia oblongifolia* (Coffee Bush), *Ozothamnus diosmifolius* (White Dogwood), *Acacia floribunda* (White Sally Wattle) and *Phyllanthus gunnii* (Shrubby Spurge). Within a typical undisturbed stand the groundcover is composed of abundant forbs, scramblers and grasses, including *Microlaena stipoides* var *stipoides*, *Dichondra repens*, *Glycine clandestina*, *Oplismenus aemulus*, *Desmodium gunnii*, *Pratia purpurascens*, *Entolasia marginata*, *Oxalis perennans*, and *Veronica plebeia*. The understorey is highly influenced by disturbances and hydrological factors and is usually composed of forbs, scramblers and grasses (OEH 2014b).

Most occurrences of this community are associated with drainage lines and represent degraded vegetation. Most areas have been historically cleared and disturbances can be present right up to the edge of the drainage line, contributing to high occurrences of exotic species and bank modification.

A total of 34.48 ha of River-Flat Eucalypt Forest have been mapped within the Precinct (**Figure 3**).

#### **4.1.3 Planted and modified vegetation**

This vegetation does not meet the listing criteria for a threatened ecological community under the TSC or EPBC Acts. This community consists primarily of non-indigenous and/or exotic planted vegetation.

A total of 28.40 ha of gardens and modified vegetation communities have been mapped within the Precinct (**Figure 3**).

#### 4.1.4 Threatened ecological communities area calculations

Areas calculations for each threatened ecological community (bold) within the Precinct are provided below in **Table 4**.

**Table 4: Vegetation communities and their likely condition within Kellyville Precinct**

Vegetation Community and condition	Total (ha)
<b>Cumberland Plains Woodland (TSC Act)</b>	<b>7.48</b>
<b>River-flat Eucalypt Forest (TSC Act)</b>	<b>34.48</b>
Other – Planted / modified vegetation (non-listed)	28.40



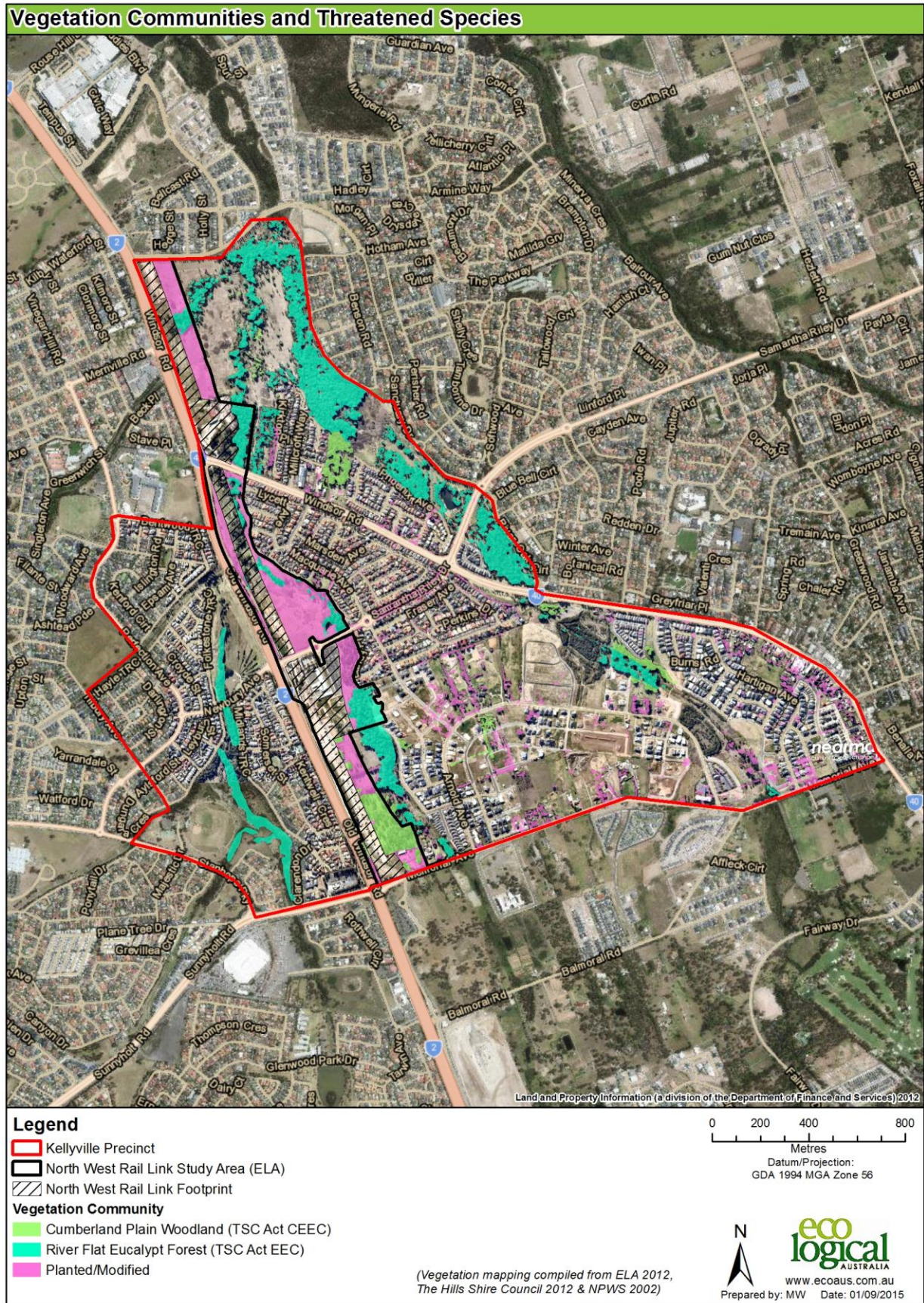


Figure 3: Vegetation communities



## 4.2 Flora and fauna species

### 4.2.1 Threatened flora

No threatened flora species listed under the TSC and/or EPBC Act was identified as having a previous recent record (NSW Wildlife Atlas) within the Precinct. Seven species were assessed as having a potential or likely occurrence within the Precinct (**Table 5**). The threatened flora identified and their potential habitat has been incorporated in the ecological constraints assessment undertaken in **Section 5**.

**Table 5: Threatened flora with a potential or likely occurrence within the precinct**

Threatened flora	Likelihood of occurrence
<i>Acacia pubescens</i> (Downy Wattle)	Potential
<i>Darwinia biflora</i>	Potential
<i>Dillwynia tenuifolia</i>	Potential
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	Potential
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Potential
<i>Pimelea curviflora</i> var. <i>curviflora</i>	Potential
<i>Pimelea spicata</i> (Spiked Rice-flower)	Potential

### 4.2.2 Threatened fauna

Five threatened fauna species (Cattle Egret, Eastern Bent-wing Bat, Eastern False Pipistrelle, Eastern Freetail Bat and Grey-headed Flying-fox) listed under the TSC and/or EPBC Act was identified as having a previous recent record (NSW Wildlife Atlas) within the Precinct. Another twelve species (mostly birds and bats) were assessed as having a potential or likely occurrence within the Precinct (**Table 6**). The relative abundance of the threatened fauna identified and their potential habitat has been incorporated in the ecological constraints assessment undertaken in **Section 5**.

It should be noted that the majority of threatened fauna species that are likely to occur or that have potential to occur within the Precinct are highly mobile and utilise a large foraging habitat. Habitat for these highly mobile species is likely to extend outside of the Precinct.

**Table 6: Threatened fauna with a potential or likely occurrence within the precinct**

Threatened flora	Likelihood of occurrence
Cattle Egret ( <i>Ardea ibis</i> )	Previous record (NSW Wildlife Atlas)
Eastern Bent-wing Bat ( <i>Miniopterus schreibersii</i> )	Previous record (NSW Wildlife Atlas)
Eastern False Pipistrelle ( <i>Falsistrellus tasmaniensis</i> )	Previous record (NSW Wildlife Atlas)
Eastern Freetail Bat ( <i>Mormopterus norfolkensis</i> )	Previous record (NSW Wildlife Atlas)
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	Previous record (NSW Wildlife Atlas)
Cumberland Plain Land Snail ( <i>Meridolum corneovirens</i> )	Likely
Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )	Likely
Southern Myotis ( <i>Myotis macropus</i> )	Likely
Green and Gold Bell Frog ( <i>Litoria aurea</i> )	Potential
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	Potential

Little Lorikeet ( <i>Glossopsitta pusilla</i> )	Potential
Swift Parrot ( <i>Lathamus discolor</i> )	Potential
Large-eared Pied Bat ( <i>Chalinolobus dwyeri</i> )	Potential
Little Bent-wing Bat ( <i>Miniopterus australis</i> )	Potential
Yellow-bellied Sheath-tail-bat ( <i>Saccolaimus flaviventris</i> )	Potential
Fork-tailed Swift ( <i>Apus pacificus</i> )	Potential
White-throated Needletail ( <i>Hirundapus caudacutus</i> )	Potential

### 4.3 Aquatic habitat and riparian corridors

The Kellyville Precinct lies within the Caddies Creek, Elizabeth Macarthur Creek and Strangers Creek sub-catchments of the broader Hawkesbury-Nepean Catchment. The Hawkesbury-Nepean River system is the second-largest in NSW and has its headwaters located within largely pristine regions including the Blue Mountains World Heritage Area and Sydney Catchment Authority's lands in the NSW Southern Highlands. These upper reaches provide over 90% of Sydney's drinking water. Once into flatter, floodplain country, the Hawkesbury River flows eastward towards the ocean through rural and semi-rural areas of Western and North-western Sydney. These middle and lower reaches of the system can often be highly impacted and degraded, both directly through waterway modifications and indirectly through adjacent land use practices.

#### 4.3.1 Riparian corridors

Riparian Corridors for corresponding stream orders are mapped in **(Figure 4)**. The watercourses mapped in the Precinct form part of the reaches and tributaries of Caddies Creek, Elizabeth Macarthur Creek and Strangers Creek and represent streams of the first to fourth order.

#### 4.3.2 Aquatic fauna habitat

Database searches were undertaken to identify threatened aquatic species that may occur within the precinct (**Appendix A**). A review of these species that are dependent on in-stream habitat revealed that no aquatic threatened species are likely to occur within the Precinct. Habitat for frogs and birds within the riparian corridors are likely to vary significantly and influenced by historical disturbances.

Regardless of the overall condition (likely to be predominantly degraded), a host of common aquatic species are likely to be present and rely on the health of aquatic habitat for their ongoing survival. Aquatic habitat is an important component of overall ecosystem health and contributes to the diversity and viability of terrestrial habitat.

### 4.4 Noxious weeds

Noxious weeds are a class of plant that are required by law to be controlled by all landholders in the area in which it has been declared noxious. In NSW, noxious weeds are listed under the Noxious Weeds Act for every Local Government Area in the state. Hawkesbury River County Council is the Local Control Authority for The Hills Shire Council and Blacktown City Council. There are 110 declared noxious weeds listed for the Hawkesbury River County Council area (DPI 2014). A number of these noxious weeds are also listed as a Weed of National Significance (WoNS).



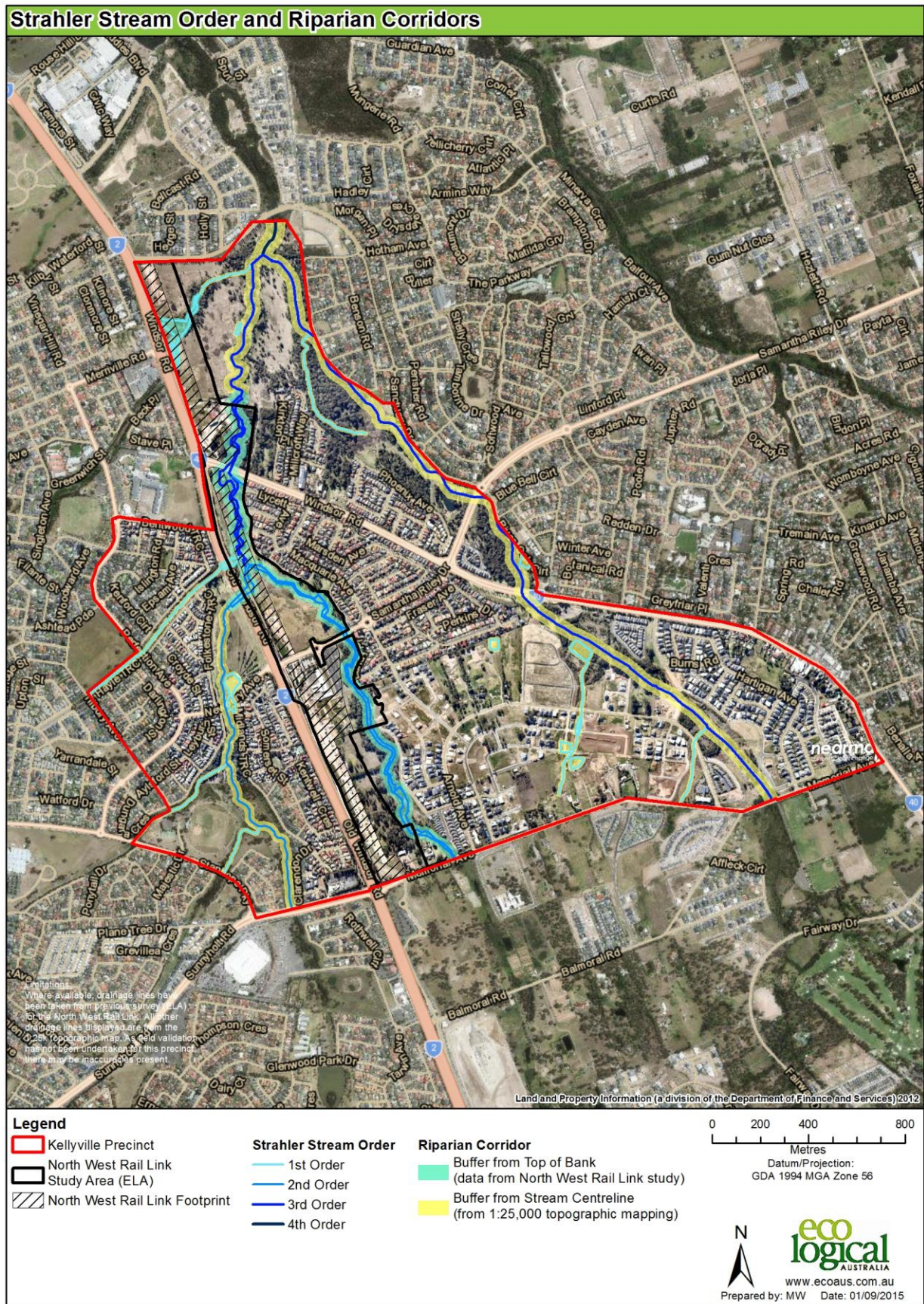


Figure 4: Strahler stream order and corresponding riparian corridors



## 5 Ecological constraints

### 5.1 Ecological constraints assessment

With an ecological constraints assessment vegetation mapping is usually combined with any site inspection data (such as on the potential for ecological recovery of sites), and threatened species information. Other data, such as riparian zones, or areas identified for ecological connectivity, may also be combined into an ecological constraints assessment to determine the relative level of ecological value or constraint across a site.

Given that this assessment has limited field data a simplified approach to an ecological constraints assessment was used for this report. Constraint mapping was based on:

- Mapped vegetation communities and their legislative status,
- Records of threatened flora species, and
- Mapped riparian corridors.

Three categories of conservation significance were used to represent the relative ecological constraints across the site; high ecological value, moderate ecological value and low ecological value. These areas are shown on **Figure 5** and represent areas of priority conservation.

#### 5.1.1 High ecological value

Areas of high ecological value are mapped due to the following characteristics:

- All vegetation listed as a Critically Endangered Ecological Community or Endangered Ecological Community under the TSC and/or EPBC Act, irrespective of condition. For the Kellyville Precinct this was Cumberland Plain Woodland and River-flat Eucalypt Forest.
- Records of threatened flora species plus an indicative 25m buffer.
- Mapped riparian buffers for third or higher order watercourse under the Strahler Stream Order classification.

#### 5.1.2 Moderate ecological value

Areas of moderate ecological value are mapped due to the following characteristics:

- Listed as a Vulnerable Ecological community under the TSC and/or EPBC Act.
- Any other remnant non-listed native vegetation of any condition.
- Mapped riparian buffers for first or second order watercourses under the Strahler Stream Order classification.

#### 5.1.3 Low ecological value

Areas of low ecological value are mapped due to the following characteristics:

- Planted / modified vegetation.

#### 5.1.4 Discussion of Outcomes

The high ecological constraints mapped in **Figure 5** are primarily associated with the listed ecological communities within the Precinct and Strangers Creek and Caddies Creek riparian corridor. The moderate constraints represent the first and second order streams within the Precinct.

It is noted that small isolated patches of listed ecological communities have been mapped as a high constraint. In reality, these small patches are likely to be degraded and would be potentially be assigned to a lower constraints due to their condition. However, taking the simplified approach and due to lack of validation of their condition, they have been mapped according to their legislative status under the TSC and/or EPBC Act and therefore, have been mapped as high.

The presence or likely occurrence of fauna has not been considered directly in the constraints assessment using the simplified approach. Fauna species with a potential, likely or recorded occurrence in the precinct are highly mobile and may require specific habitat features to be present. It is likely these species are associated with the mapped vegetation communities within the Precinct. Therefore, potential constraints in relation to fauna have been assigned based on the vegetation mapping.



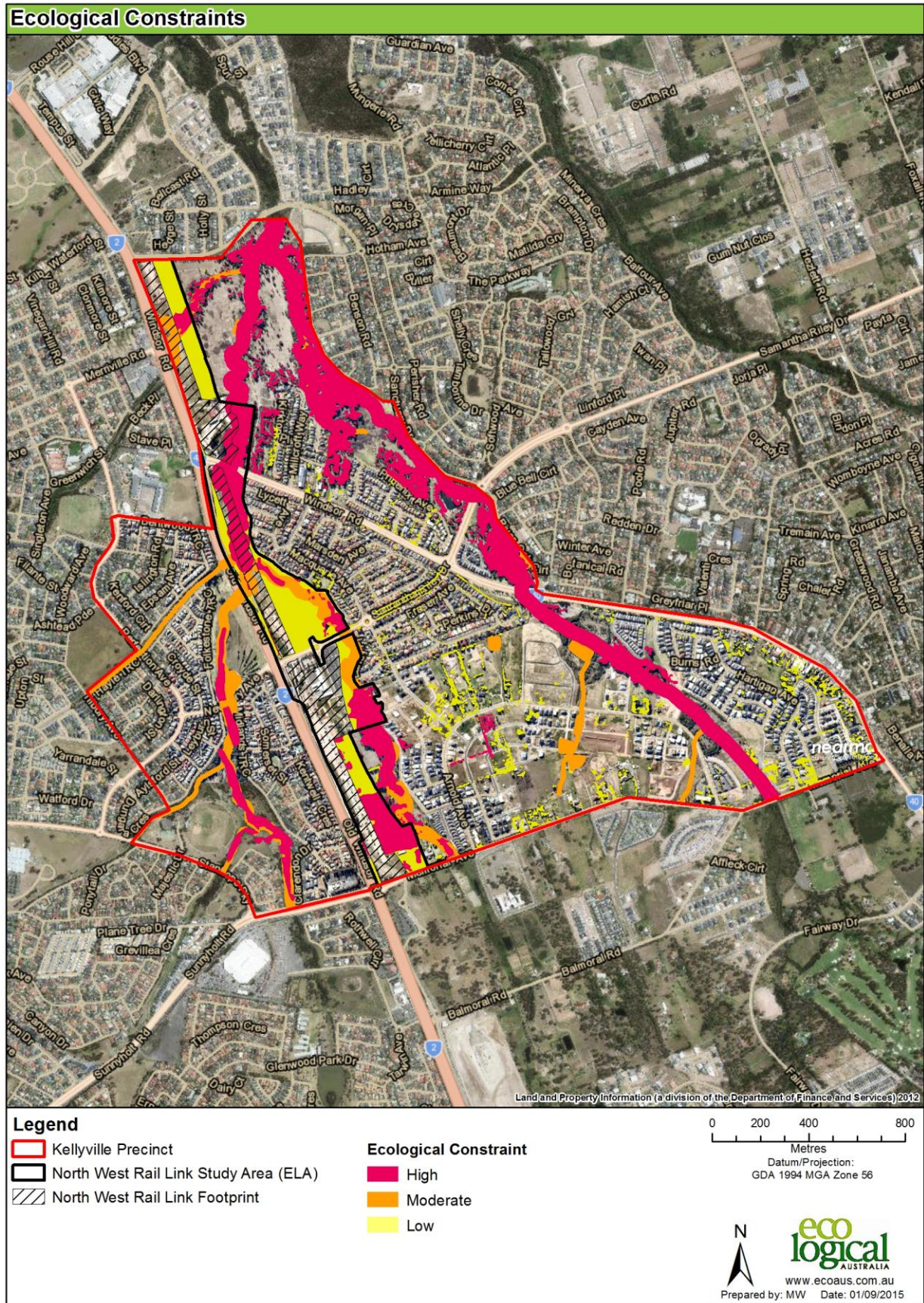


Figure 5: Mapped ecological constraints



## 6 Outcomes and recommendations

### 6.1 Zoning outcomes

A total of 7.48 ha of Cumberland Plain Woodland and 34.48 ha of River-Flat Eucalypt Forest listed under the TSC Act have been mapped within the Precinct (**Figure 3**). Based on field investigations of a small proportion of this area these vegetation communities are likely to be degraded in nature and represent native vegetation that has been modified due to long-term historical disturbances.

No threatened flora listed under the TSC and/or EPBC Act were identified as having a previous recent record within the Precinct. However, seven species may be associated with the listed vegetation communities and were assessed as having a potential or likely occurrence within the Precinct (**Appendix A**). In addition, five threatened fauna species listed under the TSC and/or EPBC Act were identified as having a previous recent record within the Precinct and another twelve species were assessed as having a potential or likely occurrence.

A total of 3.57 ha of Cumberland Plain Woodland and 2.35 ha of River-flat Eucalypt Forest have been identified and mapped as occurring within the proposed opportunity sites (**Table 7** and **Figure 6**). In addition, a total of 1.93 ha of riparian corridor has been mapped as occurring within the proposed opportunity sites (**Table 7** and **Figure 7**).

### 6.2 Impact assessment

The land use zones within each of the opportunity sites have not yet been defined. It is assumed that the opportunity sites will be developed and the amounts of vegetation identified above in **Section 6.1** will be cleared. However, some existing vegetation may be maintained within the proposed parks and pocket parks.

It is estimated that 3.57 ha of Cumberland Plain Woodland listed under the TSC Act may be changed to an urban development zoning and potentially cleared as part of the re-zoning process. Of this total, 3.42 ha was validated as poor condition TSC Act Cumberland Plain Woodland through the NWRL ecological assessment. The remaining 0.15 ha is likely to be consistent with the poor condition vegetation. It is considered likely that the clearing of 3.57 ha of a Critically Endangered Ecological Community (Cumberland Plain Woodland) will lead to a significant impact under a TSC Act Assessment of Significance (7-part test).

The validated Cumberland Plain Woodland did not meet the listing criteria under the EPBC Act.

Up to a total of 2.35 ha of River-flat Eucalypt Forest listed as Endangered under the TSC Act has also been identified as occurring within the proposed opportunity sites for the re-zoning process. It is considered unlikely that the clearing of this amount of River-flat Eucalypt Forest will lead to a significant impact under an Assessment of Significance (7-part test). Much of the mapped ecological community is associated with the riparian corridors within the Precinct. As such, it is likely to be retained through the planning process, or required to be revegetated via Vegetation Management Plan(s) to meet riparian controls under the Water Management Act (refer to **Section 6.3.4**).

**Table 7: Opportunity sites and impact areas**

Constraint	Opportunity sites (ha)				Total	Outside opportunity sites (ha)	Precinct (ha)	% to be impacted within precinct
	A	B	C	D				
Cumberland Plain Woodland	3.57	-	-	-	<b>3.57</b>	3.91	7.48	48%
River-flat Eucalypt Forest	2.22	0.09	0.04	-	<b>2.35</b>	32.13	34.48	6.82%
Riparian Corridor	1.64	0.06	0.23	-	<b>1.93</b>	54.46	56.39	3.42%

Note: The statistics provided in this table for both vegetation communities and riparian corridor areas are based on a combination of field data, where available, and desktop assessment. All areas should therefore be considered to be indicative only as they are subject to change with fieldwork and more detailed assessments.



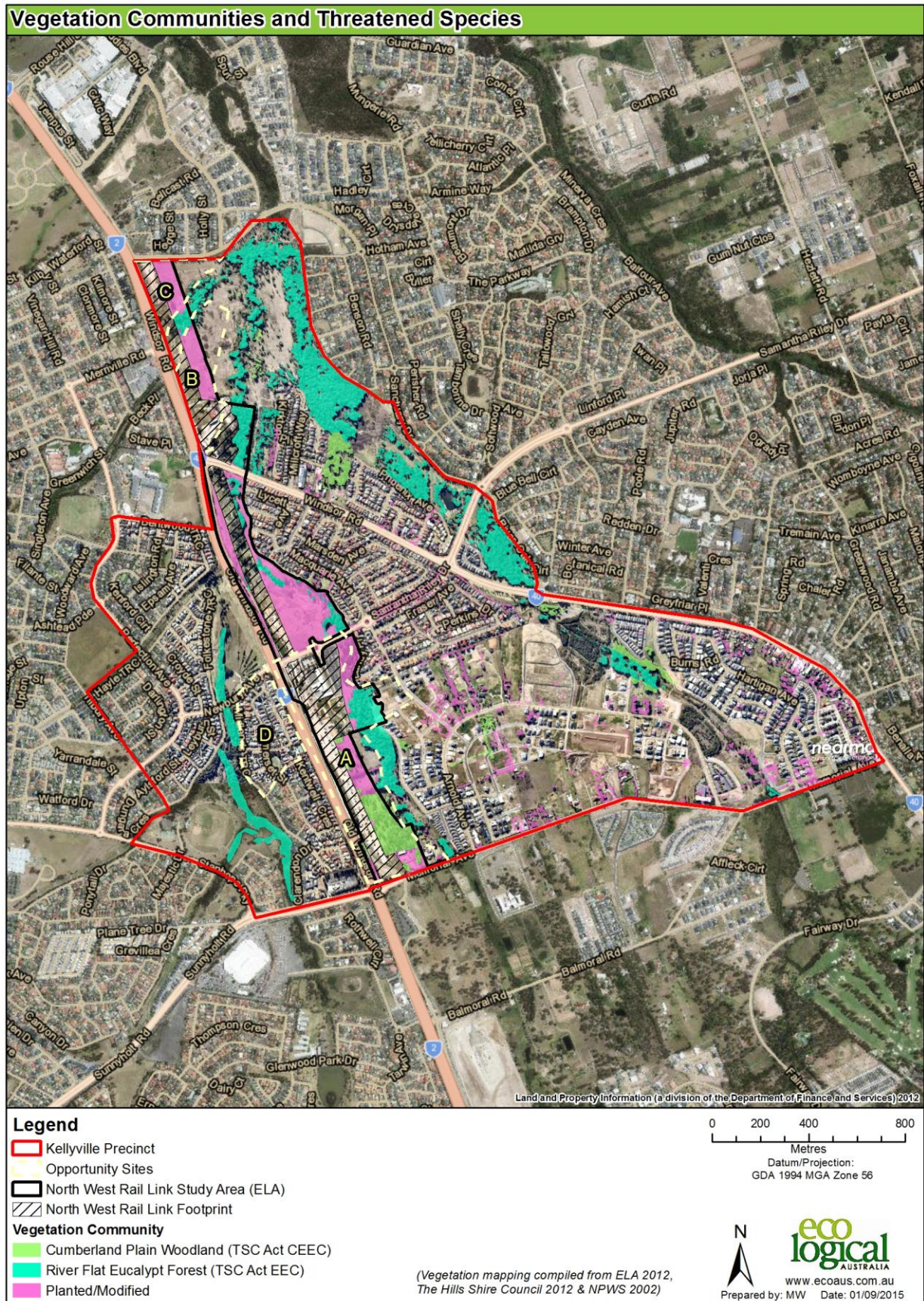


Figure 6: Opportunity sites and vegetation communities



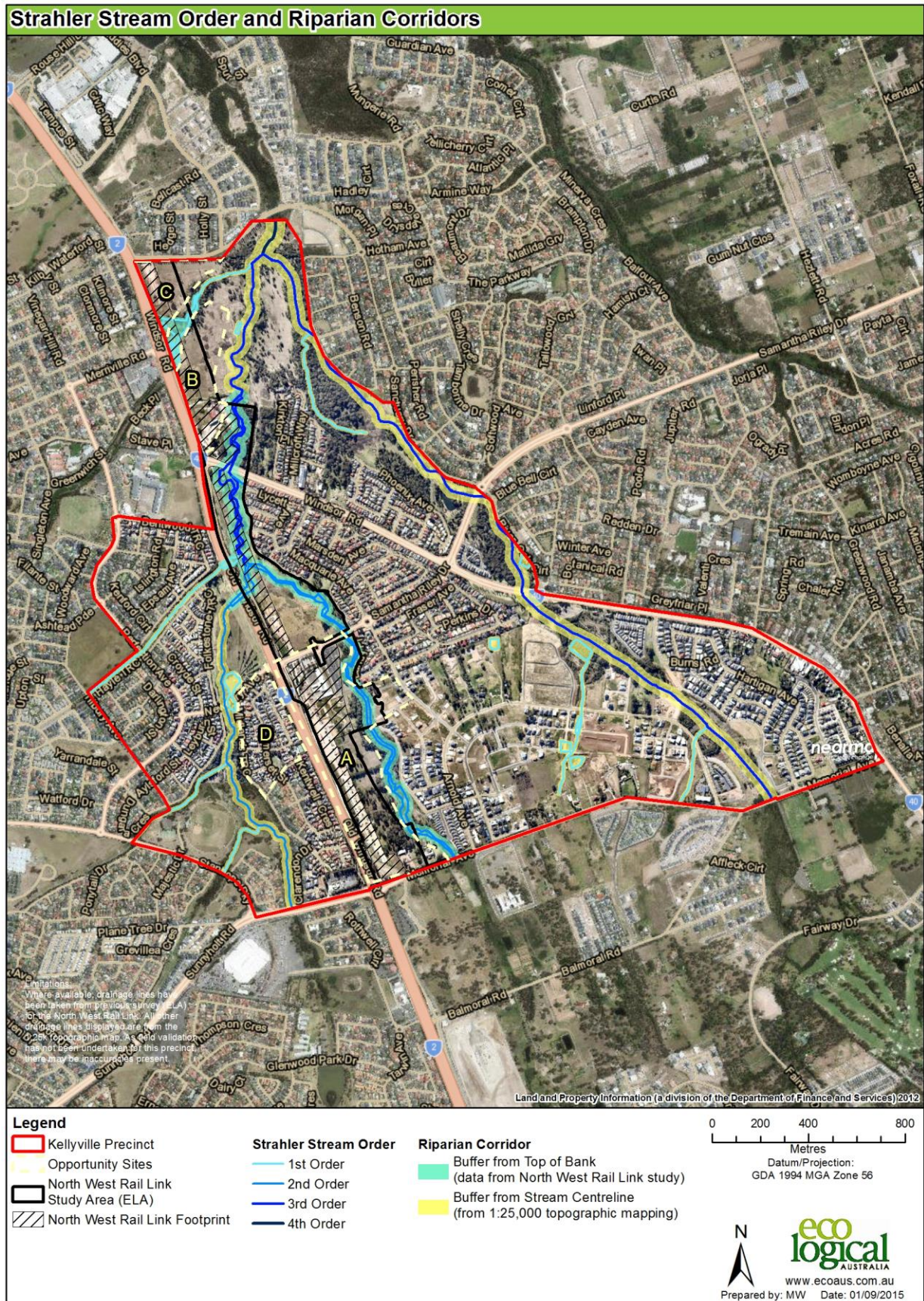


Figure 7: Opportunity sites and riparian corridors



## 6.3 Recommendations

Broad recommendations for the areas within and outside the opportunity areas are provided in the sections below, along with recommendations specific to riparian corridors.

### 6.3.1 Opportunity sites

The ecological communities within the opportunity sites are likely to be degraded due to historical disturbances. However, the sites which meet the listing definition for Cumberland Plain Woodland and River-flat Eucalypt Forest represent areas of high ecological constraint. It is recommended that options to retain these areas are considered, and where possible protected using appropriate development controls consistent with other Precincts Plans in western Sydney.

Recommendations include:

- Consider opportunities to retain vegetation within the opportunity sites. Priority should be given to conservation of larger and better quality areas of Cumberland Plain Woodland, particularly where these are in close proximity to riparian corridors.
- Seek to integrate and link retained vegetation to the riparian corridors within the Precinct (opportunity site C).
- Use of the E2 (Environmental Conservation) zone for areas of high ecological constraint that are to be retained. Other precinct plans have utilised the SP2 (Infrastructure) zone. However, although this has very few permissible land uses, it does not have conservation as an objective, and is therefore less secure than the E2 zone.
- Specify vegetation protection clauses within the Development Control Plan to prevent or minimise vegetation clearing of native vegetation, and identify that endangered vegetation which is not retained, should have ecological offsets (either within or outside of the Precinct).
- Seek to retain and enhance vegetation along Elizabeth Macarthur Creek to improve wildlife connection corridors where possible (opportunity sites A & B).
- Rehabilitate and undertake weed control in areas of retained vegetation to enhance condition where possible.
- Any asset protection zones should not be located within native vegetation that has been retained for conservation.
- Undertake best practice soil erosion control during construction, and maintain as required, to prevent sediment flow.
- Stormwater structures should be located outside of conservation areas.
- Prepare a Vegetation Management Plan to direct the overall rehabilitation of the native vegetation communities that are retained.
- A Riparian Protection Area Map be included within the amended SEPP, and linked to the WM Act in a way that defines waterfront land within the precinct as being limited to the extent of the Riparian Lands identified. It is noted that confirmation of stream locations and Top of Bank may be a condition for areas of identified Riparian Lands.

### 6.3.2 Outside opportunity sites

Similar to the opportunity sites, the listed ecological communities are likely to be degraded due to historical disturbances and dominance of exotic species in the understorey. However, sites which contain remnant Cumberland Plain Woodland and River-flat Eucalypt Forest vegetation represent areas of high ecological constraint. It is recommended that options to retain these areas as well as riparian corridors are considered wherever possible. Areas retained may potentially be able to serve as ecological offsets to vegetation impacted upon within the opportunity sites (subject to the degree of

conservation security and management to be delivered, and an appropriate mechanism for these sites to be used as offsets).

### 6.3.3 Land ownership

#### *Terrestrial*

Land ownership and degree of fragmentation of ownership can have a significant bearing on the protection and management of terrestrial ecological values. Highly fragmented lands are often poorly managed because of a lack of co-ordination between landowners, a lack of motivation to manage the land; and a higher cost of management for smaller sites.

Where opportunities exist, it is recommended that areas to be conserved are managed in a single ownership. The main opportunities are the riparian corridors and the stands of native vegetation within the central and north-east portions of the Precinct. It is recommended that ownership or stewardship options be explored including:

- Local government.
- Third party such as the Western Sydney Parklands Trust or other organisations that may express an interest in taking responsibility for management.

Under the above options for retained areas of high and moderate ecological constraint, it is recommended that a Vegetation Management Plan is prepared and costed. The developer of the adjoining land would then either undertake the initial management and then hand over responsibility (and if necessary funds) to another organisation, or they would deposit sufficient funds in a trust account for management.

#### *Riparian corridors*

Where it can be achieved, riparian corridors should be in public ownership, which would increase the likelihood of achieving consistent environmental outcomes, and provide integrated uses and access for the community.

Furthermore, where possible, drainage and detention structures should be owned and managed by The Hills Shire Council or Blacktown Council. These areas can then be revegetated and managed as a naturalised feature. It is assumed that in accordance with the WM Act, a Vegetation Management Plan will be required and prepared to the satisfaction of NOW and relevant Council for future development applications which impact on these areas.

Where public ownership cannot be achieved, consideration of suitable zoning and planning controls should be made in order to facilitate appropriate riparian land management outcomes.

### 6.3.4 Riparian corridors

It is recommended that future urban development considers the provision of good quality instream habitat, longitudinal connectivity and fringing riparian vegetation. In addition, erosion and sediment control should be a key requirement during construction, and Water Sensitive Urban Design (WSUD) principles applied to help protect downstream environments.

The controlled activity guidelines do not encompass specific planning controls. However, they do contain objectives and a guide to works and activities generally allowable on waterfront land. The overarching objective of controlled activity provisions of the WM Act is to establish and preserve the integrity of riparian corridors. Ideally, the environmental functionality of riparian corridors should be restored and maintained by applying the following principles:

- Seek to maintain or recreate a riparian corridor / vegetated riparian zone with fully structured native vegetation in accordance with the riparian corridor requirements (**Table 8**).
- Seek to minimise disturbance and harm to the recommended riparian corridor / vegetated riparian zone.
- Minimise the number of creek crossings and provide a perimeter road separating development from the riparian corridor / vegetated riparian zone.
- Locate infrastructure and services outside the riparian corridor / vegetated riparian zone.
- Where services or infrastructure are located within riparian corridors, co-locate facilities in one concentrated area to minimise overall disturbance and breaks in corridor continuity.
- Treat stormwater runoff before discharging it into the riparian corridor.

NOW does allow for a range of works and land uses within the outer (landward) edge of riparian corridors so long as they have minimal environmental harm. Activities which may be permissible are presented in **Table 8**. The following principles are contained within the NOW guidelines and are to be considered in conjunction with the matrix presented in **Table 8**.

- Riparian Corridor offsetting for non-riparian corridor uses: Non-riparian uses, such as Asset Protection Zones are allowed in the outer 50% of the vegetated riparian zone, so long as offsets are provided in accordance with the averaging rule (**Figure 8**).
- Cycleways or pedestrian paths no wider than 4m (total disturbance footprint) can be built in the outer 50% of the vegetated riparian zone.
- Detention Basins can be built in the outer 50% of the vegetated riparian zones or online (where indicated in the NOW Controlled Activity Guidelines for a) Outlet structures and b) Instream work. Online basins must:
  - Be dry and vegetated.
  - Be for temporary flood detention only with no permanent water holding.
  - Have an equivalent vegetated riparian zone for the appropriate watercourse order.
  - Not be used for water quality treatment purposes.
- Stormwater outlet structures and essential services are allowed in the riparian corridor. Works for essential services on a 4<sup>th</sup> order or greater stream are to be undertaken by directional drilling or tied to existing crossings (refer to NOW Controlled Activity Guidelines for a) Laying pipes and cables in watercourses and b) Outlet Structures).
- Stream alignment indicates that a watercourse may be re-aligned (refer to NOW Controlled Activity Guidelines for Instream Works).
- Road Crossings indicates permitted road crossing methods (refer to NOW Controlled Activity Guidelines for Watercourse Crossings and DPI (Fisheries) Policy and Guidelines for Fish Friendly Waterway Crossings for Class 1 and 2 Waterways).

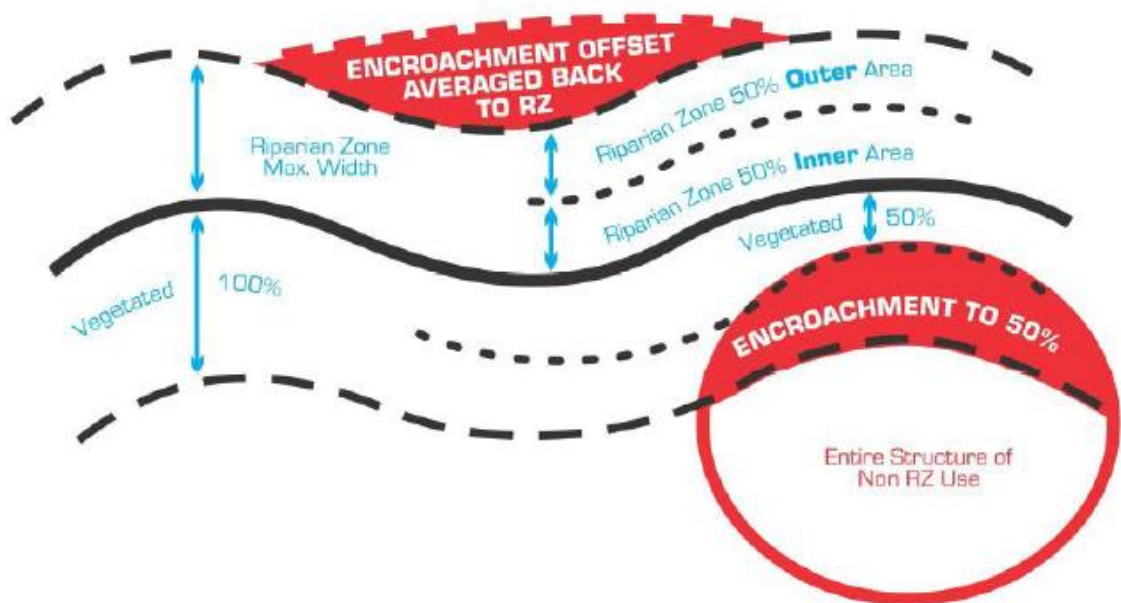
Works not associated with the establishment and maintenance of riparian corridors can be authorised within the outer riparian corridor, provided that the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate, 50% of the outer vegetated riparian zone width may be used for non-riparian uses provided that an equivalent area is offset on site and is connected to the riparian corridor vegetation. The inner 50% of the vegetated riparian zone is required to be fully protected and vegetated with native endemic riparian species, and satisfy the minimum area requirements to maintain bed and bank stability.



**Table 8: NOW riparian corridor matrix**

Requirements & allowable uses	Stream order			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup> +
Vegetated Riparian Zone (VRZ) Width	10 m each bank	20 m each bank	30 m each bank	40 m each bank
Riparian Corridor Offsetting for Non-Riparian Corridor uses	✓	✓	✓	✓
Cycleways and Pathways	✓	✓	✓	✓
Detention Basins				
• Only within outer 50% VRZ	✓	✓	✓	✓
• Online	✓	✓		
Stormwater Outlet Structures & Essential Services	✓	✓	✓	✓
Stream Re-alignment	✓			
Road Crossings				
• Any	✓	✓		
• Culvert			✓	✓
• Bridge			✓	✓

## Diagram 1 - Averaging Rule<sup>2</sup>

**Figure 8: Averaging Rule (Source NOW Controlled Activity Riparian Corridor Guidelines)**

# References

AES Environmental Consultancy (2001). *Natural asset mapping for Baulkham Hills Shire Council plant communities in Baulkham Hills Shire*. A report prepared by AES Environmental Consultancy for The Hills Shire Council.

Department of the Environment (DotE) 2014a. EPBC Act Protected Matters Report. Available: <http://www.environment.gov.au/epbc/pmst/> Accessed October 2014.

Department of the Environment (DotE) 2014b. Species Profile and Threats Database, Department of Environment, Canberra. Available <https://www.environment.gov.au/sprat>.

Department of Environment and Conservation NSW (DECC) 2005. Threatened Species Profiles.

Available: <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment, Climate Change and Water (DECCW) 2011. *Cumberland Plain Recovery Plan*. Department of Environment, Climate Change and Water.

Department of Primary Industries 2013. *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)*. Published by the NSW Department of Primary Industries, a part of the Department of Trade and Investment, Regional Infrastructure and Services.

Department of Primary Industry (DPI) 2014. *Noxious weed declarations*. NSW Department of Primary Industries, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed>

Eco Logical Australia 2012. North West Rail Link Ecological Assessment. Report prepared for Transport New South Wales.

Environment Australia 2000. *Comprehensive and Regional Assessments for North-East NSW*. Report to National Parks and Wildlife Service.

NSW Scientific Committee Final Determinations from 1996-2014. Available from <http://www.environment.nsw.gov.au/committee/finaldeterminations.htm>.

New South Wales National Parks and Wildlife Service (NPWS), 2002. Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service 1997. Urban Bushland Biodiversity Study - Western Sydney, National Parks and Wildlife Service.

NSW Scientific Committee 1998. Shale/Sandstone Transition Forest in the Sydney Basin Bioregion. Final Determination. NSW Scientific Committee, Sydney. Available from <http://www.environment.nsw.gov.au/determinations/ShaleSandstoneTransitionForestEndComListing.htm>.

Office of Environment and Heritage (OEH) 2014a. *Threatened Species Profiles*. Available: <http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?> Accessed October 2014.

Office of Environment and Heritage (OEH). 2014b. *Threatened Species Database* (10 km radius search). OEH Sydney, NSW. (Data viewed October 2014).

## Appendix A - Likelihood of occurrence

As assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. The NSW OEH Bionet Atlas and EPBC online Protected Matters database (based on a 10 km radius from the Precinct) were used. The assessment applies to the whole of the Precinct.

Each species likely occurrence was informed through a desktop assessment by incorporating the number of records for the species in the area, habitat availability based on previous vegetation mapping, knowledge of the species' ecology and professional judgement. The likelihood of occurrence was conducted using a conservative approach in the absence of being able to validate the presence of habitat types within the Precinct. Therefore, habitat was assumed to be present if habitat features were likely to occur within the mapped vegetation community

Five terms for the likelihood of occurrence of species are used in this report. The terms for likelihood of occurrence are defined below:

- “known or recorded” = the species has been observed on the site or a data point from the NSW Wildlife Atlas data exists within the Precinct.
- “likely” = a medium to high probability that a species uses the site
- “potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- “unlikely” = a very low to low probability that a species uses the site
- “no” = habitat on site and in the vicinity is unsuitable for the species.

*Records:* Indicates the number of records for each species within the locality (10km radius of Precinct), based on the NSW Wildlife Atlas database searches.

*NWRL study:* Indicates whether the species was recorded within the NWRL study area for the NWRL ecological assessment. Note, the NWRL study included study areas for all stations along the NWRL.

Name	TSC Act	EPBC Act	Habitat Associations	Known in area	Likelihood of Occurrence
<b>Ecological Communities</b>					
Blue Gum High Forest of the Sydney Basin Bioregion	CEEC	CEEC	A moist, tall open forest community, with dominant canopy trees of <i>Eucalyptus saligna</i> (Sydney Blue Gum) and <i>E. pilularis</i> (Blackbutt). <i>Allocasuarina torulosa</i> (Forest Oak) and <i>Angophora costata</i> (Sydney Red Gum) also occur. Species adapted to moist habitat such as <i>Acmena smithii</i> (Lillypilly), <i>Ficus coronata</i> (Sandpaper Fig), <i>Calochlaena dubia</i> (Soft Bracken) and <i>Adiantum aethiopicum</i> (Maiden Hair) may also occur. Originally restricted to the ridgelines in Sydney's north from Crow's Nest to Hornsby, and extending west along the ridges between Castle Hill and Eastwood. Occurs only in areas where rainfall is high (above 1100 millimetres per year) and the soils are relatively fertile and derived from Wianamatta shale. In lower rainfall areas, it grades into Sydney Turpentine-Ironbark Forest.	Yes	No
Cumberland Plain Woodlands	CEEC	CEEC	Occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Good examples can be seen at Scheyville National Park and Mulgoa Nature Reserve. The dominant canopy trees of Cumberland Plain Woodland are <i>Eucalyptus moluccana</i> (Grey Box) and <i>E. tereticornis</i> (Forest Red Gum), with <i>E. crebra</i> (Narrow-leaved Ironbark), <i>Corymbia maculata</i> (Spotted Gum) and <i>E. eugenioides</i> (Thin-leaved Stringybark) occurring less frequently. The shrub layer is dominated by <i>Bursaria spinosa</i> (Blackthorn), and it is common to find abundant grasses such as <i>Themeda australis</i> (Kangaroo Grass) and <i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Meadow Grass) (OEH 2014a).	Yes	Known
Shale Sandstone Transition Forest	EEC	EEC	Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with soils from sandstone, or where shale caps overlay sandstone. The main tree species include <i>Eucalyptus tereticornis</i> (Forest Red Gum), ( <i>E. punctata</i> ) Grey Gum, <i>E. globoidea</i> , <i>E. eugenioides</i> (Thin-leaved Stringybark) and <i>E. fibrosa</i> (Broad-leaved Ironbark) and <i>E. crebra</i> (Narrow-leaved Ironbark). Areas of low sandstone influence have an understorey that is closer to Cumberland Plain Woodland. High sandstone influence sites have poor rocky soils.	Yes	No



River-Flat Eucalypt Forests (previously known as Alluvial Woodland)	EEC	-	Occurs on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, but can be considerably shorter in regrowth stands or lower site quality. The typical dominant trees include <i>Eucalyptus tereticornis</i> (Forest red gum), <i>E. amplifolia</i> (Cabbage gum), <i>Angophora floribunda</i> (Rough-barked Apple) and <i>A. subvelutina</i> (Broad-leaved Apple). A layer of small trees may be present, including <i>Melaleuca decora</i> , <i>M. styphelioides</i> (Prickly-leaved Teatree), <i>Backhousia myrtifolia</i> (Grey Myrtle), <i>Melia azedarach</i> (White Cedar), <i>Casuarina cunninghamiana</i> (River Oak) and <i>C. glauca</i> (Swamp Oak). Scattered shrubs include <i>Bursaria spinosa</i> , <i>Solanum prinophyllum</i> , <i>Rubus parvifolius</i> , <i>Breynia oblongifolia</i> , <i>Ozothamnus diosmifolius</i> , <i>Hymenanthera dentata</i> , <i>Acacia floribunda</i> and <i>Phyllanthus gunnii</i> . The groundcover is composed of abundant forbs, scramblers and grasses including <i>Microlaena stipoides</i> , <i>Dichondra repens</i> , <i>Glycine clandestina</i> , <i>Oplismenus aemulus</i> , <i>Desmodium gunnii</i> , <i>Pratia purpurascens</i> , <i>Entolasia marginata</i> , <i>Oxalis perennans</i> and <i>Veronica plebeia</i> . The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbances, and may be dominated by exotic shrubs, grasses, vines and forbs.	Yes	Known
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	EEC	CEEC	Open forest, with dominant canopy trees including <i>Syncarpia glomulifera</i> (Turpentine), <i>Eucalyptus punctata</i> (Grey Gum), <i>Eucalyptus paniculata</i> (Grey Ironbark) and <i>E. eugenioides</i> (Thin-leaved Stringybark). In areas of high rainfall (over 1050 mm per annum) <i>E. saligna</i> (Sydney Blue Gum) is more dominant. The shrub stratum is usually sparse and may contain mesic species such as <i>Pittosporum undulatum</i> (Sweet Pittosporum) and <i>Polyscias sambucifolia</i> (Elderberry Panax). Occurs close to the Shale/Sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaux. A transitional community, between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges.	Yes	No

*Disclaimer:* Data extracted from the Atlas of NSW Wildlife and EPBC Protected Matters Report are only indicative and cannot be considered a comprehensive inventory.

'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

CEEC = Critically Endangered Ecological Community; EEC = Endangered Ecological Community.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<b>Plants</b>							
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	<i>Acacia bynoeana</i> is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (OEH 2014a).	15	No	Unlikely Suitable habitat unlikely to be present within precinct. Closest record 3km east of precinct.
<i>Acacia gordonii</i>		E	E	<i>Acacia gordonii</i> is restricted to the north-west of Sydney, occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east, within the Hawkesbury, Blue Mountains and The Hills local government areas. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops (OEH 2014a).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Acacia pubescens</i>	Downy Wattle	V	V	<i>Acacia pubescens</i> occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (NPWS 1997; Benson and McDougall 1996).	14	No	Potential Suitable habitat may be present within the precinct.
<i>Acacia terminalis</i> subsp. <i>terminalis</i>	Sunshine Wattle	E	E	<i>Acacia terminalis</i> subsp. <i>terminalis</i> has a very limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay, with most records from the Port Jackson area and the eastern suburbs of Sydney. It occurs in coastal scrub and dry sclerophyll woodland on sandy soils (OEH 2014a).	0	No	No Suitable habitat not present within precinct.
<i>Allocasuarina glareicola</i>		-	E	<i>Allocasuarina glareicola</i> is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (OEH 2014).	0	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V	-	<i>Callistemon linearifolius</i> has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW, growing in dry sclerophyll forest (OEH 2014a). For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (OEH 2014a).	0	No	Unlikely Suitable habitat unlikely to be present.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	It is known from a range of vegetation communities including swamp-heath and woodland (OEH 2014a). The larger populations typically occur in woodland dominated by <i>Eucalyptus sclerophylla</i> (Scribbly Gum), <i>E. sieberi</i> (Silvertop Ash), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Allocasuarina littoralis</i> (Black Sheoak); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid ( <i>C. subulata</i> ) and the Tartan Tongue Orchid ( <i>C. erecta</i> ) (OEH 2014a).	0	No	No Suitable habitat not present within precinct
<i>Darwinia biflora</i>		V	V	<i>Darwinia biflora</i> is an erect or spreading shrub to 80cm high associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have a high clay content (NPWS 1997).	373	No	Potential Suitable habitat may be present within the precinct. Most records are associated with Cattai Creek Area. Closest record 1 km east of precinct.
<i>Darwinia peduncularis</i>		V	-	<i>Darwinia peduncularis</i> occurs as local disjunct populations in coastal NSW in the Blue Mountains, Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland, and usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone (OEH 2014a).	0	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Dillwynia tenuifolia</i>		V	-	The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities outside the Cumberland Plain include the Bulga Mountains at Yengo in the north, and Kurrajong Heights and Woodford in the Lower Blue Mountains (OEH 2014).	40	No	Potential Suitable habitat may be present within precinct.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V	-	<i>Epacris purpurascens</i> var. <i>purpurascens</i> has been recorded between Gosford in the north to Avon Dam in the south, in a range of habitats, but most have a strong shale soil influence (OEH 2014a).	203	Yes	Potential Suitable habitat may be present within precinct. Closest records are within Fred Caterson Reserve
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark			<i>Eucalyptus camfieldii</i> is associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (OEH 2014a).	0	No	No Suitable habitat not present within precinct.
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	<i>Eucalyptus nicholii</i> naturally occurs in the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (DECC 2005). This species is widely planted as an urban street tree and in gardens but is quite rare in the wild (DECC 2005). Plantings undertaken for horticultural and aesthetic purposes are not considered threatened species under the TSC Act.	6	No	No NSW Wildlife Atlas records within locality are likely to be non-indigenous (planted) specimens.
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E	-	Known in NSW only from the Tenterfield district where it is very uncommon. Grows on rocky hillsides in shrubby woodland close to granite outcrops (OEH 2014a).	1	No	No Suitable habitat not present within precinct.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Eucalyptus</i> sp. Cattai		E	-	<i>Eucalyptus</i> sp. Cattai occurs in the area between Colo Heights and Castle Hill, north western Sydney. It occurs as a rare emergent in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small groups. The sites at which it occurs are generally flat and on ridge tops and associated soils are laterised clays overlying sandstone.	46	No	No Suitable habitat not present within precinct. Records associated with Fred Caterson Reserve.
<i>Galium australe</i>		E	-	<i>Galium australe</i> is known from the Towamba Valley near Bega, Lake Yarrunga near Kangaroo Valley, Cullendulla Creek Nature Reserve near Batemans Bay, Conjola National Park, Swan Lake near Swanhaven, and the Big Hole in Deua National Park. Tangled Bedstraw was recorded historically from the Clyde River near Batemans Bay and the Mongarlowe area near Braidwood (OEH 2014a). In NSW it has been found in moist gullies of tall forest, <i>Eucalyptus tereticornis</i> forest, coastal Banksia shrubland, and <i>Allocasuarina nana</i> heathland.	0	No	No Suitable habitat not present within precinct.
<i>Genoplesium baueri</i>	Mauer's Midge Orchid	V	-	Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils and flowers from December to March (OEH 2014a).	3	No	Unlikely No recent records within locality. Suitable habitat also unlikely to be present.
<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	E	-	In NSW, <i>Grammitis stenophylla</i> has been found on the south, central and north coasts, and as far west as Mount Kaputar National Park near Narrabri, in moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>		V	-	Endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels (OEH 2014).	64	No	Potential Suitable habitat likely to be present. Nearest record for species is 2-3 km west of precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Hibbertia superans</i>		E	-	<i>Hibbertia superans</i> mainly occurs in the north west Sydney region between Baulkham Hills and Wisemans Ferry, with a disjunct occurrence near Mt Boss (inland from Kempsey) on the Mid North Coast of NSW. In the Sydney region it occurs in dry sclerophyll forest on sandstone ridgetops while the northern occurrence is on granite.	172	No	Unlikely Suitable habitat unlikely to be present within precinct. Nearest records within Fred Caterson Reserve.
<i>Lasiopetalum joyceae</i>		V	V	<i>Lasiopetalum joyceae</i> grows in ridgetop woodland, heath, woodland or open scrub, often with a clay influence.	1	No	No Suitable habitat not present within precinct
<i>Leptospermum deanei</i>		V	V	It has been recorded in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs, in woodland on lower hill slopes or near creeks, at sites with sandy alluvial soil or sand over sandstone (DECC 2005). It has also been recorded in riparian scrub dominated by <i>Tristaniopsis laurina</i> and <i>Baeckea myrtifolia</i> ; woodland dominated by <i>Eucalyptus haemastoma</i> ; and open forest dominated by <i>Angophora costata</i> , <i>Leptospermum trinervium</i> and <i>Banksia ericifolia</i> .	0	No	No Suitable habitat not present within precinct
<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i>		E	-	<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i> is restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains. It occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs (DECC 2007).	27	No	Unlikely Suitable habitat unlikely to be present within precinct. Closest record is 2 km north-east of precinct.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>		E2	-	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range and grows in vine thickets and open shale woodland (OEH 2014).	0	No	No Suitable habitat not present within precinct
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	<i>Melaleuca biconvexa</i> occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (OEH 2014a)	0	No	No Suitable habitat not present within precinct

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Found in heath on sandstone, and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (OEH 2014a).	1	No	No Suitable habitat not present within precinct
<i>Micromyrtus minutiflora</i>		E	V	Restricted to the general area between Richmond and Penrith, western Sydney and grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments (OEH 2014).	6	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	<i>Persoonia hirsuta</i> occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (DECC 2007). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2011).	21	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Persoonia mollis</i> subsp. <i>mollis</i>		E	E	Deep gullies or on the steep upper hillsides of narrow gullies incised from Hawkesbury Sandstone, characterised by steep side slopes, rocky benches and broken scarps, with creeks fed by small streams and intermittent drainage depressions. It been recorded on the dry upper hillsides of gullies and in more exposed aspects <i>E. haemastoma</i> (Scribbly Gum), <i>E. punctata</i> (Grey Gum)	1	No	No Suitable habitat not present within precinct
<i>Persoonia nutans</i>	Nodding Geebung	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond and Macquarie Fields. The species has a disjunct distribution, with the majority of populations (and 99% of individuals) occurring in the north of the species range. Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000) (OEH 2014a).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	E	-	In NSW, Austral Pillwort has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong), Oolambeyan National Park near Carathool and at Lake Cowal near West Wyalong. It grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous (OEH 2014a).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	<i>Pimelea curviflora</i> var. <i>curviflora</i> is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (DECC 2007).	28	No	Potential Suitable habitat may be present. However, most records associated with Cattai Creek riparian corridor.
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	In western Sydney, <i>Pimelea spicata</i> occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines ( <i>Ibid.</i> ). Has been located in disturbed areas that would have previously supported CPW ( <i>Ibid.</i> ).	55	No	Potential Suitable habitat may be present. Closest record greater than 1.5 km west of precinct.
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	Known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra (DECC 2005). Plants grow in a variety of woodland and open forest communities with shallow rocky soils.	0	No	No Suitable habitat not present within precinct.
<i>Pterostylis nigricans</i>	Dark Greenhood	V	-	Known in NSW from a small number of populations on the North Coast north from about Coffs Harbour. A recently discovered population at Kurnell also appears to be this species which extends its range considerably to the south. Plants grow in coastal heath either in deep sandy soils or rarely in rocky areas with sandstone outcrops (Sydney/Kurnell population)	0	No	No Suitable habitat not present within precinct.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (NSW Scientific Committee 1999).	0	No	No Suitable habitat not present within precinct.
<i>Pultenaea parviflora</i>		E	V	Endemic to the Cumberland Plain. Core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (OEH 2014).	26	No	Unlikely Habitat unlikely to be suitable within precinct.
<i>Syzygium paniculatum</i>	Magenta Lillypilly	V	V	It occupies a thin coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities. In the Ourimbah Creek valley, <i>S. paniculatum</i> occurs within gallery rainforest with <i>Alphitonia excelsa</i> , <i>Acmena smithii</i> , <i>Cryptocarya glaucescens</i> , <i>Toona ciliata</i> , <i>Syzygium oleosum</i> with emergent <i>Eucalyptus saligna</i> . At Wyrabalong NP, <i>S. paniculatum</i> occurs in littoral rainforest as a co-dominant with <i>Ficus fraseri</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Cassine australe</i> , and <i>Endiandra sieberi</i> .	5	No	No Suitable habitat not present within precinct.
<i>Tetratheca glandulosa</i>		V	V	Occurs on predominantly low nutrient soils with a dense grassy understorey of grasses although it has been recorded in heathland and moist forest (DECC 2007). It is associated with dry open forest or woodland habitats dominated by <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> , <i>E. haemastoma</i> and <i>Angophora costata</i> (Payne 1993). <i>Themeda australis</i> is generally the dominant ground cover (Payne 1993). <i>T. juncea</i> also displays a preference for southern aspect slopes, although is slopes with different aspects (DECC 2007).	49	No	Unlikely Habitat unlikely to be suitable within precinct. Closest records within Fred Caterson Reserve.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of Occurrence
<i>Thesium australe</i>	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass ( <i>Themeda australis</i> ).	0	No	Unlikely Habitat unlikely to be suitable within precinct.
<i>Triplarina imbricata</i>	Creek Triplarina	E	E	Found only in a few locations in the ranges south-west of Glenreagh and near Tabulam in north-east NSW. Along watercourses in low open forest with Water Gum ( <i>Tristaniopsis laurina</i> ) (OEH 2014a).	0	No	No Suitable habitat not present within precinct.

*Disclaimer:* Data extracted from the Atlas of NSW Wildlife and EPBC Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

CE = Critically Endangered E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<b>Fish</b>							
<i>Macquarie australasica</i>	Macquarie Perch	E (FM Act)	E	Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	0	No	No Suitable habitat not present within precinct.
<i>Prototroctes maraena</i>	Australian Grayling	-	V	Historically, this species inhabited coastal streams from the Grose River southwards through NSW, VIC and TAS. On the mainland, this species has been recorded from rivers flowing east and south of the main dividing range. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous species (migratory between fresh and salt waters).	0	No	No Suitable habitat not present within precinct.
<b>Frogs</b>							
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	1	No	No Suitable habitat not present within precinct.
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	This species has can utilise a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, lakes, other estuary wetlands, riverine floodplain wetlands, stormwater detention basins, farm dams, bunded areas, drains, ditches and other structures capable of storing water (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes— <i>Typha</i> sp. and spikerushes— <i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging and free from predatory fish such as Mosquito Fish ( <i>Gambusia holbrooki</i> ) are also preferable (Ehmann 1997; Robinson 1994; DECC 2007).	9	No	Potential Habitat has been identified within the precinct. However, targeted surveys did not recorded any individuals (ELA 2012).

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	It has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria (DECC 2005). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer (NSW Scientific Committee 2011).	0	No	No Suitable habitat not present within precinct.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Occurs in a variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2005) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2011).	0	No	No Suitable habitat not present within precinct.
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2005; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 2011). During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2005).	0	No	No Suitable habitat not present within precinct.
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	They are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2005). It also mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop (DECC 2005). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997).	16	No	No Suitable habitat not present within precinct. Records mostly associated with Fred Caterson Reserve.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<b>Reptiles</b>							
<i>Varanus rosenbergi</i>	Heath Monitor	V	-	Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (Environment Australia 2000). Terrestrial termitaria are required for reproduction (King and Green 1999).	0	No	No Suitable habitat not present within precinct.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b). Some of the canopy tree species found to regularly co-occur at known sites include <i>Corymbia eximia</i> , <i>C. gummifera</i> , <i>Eucalyptus sieberi</i> , <i>E. punctata</i> and <i>E. piperita</i> (DECC 2007).	0	No	No Suitable habitat not present within precinct.
<b>Diurnal birds</b>							
<i>Anthochaera Phrygia</i> (aka <i>Xanthomyza phrygia</i> )	Regent Honeyeater	E	E & M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak ( <i>C. cunninghamiana</i> ) (Garnett 1993). It primarily feeds on nectar from box and ironbark eucalypts and occasionally from Banksia's and mistletoes (NPWS 1995). It is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). Suitable habitat likely to be present within the Precinct.	7	No	Potential Highly mobile species with previous records within the locality (Wildlife Atlas records). However, no recent records exist.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	V	E	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	2	No	Unlikely Habitat unlikely to be suitable within precinct.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	During summer it is found in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	9	No	Unlikely Habitat unlikely to be suitable within precinct

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Calyptorhynchus lathamii</i>	Glossy Black Cockatoo	V	-	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Environment Australia 2000).	10	No	Unlikely Habitat unlikely to be suitable within precinct
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	Occupies a wide range of eucalypt dominated communities with a grassy understorey, often on rocky ridges or in gullies (DECC 2005). Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DECC 2005). Large, relatively undisturbed remnants are required for the species to persist in an area (DECC 2005). Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding (DECC 2005).	1	No	Unlikely Habitat unlikely to be suitable within precinct.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	Distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. It occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories. (NSW Scientific Committee 2011).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Distribution includes most of mainland Australia except deserts and open grasslands. Prefers eucalypt forests and woodlands with rough-barked species, or mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods from bark, dead branches, or small branches and twigs.	23	No	Unlikely Preferable habitat unlikely to be present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993; DECC 2005).	0	No	No Suitable habitat not present within precinct.
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	Endemic to Australia, in particular southern regions of Australia (OEH 2012). In NSW it occupies temperate to arid habitats from foothills to 1000 m altitude (OEH 2012). In NSW the White-fronted Chat occurs in open habitats near the coast in close proximity to waterways including estuaries, saltmarsh or marshy wetlands (NSW SC 2009).	0	No	No Suitable habitat not present within precinct.
<i>Falco hypoleucos</i>	Grey Falcon	V	-	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast (DECC 2005).	0	No	No Suitable habitat not present within precinct.
<i>Falco subniger</i>	Black Falcon	V	-	The Black Falcon has broad range across inland regions New South Wales, where it has a sparse distributed. However, there are reports of 'Black Falcons' occurring on the tablelands and along the NSW coast. These reports are likely to represent Brown Falcons. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling over hundreds of kilometres (Marchant & Higgins 1993).	1	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	In NSW Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including <i>melaleuca</i> and mistletoes. On the western slopes and tablelands <i>Eucalyptus albens</i> and <i>E. melliodora</i> are particularly important food sources for pollen and nectar respectively.	5	No	Potential Suitable habitat may be present within precinct.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Uses tall trees for nesting, with a large stick nest being built. Lays eggs in spring, and young fledge in early summer. Preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion.	7	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2005). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2005).	3	No	No Suitable habitat not present within precinct.
<i>Lathamus discolor</i>	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ) (DECC 2007).	25	No	Potential Suitable foraging habitat present within precinct. Highly mobile species.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECC 2007). May be recorded inland along timbered watercourses (DECC 2007). In NSW it is commonly associated with ridge or gully forests dominated by <i>Eucalyptus longiflora</i> (Woollybutt), <i>E. maculata</i> (Spotted Gum), or <i>E. elata</i> , <i>E. smithii</i> (Peppermint Gum) (DECC 2007).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (eastern subspecies)	V	-	It is widespread, found across Australia, except for the driest deserts and the wetter coastal areas. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	Predominantly associated with box-ironbark association woodlands and River Red Gum (NSW Scientific Committee, 2001). Also associated with drier coastal woodlands of the Cumberland Plain and the Hunter, Richmond and Clarence Valleys (NSW Scientific Committee, 2001).	2	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range compromise the topography inhabited by this species (Marchant & Higgins 1993). Spends much of the time on the ground foraging on seed and grasses (DECC 2005). It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs (Environment Australia 2000).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Oxyura australis</i>	Blue-billed Duck	V	-	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (OEH 2014). The species is completely aquatic, swimming low in the water along the edge of dense cover (OEH 2014). It will fly if disturbed, but prefers to dive if approached (OEH 2014). Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and over-wintering lakes with some long-distance dispersal to breed during spring and early summer (OEH 2014). Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes (OEH 2014).	2	No	No Suitable habitat not present within precinct.
<i>Petroica boodang</i>	Scarlet Robin	V	-	Occurs from the coast to the inland slopes in NSW. After breeding (July-Jan), some disperse to the lower valleys and plains of the tablelands and slopes, and may appear as far west as the eastern edges of the inland plains in autumn and winter. Primarily resides in dry eucalypt forests and woodlands, with usually open and grassy understorey, with scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter may live in open grassy woodlands, grasslands or grazed paddocks with scattered trees, and may join mixed flocks of small insectivorous birds.	7	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Petroica phoenicea</i>	Flame Robin	V	-	Flame Robins are found in a broad coastal band around the south-east corner of the Australian mainland, from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. Flame Robins prefer forests and woodlands up to about 1800 m above sea level.	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Petroica rodinogaster</i>	Pink Robin	V	-	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	1	No	Unlikely Suitable habitat unlikely to be present within precinct. No recent records within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	It is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. Inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest and in the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland (OEH 2014).	2	No	Unlikely Not typically associated with the habitats that are present within the precinct.
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	-	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECC 2005). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn. Breeding takes place from September to January. Will feed in adjacent mangroves or eucalypt forests (Blakers <i>et al.</i> 1984).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Rostratula australis</i> (a.k.a. <i>R. benghalensis</i> )	Painted Snipe (Australian subspecies)	E	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	0	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Typically found in grassy eucalypt woodlands, but also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities (DECC 2005). It is often found in riparian areas and sometimes in lightly wooded farmland (DECC 2005). Appears to be sedentary, though some populations move locally, especially those in the south (DECC 2005).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (OEH 2014).	0	No	No Suitable habitat not present within precinct.
<b>Nocturnal Birds</b>							
<i>Ninox connivens</i>	Barking Owl	V	-	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as <i>Allocasuarina cunninghamiana</i> , other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	4	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Ninox strenua</i>	Powerful Owl	V	-	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000). Has been recorded approximately 1 km from the proposed sewer lines.	43	No	Unlikely Suitable habitat unlikely to be present within precinct. Records from Fred Caterson Reserve and heavily wooded areas.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2005) and especially the ecotone between wet and dry forest, and non-forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh & Peake 1993).	2	No	No Suitable habitat not present within precinct.
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus 1994, Garnett 1993, Hyem 1979).	1	No	No Suitable habitat not present within precinct.
<b>Mammals (excluding bats)</b>							
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	V	-	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of <i>Banksia</i> sp. and <i>Leptospermum</i> sp. are an important habitat feature (DECC 2005). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old bird's nests and in the branch forks of tea-trees (Turner & Ward 1995).	0	No	No Suitable habitat not present within precinct.
<i>Dasyurus maculatus</i> <i>Dasyurus maculatus</i> <i>maculates</i>	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V -	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	8	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Isoodon obesulus</i>	Southern Brown Bandicoot	E	E	This species is associated with heath, coastal scrub, heathy forests (Menkhorst & Knight 2004), shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (Menkhorst & Seebeck 1990).	0	No	No Suitable habitat not present within precinct.
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; DEC 2007). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; DEC 2007).	7	No	No Suitable habitat not present within precinct.
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (DECC 2005).	0	No	No Suitable habitat not present within precinct.
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE Mainland Population)	V	V	Associated with dry coastal heath and dry and wet sclerophyll forests with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004).	0	No	No Suitable habitat not present within precinct.
<i>Phascolarctos cinereus</i>	Koala	V-E2	-	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> .	2	No	No Suitable habitat not present within precinct.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (DoE 2014).	0	No	No Suitable habitat not present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	56	Yes	Recorded Previous records are known from within the precinct (NSW Wildlife Atlas).
<b>Mammals (Bats)</b>							
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	3	No	Potential Suitable habitat may be present within precinct.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Prefers moist habitats with trees taller than 20m (DECC 2007). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	25	No	Recorded Previous record from within the precinct (NSW Wildlife Atlas).
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Environment Australia 2000). Relatively large areas of dense vegetation of either wet sclerophyll forest, rainforest or dense coastal banksia scrub are usually found adjacent to caves in which this species is found (DECC 2007). Breeding occurs in caves, usually in association with <i>M. schreibersii</i> (Environment Australia 2000, DECC 2007).	12	No	Potential Suitable habitat may be present within precinct.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995 and Dwyer 1995). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000 and Dwyer 1995).	64	No	Recorded  Previous records are known from within the precinct (NSW Wildlife Atlas).
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoyer 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoyer 1998).	39	No	Recorded  Previous records are known from within the precinct (NSW Wildlife Atlas).
<i>Myotis macropus</i> (formerly <i>M. adversus</i> )	Southern Myotis, Large-footed Myotis	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting (in groups of 10-15) is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998). Forages over streams and pools catching insects and small fish by raking their feet across the water surface.	21	No	Likely  Suitable habitat present within precinct.  Previous records close to precinct (NSW Wildlife Atlas).

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies. Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheath-tail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	9	No	Potential Suitable habitat present within precinct.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 2008). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 2008).	17	No	Likely Suitable habitat present within precinct. Previous records close to precinct (NSW Wildlife Atlas).
<b>Invertebrates</b>							
<i>Meridolum corneovirens</i>	Cumberland (Large) Land Snail	E	-	Associated with open eucalypt forests, particularly Cumberland Plain Woodland (CPW) described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass (NPWS 1997; Rudman 1998). Urban waste may also form suitable habitat (NSW NPWS 1997; Rudman 1998).	123	No	Likely Suitable habitat present within precinct. Previous records adjacent to precinct (NSW Wildlife Atlas).
<b>Migratory species (EPBC Act)</b>							
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 1999).	3	No	Potential Highly mobile species.



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Ardea alba</i>	Great Egret	-	M	It has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Kushlan & Hancock 2005; Marchant & Higgins 1993; Martínez-Vilalta & Motis 1992). The species usually frequents shallow waters. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Ardea ibis</i>	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	26	Yes	Recorded Previous records are known from within the precinct (NSW Wildlife Atlas).

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson and Day 1999). Can occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers (Frith et al. 1977; Naarding 1983; Patterson 1991). They are regularly recorded in or around modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches, ricefields, orchards, saltworks, and sewage and dairy farms (Frith et al. 1977; Lane & Jessop 1985; Naarding 1983). They can also occur in various sites close to humans or human activity (e.g. near roads, railways, airfields, commercial or industrial complexes) (Frith et al. 1977; Naarding 1983).	3	Yes	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline water bodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	3	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	9	No	Potential Highly mobile species.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Records	NWRL study	Likelihood of occurrence
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	Resident in coastal and subcostal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunneled in flat or sloping ground, sandy back or cutting (ibid).	1	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	0	No	Unlikely Suitable habitat unlikely to be present within precinct.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	0	No	SEE DIURNAL BIRDS ABOVE

*Disclaimer:* Data extracted from the Atlas of NSW Wildlife and EPBC Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

CE = Critically Endangered E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory

## Appendix B – NSW 7-part test Assessment of Significance

The Assessment of Significance (7-part test) is applied to species, populations and ecological communities listed on Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5 of the FM Act that are likely or have the potential to occur within the proposal footprint. The assessment sets out 7 factors, which when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS). All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the 7-part test, an action is considered likely to have a significant impact on a threatened species, population or ecological community.

### 7-Part Test Assessment of Significance

1. *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
2. *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
  - I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*
4. *In relation to the habitat of a threatened species, population or ecological community:*
  - I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
  - III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*
5. *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*
6. *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*
7. *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

A 7-part test Assessments of Significance has been conducted below for:

- Cumberland Plain Woodland
- River-flat Eucalypt Forest

### Cumberland Plain Woodland Assessment

Cumberland Plain Woodland is a Critically Endangered Ecological Community (CEEC) listed under the TSC Act that occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. There are two sub-communities of Cumberland Plain Woodland, being Shale Plains Woodland and Shale Hills Woodland (DECCW 2011). The species compositions of both sub-communities are similar, and it is their position in landscape that predominantly determines whether an area is classified as Shale *Plains* or Shale *Hills* Woodland. Both sub-communities are equally protected under legislation and are referred to as Cumberland Plain Woodland in this document.

Cumberland Plain Woodland is the most widely distributed community on the Cumberland Plain and has seen extensive contractions since European settlement. Today, it is estimated that only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain likely to be disturbed or impacted.

Cumberland Plain Woodland supports threatened endemic flora and endemic and migratory fauna species. Tree hollows are commonly found in the old growth canopy species, and are of high conservation value.

Clearing for agriculture and urban development is the greatest threat to Cumberland Plain Woodland. Given it exists now only in fragments, Cumberland Plain Woodland is vulnerable to disturbances, such as weed invasion, increased soil nutrients, rubbish dumping and frequent fire. Weeds, such as *Eragrostis curvula* (African Lovegrass), *Olea europaea* subsp. *cuspidata* (African Olive) and *Chloris gayana* (Rhodes Grass), are major threats to the ecological community.

This desktop assessment has assumed that The Hills Shire Council vegetation mapping (2012) of Cumberland Plain Woodland represents the NSW listed ecological community. The majority of Cumberland Plain Woodland within the Precinct is likely to be in a poor condition with a scattered overstorey present and an understorey dominated by weeds and/or exotic grasses. However, some larger stands of the community representing good quality native vegetation maybe present.

A total 7.48 ha of Cumberland Plain Woodland listed under the TSC Act has been mapped within the Kellyville Precinct. The local occurrence is likely to be represented by all of the ecological community within the Precinct, which occurs across three main isolated and/or fragmented patches of vegetation. Furthermore, all patches of Cumberland Plain Woodland within the Precinct are separated by greater than 1 km, and it is possible that the exchange of genetic material would not occur between patches. Approximately 4340 ha of Cumberland Plain Woodland has been mapped within a 10 km radius (locality). The land use zones within each of the opportunity sites have not yet been defined. However, it is assumed that all vegetation within the opportunity sites will be developed. It is also not known if the remaining vegetation within the Precinct, but outside of the opportunity sites will be conserved.

Therefore, an estimated 3.57 ha of Cumberland Plain Woodland listed under the TSC Act (of which 3.42 ha has been validated) is assumed will be cleared as part of the re-zoning process, and forms the basis for this Assessment of Significance. The clearing will occur across a single patch (**Figure 6**) and represents 48% of the community within the Precinct and of the local occurrence (**Table 9**).

**Table 9: Cumberland Plain Woodland**

Constraint	Opportunity sites (ha)	Outside opportunity sites (ha)	Precinct (ha)	% impacted within Precinct
Cumberland Plain Woodland	3.57	3.91	7.48	48%

- a. **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable, Cumberland Plain Woodland is not a threatened species.

- b. **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable, Cumberland Plain Woodland is not a threatened species.

- c. **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

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

A total of 3.57 ha of Cumberland Plain Woodland has been mapped within the opportunity sites of the Precinct. A further 3.91 ha of Cumberland Plain Woodland has been mapped within the study area and would be considered part of the local occurrence for this ecological community. Therefore, the local occurrence (same as Precinct) of Cumberland Plain Woodland totals 7.48 ha.

Approximately 3.57 ha of Cumberland Plain Woodland will be cleared as part of the re-zoning process. The proposed clearing will remove the largest of three patches of the ecological community within the Precinct, and represents 48% of the local occurrence (**Table 9**).

The clearing of Cumberland Plain Woodland will reduce the extent of the community within the study area and of the local occurrence. It is considered possible that this amount of clearing may adversely affect the extent of the community such that the local occurrence of Cumberland Plain Woodland would be placed at risk of extinction in the long-term.

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

The majority of Cumberland Plain Woodland within the Precinct is likely to be in a poor condition due to historical disturbances. The community is likely to consist of a scattered overstorey with an understorey dominated by weeds and/or exotic grasses.

Approximately 3.57 ha of Cumberland Plain Woodland will be cleared as part of the re-zoning process. The native vegetation to be removed is likely to represent a disturbed form of the community with an exotic and weedy understorey. However, the proposed clearing will remove the largest of the three patches of the ecological community within the Precinct, which also represents 48% of the local occurrence (**Table 9**). The works will not impact on the remaining 3.91 ha of Cumberland Plain Woodland of the local occurrence. However, the remaining two patches of the ecological community are scattered across the Precinct are likely to be degraded.

It is considered possible that this amount of clearing of Cumberland Plain Woodland may substantially and adversely modify the composition of the ecological community, such that the local occurrence of Cumberland Plain Woodland could be placed at risk of extinction in the long-term.

- d. **in relation to the habitat of a threatened species, population or ecological community:**



**i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

Approximately 3.57 ha of Cumberland Plain Woodland will be cleared as part of the re-zoning process. The proposed clearing will remove the largest of three patches of the ecological community within the Precinct, and represents 48% of the local occurrence (**Table 9**). It is considered that the clearing of 3.57 ha is a significant amount for a critically endangered ecological community, and it will represent a significant impact / reduction in the total extent of Cumberland Plain Woodland.

**ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

Approximately 3.57 ha of Cumberland Plain Woodland will be cleared as part of the re-zoning process, which is represented by the largest of three main patches of the community within the Precinct. All patches of Cumberland Plain Woodland within the Precinct are already likely to be considered isolated from one another, due to a separation distance of greater than 1 km which would limit the ability to share genetic material between patches.

The removal of this 3.57 ha of Cumberland Plain Woodland will not further isolate or fragment the remaining stands of the community, as they are already considered to be isolated.

**iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

Whilst the Cumberland Plain Woodland to be cleared is likely to be in a degraded and disturbed condition, it is not considered important for the long-term survival of this community in the locality. The locality would maintain 99.9% of this community, which could continue to allow this community to mature and regenerate in the locality. Furthermore, the impacts are not within any Priority Conservation Lands outlined in the Cumberland Plain Recover Plan (DECCW 2011).

With a restriction of direct impacts to the opportunity sites within the Precinct, the magnitude and duration of the impacts on this community are not likely to impact its long-term survival in the locality.

**e. whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

There is no critical habitat listed on the register of critical habitat (OEH 2013c) relevant for Cumberland Plain Woodland or other species or ecological communities in the study area.

**f. whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

The Cumberland Plain Woodland critically endangered ecological community is covered under the Cumberland Plain Recovery Plan (DECCW 2011). This recovery plan is a multi-entity plan and includes all of the threatened ecological communities and species occurring across the Cumberland Plain of Sydney. The overall objective is to provide for the long-term survival of the threatened biodiversity of the Cumberland Plain, through a focus on Priority Conservation Lands.

Actions within the recovery plan are identified for implementation by local, State and Australian government authorities and are grouped under four main recovery objectives. No relevant threat abatement plans have been prepared for this community and a number of priority actions have been identified for this community. The re-zoning process is not inconsistent with the main recovery objectives or any priority actions.

However, the recovery plan states that ‘where impacts on biodiversity cannot be avoided, they should be offset using appropriate means.’ Therefore, as long as offsets are provided to compensate for the proposed loss, the re-zoning process would be consistent with the Recovery Plan requirements.

**g. whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

A key threatening process is defined under the TSC Act as “*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*”. The following key threatening processes are likely to already exist in the locality and may be relevant to this community:

- Direct impact
  - Clearing of native vegetation
  - Loss of hollow-bearing trees
  - Removal of dead wood and dead trees.
- Invasive species
  - Invasion of native plant communities by exotic perennial grasses
- Environmental modification
  - High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

It is possible that the works associated with the re-zoning process could exacerbate some of these key threatening processes in the area. However, they are unlikely to impact on the survival or evolutionary development of the community in this area, which has been subject to similar historical disturbances.

## **Conclusion**

It is considered that the clearing of 3.57 ha of Cumberland Plain Woodland may represent a significant reduction in the extent of the local occurrence of the critically endangered ecological community. This amount of clearing of Cumberland Plain Woodland represents 48% of the community within the Precinct (and local occurrence), and may substantially modify its composition, placing the local occurrence at risk of extinction in the long-term. Furthermore, key threatening processes may be exacerbated through the re-zoning process.

Therefore, the re-zoning process is considered likely to have a significant impact on Cumberland Plain Woodland listed under the TSC Act.

### River-flat Eucalypt Forest Assessment

River-flat Eucalypt Forest is found on the river flats of the coastal floodplains and typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (Forest Red Gum), *E. amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (Blue Box), *E. botryoides* (Bangalay) and *E. elata* (River Peppermint) may be common south from Sydney, *E. ovata* (Swamp Gum) occurs on the far south coast, *E. saligna* (Sydney Blue Gum) and *E. grandis* (Flooded Gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain (OEH 2014a).

A layer of small trees may be present, including *Melaleuca decora*, *M. styphelioides* (Prickly-leaved Teatree), *Backhousia myrtifolia* (Grey Myrtle), *Melia azedarach* (White Cedar), *Casuarina cunninghamiana* (River Oak) and *C. glauca* (Swamp Oak). Scattered shrubs include *Bursaria spinosa*, *Solanum prinophyllum*, *Rubus parvifolius*, *Breynia oblongifolia*, *Ozothamnus diosmifolius*, *Hymenanthera dentata*, *Acacia floribunda* and *Phyllanthus gunnii* (OEH 2014a).

The groundcover is composed of abundant forbs, scramblers and grasses. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs (OEH 2014a).

This desktop assessment has assumed that The Hills Shire Council vegetation mapping (2012) of River-flat Eucalypt Forest represents the NSW listed ecological community. The majority of River-flat Eucalypt Forest within the Precinct is likely to be in a poor condition with an understorey dominated by weeds and/or exotic grasses.

A total 34.48 ha of River-flat Eucalypt Forest listed under the TSC Act has been mapped within the Kellyville Precinct. An additional stand of approximately 14.0 ha of this ecological community occurs adjacent to the north of the Precinct and would be considered part of the local occurrence. Approximately 900 ha of River-flat Eucalypt Forest has been mapped within a 10 km radius (locality). The land use zones within each of the opportunity sites have not yet been defined. However, it is assumed that all vegetation within the opportunity sites will be developed. It is also not known if the remaining vegetation within the Precinct, but outside of the opportunity sites will be conserved.

Therefore, an estimated 2.35 ha of River-flat Eucalypt Forest listed under the TSC Act is assumed will be cleared as part of the re-zoning process, and forms the basis for this Assessment of Significance. The clearing will occur across three patches (**Figure 6**) and represents 1.7% of the community within the Precinct and 2.19% of the local occurrence (**Table 10**).

**Table 10: River-flat Eucalypt Forest**

Constraint	Opportunity sites (ha)	Outside opportunity sites (ha)	Precinct (ha)	% within Precinct impacted	Total of local occurrence	% of local occurrence impacted
River-flat Eucalypt Forest	2.35	32.13	34.48	6.82%	48.87	4.81%

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

Not applicable, River-flat Eucalypt Forest is not a threatened species.

**b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable, River-flat Eucalypt Forest is not a threatened species.

**c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

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

The proposed works would involve the clearing of 2.35 ha of what is likely already modified and historically disturbed River-flat Eucalypt Forest. Given the historical disturbance which the study area has been subject to, the proposed removal of only 4.81% of the local occurrence of this ecological community is unlikely it at risk of extinction in the long-term.

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

The stand of River-flat Eucalypt Forest which would be impacted upon by the proposed re-zoning is likely to be infested with exotic weed species. However, the proposed re-zoning will involve the clearing of only 4.81% of the local occurrence of the ecological community, although this is unlikely to further modify species composition that would place it at risk of extinction. The implementation of weed management procedures during any proposed clearing works would further reduce potential for weeds to become more widespread.

**d) in relation to the habitat of a threatened species, population or ecological community:**

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

Approximately 2.35 ha of River-flat Eucalypt Forest will be cleared as part of the re-zoning process. The proposed clearing will occur across three small patches and represents 6.82% of the community in the Precinct and 4.81% of the local occurrence (**Table 10**). These areas are also likely to have already been degraded from historical disturbances. It is considered that the clearing of 2.35 ha is relatively minor and does not represent a significant modification to the extent of this community.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The proposed clearing from the re-zoning process will remove three small patches of the ecological community (**Table 7**). However, this clearing will not fragment or isolate the community in this occurrence.

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

The areas in which the proposed re-zoning clearing works are to occur is not likely to be considered important to the long-term survival of River-flat Eucalypt Forest in the locality. The clearing represents 4.81% of the local occurrence and 0.26% of the community in the locality. Furthermore, the patches are likely to represent a degraded form of the community with widespread occurrences of weed species. As such, it is unlikely that this area is important to the long-term survival of River-flat Eucalypt Forest within the locality.

**(e) Whether the action proposed is likely to have an adverse effect on critical habitat.**

There is no critical habitat listed on the register of critical habitat (OEH 2013c) relevant for River-flat Eucalypt Forest or other species or ecological communities in the study area.

**(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

No recovery plan has been prepared for River-flat Eucalypt Forest. The proposed re-zoning is not in conflict with the Priority Actions Statements (PAS) for this community.

**(g) The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

A key threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. The following key threatening processes are likely to already exist in the locality and may be relevant to this community:

- Direct impact
  - Clearing of native vegetation
  - Loss of hollow-bearing trees
  - Removal of dead wood and dead trees.
- Invasive species
  - Invasion of native plant communities by exotic perennial grasses
- Environmental modification
  - High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

It is possible that the works associated with the re-zoning process could exacerbate some of these key threatening processes in the area. However, they are unlikely to impact on the survival or evolutionary development of the community in this area, which has been subject to similar historical disturbances.

## Conclusions

The clearing works associated with the re-zoning process are unlikely to impose a significant impact on River-flat Eucalypt Forest given that they will:

- only involve clearing of a small amount (1.07 ha) of this community, which has been subject to similar historical disturbances in the past and is not considered to be important for the long-term survival of this ecological community;
- will not reduce the extent or substantially modify the composition of the ecological community such that the local occurrence is placed at risk of extinction; and
- will not isolated or fragment the ecological community in this occurrence.



#### HEAD OFFICE

Suite 2, Level 3  
668-672 Old Princes Highway  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

#### CANBERRA

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 6103 0148

#### COFFS HARBOUR

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

#### PERTH

Suite 1 & 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 08 9322 1358

#### DARWIN

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601  
F 08 8941 1220

#### SYDNEY

Level 6  
299 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9264 0717

#### NEWCASTLE

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 4910 0126

#### ARMIDALE

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2681  
F 02 6772 1279

#### WOLLONGONG

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 4268 4361

#### BRISBANE

Suite 1 Level 3  
471 Adelaide Street  
Brisbane QLD 4000  
T 07 3503 7191  
F 07 3854 0310

#### ST GEORGES BASIN

Unit 1 51 Owen Street  
Huskisson NSW 2540  
T 02 4201 2264  
F 02 4443 6655

#### NAROOMA

5/20 Canty Street  
Narooma NSW 2546  
T 02 4476 1151  
F 02 4476 1161

#### MUDGEES

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1230  
F 02 6372 9230

#### GOSFORD

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1220  
F 02 4322 2897

1300 646 131  
[www.ecoaus.com.au](http://www.ecoaus.com.au)