Flora and Fauna Assessment for the Bringelly Road Business Hub State Significant Development (SSD 6324)

Prepared for
Western Sydney Parklands Trust

13 November 2014

DOCUMENT TRACKING

Item	Detail
Project Name	Flora and Fauna Assessment for the Bringelly Road Business Hub State Significant Development
Project Number	14SUTECO-0010
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Status	Final
Version Number	3
Last saved on	13 November 2014
Cover photographs	Clockwise from the top left hand corner: view of the Bringelly Road site from Stuart Street, a patch of Grey Box –Forest Red Gum grassy woodland on flats, the pasture that dominates that site and the highly modified vegetation located on the south-side of Bringelly Road (R. Armistead)

This report should be cited as 'ELA 2014. *Flora and Fauna Assessment for the Bringelly Road Business Hub, State Significant Development.* Prepared for Western Sydney Parklands Trust' by Eco Logical Australia, Sutherland'.

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support Tim Colless and David Kirkland from Western Sydney Parklands.

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Abbreviations

Abbreviations	Description
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland, a CEEC listed under the TSC Act and EPBC Act
DECC	Former NSW Department of Environment and Climate Change (now OEH)
DECCW	Former NSW Department of Environment, Climate Change and Water (now OEH)
DGRs	Director General Requirements
DotE	Commonwealth Department of the Environment
DPI	NSW Department of Primary Industries
DP&E	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
GB-FRG	Grey Box - Forest Red Gum grassy woodland
GGBF	Green and Golden Bell Frog
ha	hectares
HBT	hollow bearing tree
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matter of National Environmental Significance
NW Act	*Noxious Weeds Act 1993* (NSW)
OEH	NSW Office of Environment and Heritage
SPW	Shale Plains Woodland
SSD	State Significant Development
TEC	Threatened Ecological Community
The Trust	Western Sydney Parklands Trust
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
WM Act	*Water Management Act 2000* (NSW)
WONS	Weeds of National Significance

Executive summary

This report provides the results of a Flora and Fauna Assessment (FFA) undertaken prior to the development of the Bringelly Road Business Hub, Bringelly Road, Leppington. The proposed development requires removal of native vegetation for a large scale retail, service centre and associated infrastructure. This development, referred to as 'a superlot subdivision', has been deemed a Stand Significant Development (SSD) under Part 4 (Division 4.1) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) because it is located in Western Sydney Parkland. Furthermore, the total capital invested is greater than $10 million.

In accordance with the specific matter 'No. 13: Flora and Fauna', of the Director General Requirements (DGRs), this report examines the flora, fauna and fauna habitat present at the site and the potential impacts of the proposed works. The report also evaluates the extent and status of the vegetation communities, including areas mapped as existing native vegetation (ENV).

A search of the EPBC Act Protected Matters Search Tool and Atlas of New South Wales (NSW) Wildlife identified 59 threatened flora and fauna species, and 12 migratory species that have been recorded or are likely to occur within 10 km of the subject site. A likelihood of occurrence analysis identified three threatened microbats, one invertebrate and three migratory birds that could potentially use the subject site for foraging and may be impacted upon by the proposed development. Species included *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat), *Mormopterus norfolkensis* (East Coast Freetail Bat), *Myotis macropus* (Large-footed Myotis), *Meridolum corneovirens* (Cumberland Plain Land Snail), *Ardea alba* (Great Egret), *A. ibis* (Cattle Egret) and *Gallinago hardwickii* (Latham's Snipe).

The field assessment concluded the site to be in a highly modified and degraded state. The main vegetation type present was exotic grass, sedge and shrub dominated pasture. However, a total of 1.82 ha of the Biometric Vegetation Type (BVT), '*Grey Box – Forest Red Gum (GB-FRG) grassy woodland on flats of the Cumberland Plain, Sydney Basin* (DECC 2008)', was identified at the site in nine small patches ranging in size from 0.01 ha to 0.69 ha. This vegetation community is the BVT equivalent of Cumberland Plain Woodland (CPW), which is a listed critically endangered ecological community (CEEC) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

No threatened plants or fauna species were recorded at the subject site and the habitat was regarded as having low to moderate ecological value. Features contributing to this were five farm dams, riparian habitat, a fallen log and 13 hollow bearing trees (HBT). The farm dams and HBTs are likely to provide foraging and roosting habitat for threatened microbats. In contrast, the dam was deemed unsuitable for the threatened *Litoria aurea* (Green and Golden Bell Frog (GGBF)) due an abundance of *Gambusia holbrooki* (Mosquito Fish). Included as having low ecological value were the pasture and orchard areas.

The potential impacts resulting from the development upon CPW and threatened species was assessed under Part 4.1 of the EP&A Act (provisions for SSD) in accordance with the *Guidelines for Threatened Species Assessment* (DEC and DPI 2005) (**Appendix D**). Similarly, the impact of the proposal on Matters of National Environmental Significance (MNES), CPW and migratory species, were assessed under the Significant Impact Guidelines 1.1 (DotE 2013). The results determined that the development is unlikely to significantly impact upon any threatened flora or fauna (including migratory) species.

As required by the DGRs, '*steps to be taken to avoid, mitigate or offset any impacts to the environment, threatened species, populations and endangered ecological communities*' must be consistent with the NSW offset principles for major projects (SSD & SSI) in assessing and determining the adequacy of any

offsets. Options to avoid and mitigate losses to CPW at the site were not deemed adequate given any retained vegetation would require intensive ongoing management due to the proposed future land use, with offsite offset measures in larger consolidated patches considered more appropriate.

NSW Offset Principle 1 requires proponents to '*offset any impacts that can't be avoided or mitigated against*', and Principle 9 requires that *'offsets must be quantifiable…* and *…should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset*'.

In NSW, the most appropriate methodology for quantifying impacts and benefits reliably is the NSW BioBanking Assessment Methodology (BBAM) (DECC 2008). This report provides an estimate of the offset requirements from impacts at the subject site, and a Biodiversity Offset Strategy is currently in preparation utilising the BBAM.

1 Introduction

Western Sydney Parklands Trust is seeking approval from the NSW Department of Planning and Environment (DP&E) for a proposed superlot subdivision and development at the 'Bringelly Road Business Hub', Bringelly Road, Leppington. The proposal is listed as a State Significant Development (SSD) under Part 4 (Division 4.1) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Terminology

The following terminology is used throughout this report:

- *Subject site*: includes the areas within the Bringelly Road SSD site that will be directly affected by the proposed works (**Figure 1**)
- *Study area*: includes the subject site and any additional areas that are likely to be indirectly affected by the proposed development. This includes the riparian zone and associated waterways that are downstream of the Bringelly Road site.
- *Locality*: includes the area within a 10 km radius of the study area, unless otherwise stated.

1.2 Subject site

The subject site is located approximately 40 km west of Sydney's Central Business District (CBD) (**Figure 1** and **Figure 2**). The study area is bound by Bringelly Road to the south, Stuart Road and Bedwell Park to the north, and private landholdings to the east. The study area lies within the Liverpool City Council Local Government Area (LGA) and forms part of Western Sydney Parklands estate. The Western Sydney Parklands estate includes 5,500 ha of land between Quakers Hill in the north and Leppington in the south. The study area is approximately 40 hectares (ha) in size.

The subject site is located within the South Western Growth Centres, which is subject to Biodiversity Certification under the NSW *Threatened Species Conservation Act 1995* (TSC Act). However, the subject site is predominantly on non-certified land.

1.3 Description of the proposed project

The proposed development is depicted in **Figure 2**, and will involve:

- the subdivision of the site into five lots and a sixth off the re-aligned Bringelly Road
- bulk earthworks, which includes clearing of native vegetation to:
  - accommodate the needs of the development
  - achieve a practical and balanced approach that is relative to the sites topography
- the construction and delivery of site services and infrastructure
- development of internal access roads and car parking
- estate landscaping

1.4 Director General Requirements

Specific matter 13 – Flora and Fauna of the Director Generals Requirements (DGRs) states:

- *Undertake a fauna and flora survey of the site in accordance with the OEH Threatened Species Survey and Assessment Guidelines. Address impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats and any draft/final recovery plans. Identify steps to be taken to avoid, mitigate or offset any impacts to the environment, threatened species, populations and endangered ecological communities. The NSW offset principles for major projects (SSD & SSI) are to be used in assessing and determining the adequacy of any offsets, refer to: (https://www.environment.nsw.gov.au/biocertification/offsets.htm).*
- *Assess the impacts of the proposal in regards to the Biodiversity Certification Order for the Sydney Region Growth Centres. Identify removal of any 'existing native vegetation' (as defined under the Order) and address provisions of the Order regarding removal of such vegetation. Note: the development is located within the South West Growth Centre which is subject to Biodiversity Certification under the Threatened Species Conservation Act 1995. The subject land is pre-dominantly within a 'non-certified' area.*

1.5 The aim of the report

This document will support a Development Application that will be submitted to the DP&E, consistent Specific matter 13 of the DGRs.

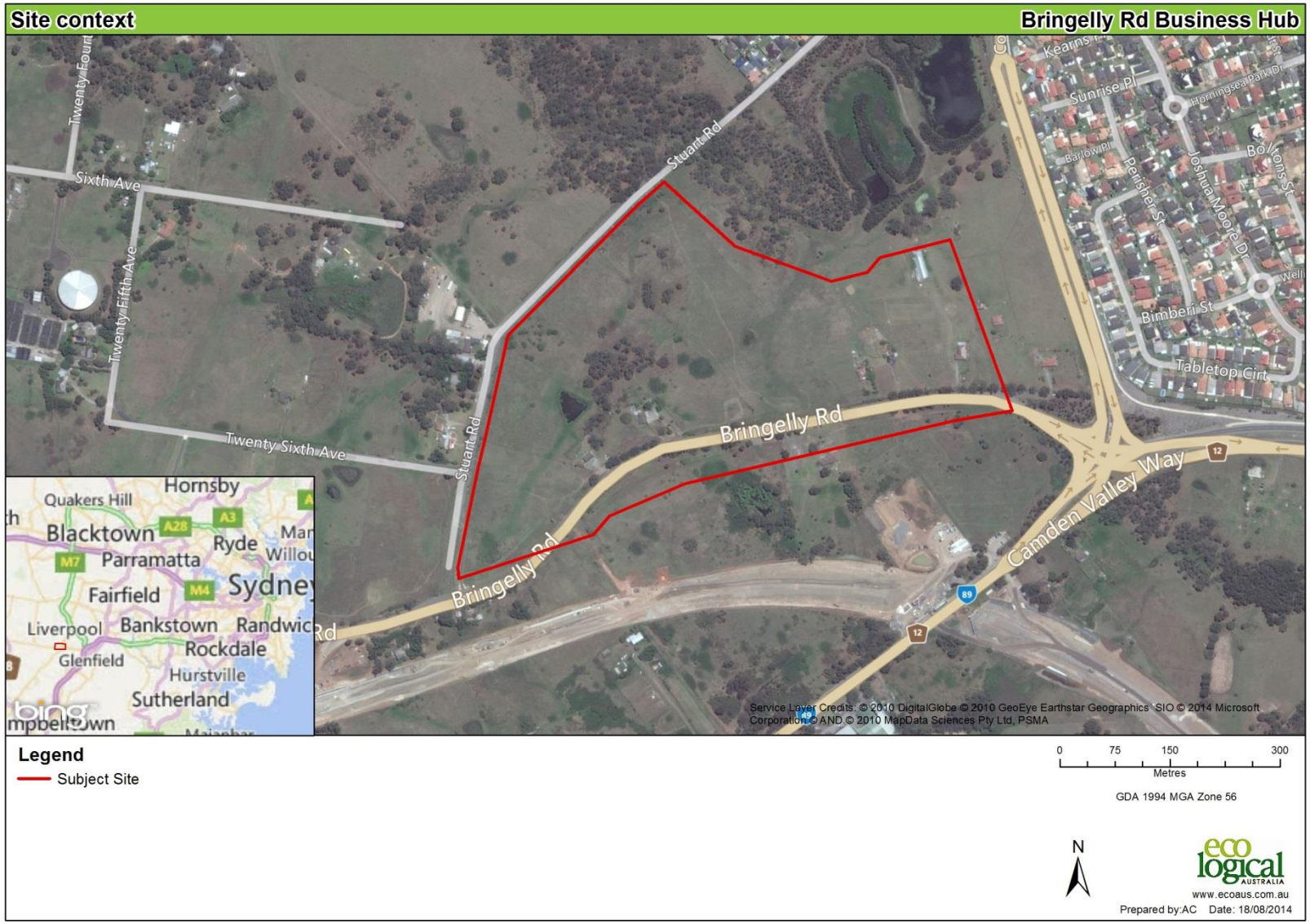

Figure 1: Location of the subject site

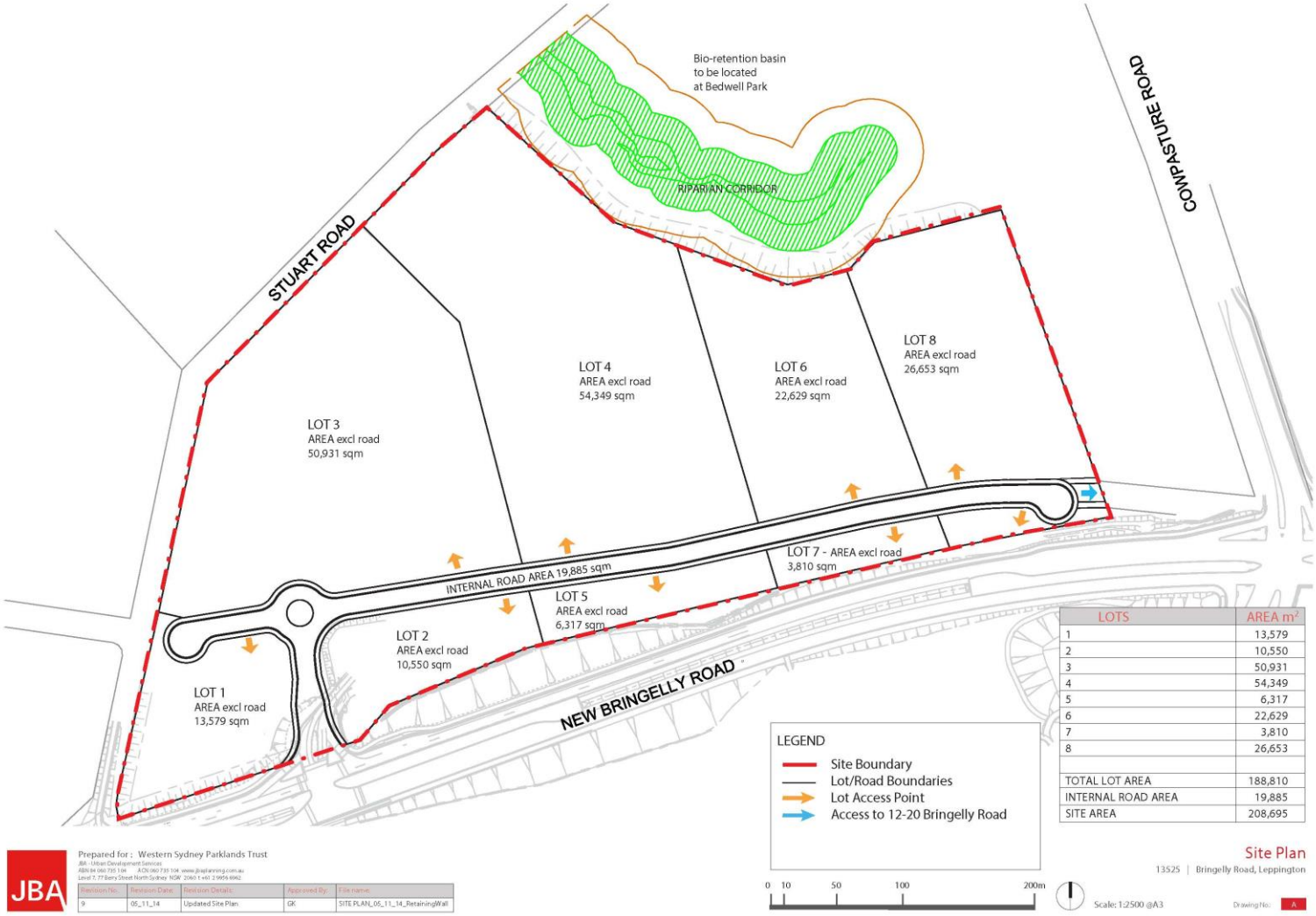

Figure 2: Proposed development layout within the subject site

2 Legislation

A brief outline of the relevant Commonwealth, State, local government acts and policies that apply to this development and ELA's assessment are provided in **Table 1**.

Table 1: Legislation relevant to the project

Name	Relevance to the project	Section in this report
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	The Protected Matters search tool identified EPBC Act listed Matters of National Environmental Significance (MNES) on or near the study area. MNES are considered against Significant Impact Guidelines 1.1.	Section 4 Appendix C
State		
Environmental Planning & Assessment Act 1979	The proposed development is State Significant Development and is to be assessed under Part 4.1 of the EP&A Act. Director-Generals Requirements have been issued.	**Section 1.4**, addressed throughout the report
Threatened Species Conservation Act 1995	The proposed development is a State Significant Development and impacts to threatened species, populations and/or ecological communities are assessed in accordance with the DGR's.	DGRs outlined in **Section 1.4**
State Environmental Planning Polices (SEPP)		
State and Regional Development 2011	The aim of this policy, amongst other things, is to identify development that is SSD. Once identified as such, the provisions of Part 4.1 of the EP&A Act will apply.	Throughout the document
Western Sydney Parklands 2009	This environmental planning instrument sets up the framework for the establishment and ongoing management of the ecological network of wildlife and habitat corridors that comprise the Western Sydney Parklands Estate.	Throughout the document
State Environmental Planning Policy (Sydney Region Growth Centres) 2006	The objective of the Growth Centres SEPP is to co-ordinate the release of land for residential, employment and other urban development in the North West and South West growth centres. A small portion of the Site (3.05 ha), south of and including Bringelly Road, is subject to the zoning and land use provisions of the SEPP.	Throughout the document
Western Sydney Parklands Framework		
Western Sydney Parklands Plan of Management (PoM)	This PoM details the 10 year plan for the entire Western Sydney Parklands Estate. The Environment and Conservation management priorities include establishing	Throughout the document

Name	Relevance to the project	Section in this report
(2011)	biodiversity links in Parklands bushland corridor. The Western Sydney Parklands Biodiversity Restoration Strategy 2012 – 2020 acknowledges the POM	
Local Government		
Liverpool LEP 2008	The provisions in the Liverpool Local Environment Plan 2008 do not apply to the site as they are otherwise overridden by Parklands SEPP and Growth Centres SEPP.	This LEP is not applicable to this site.

3 Methods

3.1 Database and literature review

The following datasets, literature, maps and interpretation guidelines were reviewed to evaluate the ecological values and constraints at the study area:

Aerial photographs of the study area were used to determine the distribution of vegetation cover, existing native vegetation (ENV), landscape and ecological features

- BioNet (Atlas of NSW Wildlife) (OEH 2014) using a 10 km radius search area
- EPBC Act Protected Matters Search Tool (DoE 2014) using a 5 km radius search area
- Biometric Vegetation Types database (DECC 2008)
- Liverpool City Council Biodiversity Management Plan (ELA 2012)
- Native Vegetation Interpretation Guidelines for Western Sydney Vegetation (NPWS 2002)

Threatened species, populations, ecological communities (TECs) and migratory species recorded during the data base searches and literature review were combined into a likelihood of occurrence table (**Appendix A**). This was assembled by:

- reviewing historical and recent records
- reviewing the available habitat at the study and surrounding areas
- reviewing the ecological and biological literature pertaining to each species
- applying expert knowledge of each species

This information was then used to define likelihood of occurrence as either:

- "Known" = flora and fauna species that have been observed or are likely to occur on the site
- "Likely" = a medium to high probability that a species uses the site
- "Potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely, 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

3.2 Field survey

The subject site was visited by ELA ecologist Dr Rodney Armistead on 8 of July 2014. Survey was undertaken over approximately six hours, with the assessments undertaken outlined below.

3.2.1 Vegetation communities and flora

Field survey was conducted to validate the NPWS (2002) vegetation mapping; determine whether ENV and TEC were present; to assess vegetation condition, and search for potential threatened flora and/or habitat. Field survey involved traversing the subject site with native and exotic flora recorded to validate vegetation types present, determine condition and relative abundance of flora species.

The vegetation classification system used in this report follows the BioMetric Vegetation Type (BVT) Database (DECC 2008a), which are correlated with the NPWS (2002) mapping units and TEC listings (NSWSC 2011, DEWHA 2010). BioMetric Vegetation Types were used as they are the basic unit

utilised by the Biobanking Assessment Methodology (DECC 2008b), which will be required by the DGRs to quantify any impacts from the proposal.

3.2.2 Fauna and fauna habitat

Searches were conducted for potential foraging, roosting, breeding, nesting trees of nocturnal birds, amphibians, reptiles and mammals. Signs of direct and indirect occupancy (i.e. scats, owl pellets, fur, tracks, dens, bark scratches and foliage chew marks) were also searched for.

All opportunistic fauna observations were recorded (**Appendix B**).

3.2.3 Impact assessment

The impacts of the proposed superlot division on those threatened entities considered known, likely or with potential to occur at the subject site were analysed in accordance with the DGRs (**Section 1.4**), Draft Guidelines for Threatened Species Assessment (DEC and DPI 2005) and the NSW Offsetting Principles (OEH 2014).

Significant Impact Criteria (SIC) tests were undertaken for Matters of NES listed under the EPBC Act that were known, likely or had the potential to occur in the study area (DotE 2014).

3.2.4 Survey limitations

The botanical survey aimed to record as many species as possible. However, it is acknowledged that this is not a definitive list of the flora within the study area. More species would likely be recorded during a longer survey over various seasons. Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to complete the project brief.

Full fauna survey following Threatened Species Survey and Assessment Guidelines (OEH 2013) were not undertaken as sufficient detail to determine the likelihood of occurrence of threatened and migratory species was achieved through habitat assessment. As such, further detailed fauna survey was not considered necessary.

4 Results

4.1 Database and literature review

4.1.1 Threatened species, populations and migratory species

A search of the relevant databases and literature identified 26 threatened flora species, 33 threatened fauna (including two fish, five frogs, one reptile, 12 birds, 13 mammals (five terrestrial and seven bat species), one invertebrate and 12 migratory birds that have been recorded or are likely to occur within a 10 km radius of the subject site. The results of the likelihood of occurrence analysis undertaken prior to field assessment identified five threatened and two migratory species that have the potential to use the subject site and may be impacted by the proposed works (**Appendix A**). These include:

- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
- *Mormopterus norfolkensis* (East Coast Freetail Bat)
- *Myotis macropus* (Large-footed Myotis)
- *Meridolum connivens* (Cumberland Plain Land Snail)
- *Gallinago hardwickii* (Latham's Snipe)
- *Ardea alba* (Great Egret)
- *Ardea ibis* (Cattle Egret)

4.1.2 Vegetation communities

The site assessment determined that 1.87 ha of the Biometric Vegetation Type (BVT), 'Grey Box – Forest Red Gum (GB-FRG) grassy woodland on flats', was present at the site (**Figure 3** and **Figure 4**). This BVT is equivalent to the communities shown in **Table 2**.

Table 2: Vegetation community nomenclature

Biometric Vegetation Type (DECC 2008)	Vegetation Community (NPWS 2002)	Threatened Ecological Communities
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (GB-FRG)	Shale Plains Woodland (SPW)	Cumberland Plain Woodland (TSC Act 1995) Cumberland Plain Woodland and Shale-gravel Transition Forest (EPBC Act 1999)

4.2 Field survey

The subject site supported the following remnant and managed vegetation in various condition states:

- GB-FRG Grassy Woodland on flats – disturbed woodland
- GB-FRG Grassy Woodland on flats – scattered paddock trees
- GB-FRG Grassy Woodland on flats – derived native shrubland
- Exotic pasture and orchards

Table 3 shows the area of these vegetation types and the condition assigned to each of them, which are described further below.

Table 3: Vegetation types found on the subject site showing the condition and area

Vegetation type	Condition	Area (ha)
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (GB-FRG)	Disturbed woodland	1.48
	Scattered paddock trees	0.23
	Derived native shrubland	0.16
Exotic pasture and orchards	Cleared and managed for agriculture	18.02
	Total	*19.89*

4.2.1 Grey Box – Forest Red Gum (GB-FRG) grassy woodland on flats

Grey Box – Forest Red Gum grassy woodlands on flats is the vegetation community mapped at the subject site and validated through site assessment. This vegetation type is the equivalent of Shale Plains Woodland described by Tozer (2003) as generally being dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), with *E. crebra* (Small-leaved Ironbark), *E. eugenioides* (Thin-leaved Stringybark) and *Corymbia maculata* (Spotted Gum) occurring less frequently. It is the most widely distributed community on the Cumberland Plain, and predominantly occurs on soils derived from Wianamatta Shale, but also occurs on Holocene alluvium in well drained areas that are infrequently inundated.

Disturbed woodland

Nine small and discrete patches of GB-FRG (Disturbed woodland) totalling 1.48 ha occur at the subject site. These *E. moluccana* dominated patches range in size from 0.01 ha to 0.69 ha (**Figure 4**).

The shrub layer and groundcover vegetation in these patches was either open or dominated by weeds. The midstorey consisted of *Bursaria spinosa* subsp. *spinosa* (Native Blackthorn), and the exotic shrubs *Sida rhombifolia* (Paddy's Lucerne), *Lycium ferocissimum* (African Boxthorn), *Bidens pilosa* (Cobblers Pegs), *Conyza* spp. (Fleabane) and *Rubus fruticosus* (Blackberry). The groundcover vegetation was dominated by native grasses and herbs including, *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Rye Grass), and *Dichondra repens* (Kidney Weed), with the exotic grass *Ehrharta erecta* (Panic Veldt Grass) present in lower abundance.

Scattered paddock trees

The subject site also contained 0.23 ha of scattered paddock trees; all *E. tereticornis* over a ground layer dominated by pasture. These trees are characteristic of the GB-FRG Grassy Woodland and would have previously been a component of this community across the site.

Derived native shrubland

A small patch (0.16 ha) of regrowth native shrubland characteristic of GB-FRG Grassy Woodland was located along the Stewart Road boundary. Whilst not retaining any canopy species typical of this woodland community, the midstorey and groundcover species are consistent with this community description and is considered to be a 'derived native shrubland'.

4.2.2 Exotic pasture and orchard

Exotic pasture/grassland is the predominant vegetation type on the subject site, it occupies 18.02 ha of the 19.89 ha subject site. The dominant species are all exotic pasture species including *Paspalum dilatatum* (Caterpillar Grass), *Chloris gayana* (Rhodes Grass) and *Pennisetum clandestinum* (Kikuyu) (**Figure 8** and **Figure 9**). At the time of the survey, the grasses were tall suggesting that it had not been grazed for some time. Horticultural plantings (in the form of an orchard) and noxious weeds were also present in this vegetation type (**Section 4.3.2**).

4.2.3 Threatened ecological communities

Grey Box – Forest Red Gum (GB-FRG) grassy woodland, was identified at the site in nine small patches ranging in size from 0.01 ha to 0.69 ha. This vegetation community is equivalent Cumberland Plain Woodland (CPW), which is a listed critically endangered ecological community (CEEC) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act 1995).

However, in its present condition, this CPW failed to meet the condition thresholds under the EPBC Act criteria for, Cumberland Plain Shale Woodlands and Shale-gravel Transition Forest (DEWHA 2009). This was due to the remaining perennial vegetation being dominated by exotic plant species. Consequently, native plant species did not contribute to 50% of the perennial vegetation cover, which is required to meet the thresholds under the EPBC Act (**Table 4**).

Table 4: Condition Thresholds for Patches[1] that meet the Description for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community (TSSC 2011)

Category and rationale	Thresholds	✓or ×
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 patch1 size is ≥0.5ha; **AND** ≥50% of the perennial understorey vegetation cover[2] is made up of native species.	**X**
OR		
B. Larger patches which are inherently valuable due to their rarity.	The patch size is ≥5ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species.	**X**
OR		
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥0.5 ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** The patch is contiguous[3] with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area.	**X**
OR		
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥0.5 ha in size; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A.	**X**

[1] 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.

[2] *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 no alter functionality as per footnote 3 and the *Description* and *Condition Thresholds* are met).

[3] *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.

4.3 Flora

A total of 53 flora species were identified within the subject site. Of these 24 were native and 29 were exotic. A full list of all of these species is in **Appendix B**.

4.3.1 Threatened flora

No threatened flora species were observed during the field survey. However, the survey was conducted outside the peak flowering period for some species, such as *Pimelea spicata* (Spiked Rice Flower). However, due to the modified nature of the subject site, exotic dominated pastures and grazing history it is unlikely that any of threatened species recorded from the broader locality would persist onsite (see **Appendix A**).

4.3.2 Noxious weeds

Of the 29 exotic species recorded on site, eight are listed as noxious in the Liverpool City Council LGA under the *Noxious Weeds Act 1993* (NSW DPI 2012) (**Table 5**). Five of these noxious weeds, along with Fireweed (*Senecio madagascariensis*), are considered Weeds of National Significance (WONS) (AWC 2012) (**Table 5**).

Table 5: Noxious and Weeds of National Significance recorded within the subject site

Scientific name	Common name	Noxious Weed Control Class[1]	Weeds of National Significance (WONS)
Asparagus aethiopicus	Asparagus	4	-
Cortaderia selloana	Pampas Grass	3	-
Eichhornia crassipes	Water Hyacinth	2	Yes
Lantana camara	Lantana	4	Yes
Ligustrum lucidum	Narrow-leaf Privet	4	-
Lycium ferocissimum	African Boxthorn	4	Yes
Opuntia stricta	Common Prickly Pear	4	Yes
Rubus fruticosus	Blackberry	4	Yes
Senecio madagascariensis	Fireweed	-	Yes

Control Class 2: The plant must be eradicated from the land and the land be kept free of the plant. Control Class 3: The plant must be fully and continuously suppressed and destroyed. Control Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

4.4 Fauna habitats

A limited range of fauna habitat features are present in the study area which provide potential foraging, roosting, breeding and nesting resources for fauna species (**Table 6**).

4.4.1 Aquatic habitat and riparian zone

Figure 5 shows five farm dams within the subject site including:

- dam #1, #2 and #3 that are linked via the same channel in the north-western section of the subject site
- dam #4, a small, vegetated dam located in the centre of the subject site
- dam #5, a small dam with disturbed banks due to livestock activities

At the time of the survey, the small vegetated dam (**Figure 5**) contained little or no water whilst the four other dams were full (**Figure 6** and **Figure 7**). The habitat in the two most westerly dams consisted of clear, unshaded water with plentiful emergent, floating and riparian vegetation. Typically, this would be regarded as being of high quality to the TSC Act and EPBC Act listed *Litoria aurea* (Green and Golden Bell Frog (GGBF)). However, it was discovered that these dams were infested by the introduced *Gambusia holbrooki* (Plague Minnow or Mosquito Fish). The Plague Minnow predates upon frog eggs and tadpoles and is recognised as a key threatened process (KTP) to the GGBF (NSWSC 1999). Therefore, it is very unlikely that GGBFs would occur at the subject site.

The two vegetated riparian zones were dominated by a dense ground cover of *P. clandestinum* (Kikuyu) (**Figure 8**). This habitat would normally provide foraging and migration habitat for fauna, including threatened GGBF and *Gallinago hardwickii* (Latham's Snipe) (Naarding 1982, 1983). However, as discussed this habitat is unlikely support GGBF due to the presence of the Plague Minnow. Despite this, the riparian habitat remains suitable to Latham's Snipe and migratory species such Great Egret and Cattle Egret.

4.4.2 Terrestrial fauna habitat

Table 6 outlines the habitat features present for fauna groups and indicates where these were located in the subject site. The locations of hollow-bearing trees are shown in **Figure 3**. Prior to field assessment it was considered that potential habitat would occur for the Cumberland Plain Land Snail, though management of the site through grazing and underscrubbing have reduced any leaf or bark litter habitat necessary for this species survival.

Table 6: Fauna habitats recorded at the subject site

Habitat feature	Vegetation type	Fauna group using habitat feature	Abundance of feature
Hollow-bearing Tree / Stag	GB-FRG grassy woodland and scattered paddock trees	Birds, mammals, micro-chiropteran bats, amphibians	13 HBTs were recorded.
Fallen timber	Pasture	Small mammals, reptiles, and insects	One large log was observed
Drainage channel and impeded drainage areas with wetland flora	Pasture	Amphibians, birds, reptiles, micro-chiropteran bats	Two formalised channels were present
Dense exotic grasslands, vines and shrubs	Pasture	Small birds, common and ground dwelling mammals to urban environments.	Majority of study site with scattered occurrences of blackberries
Aquatic habitat	Pasture	Amphibians	Farm dams and drainage channels

4.5 Fauna

Thirteen fauna (two exotic and 11 native) species including nine birds, two amphibians, one fish and one reptile were recorded during the survey (**Appendix B**). As stated previously, this includes the exotic Plague Minnow, which is recognised as a key threatening process to the GGBF (NSWSC 1999).

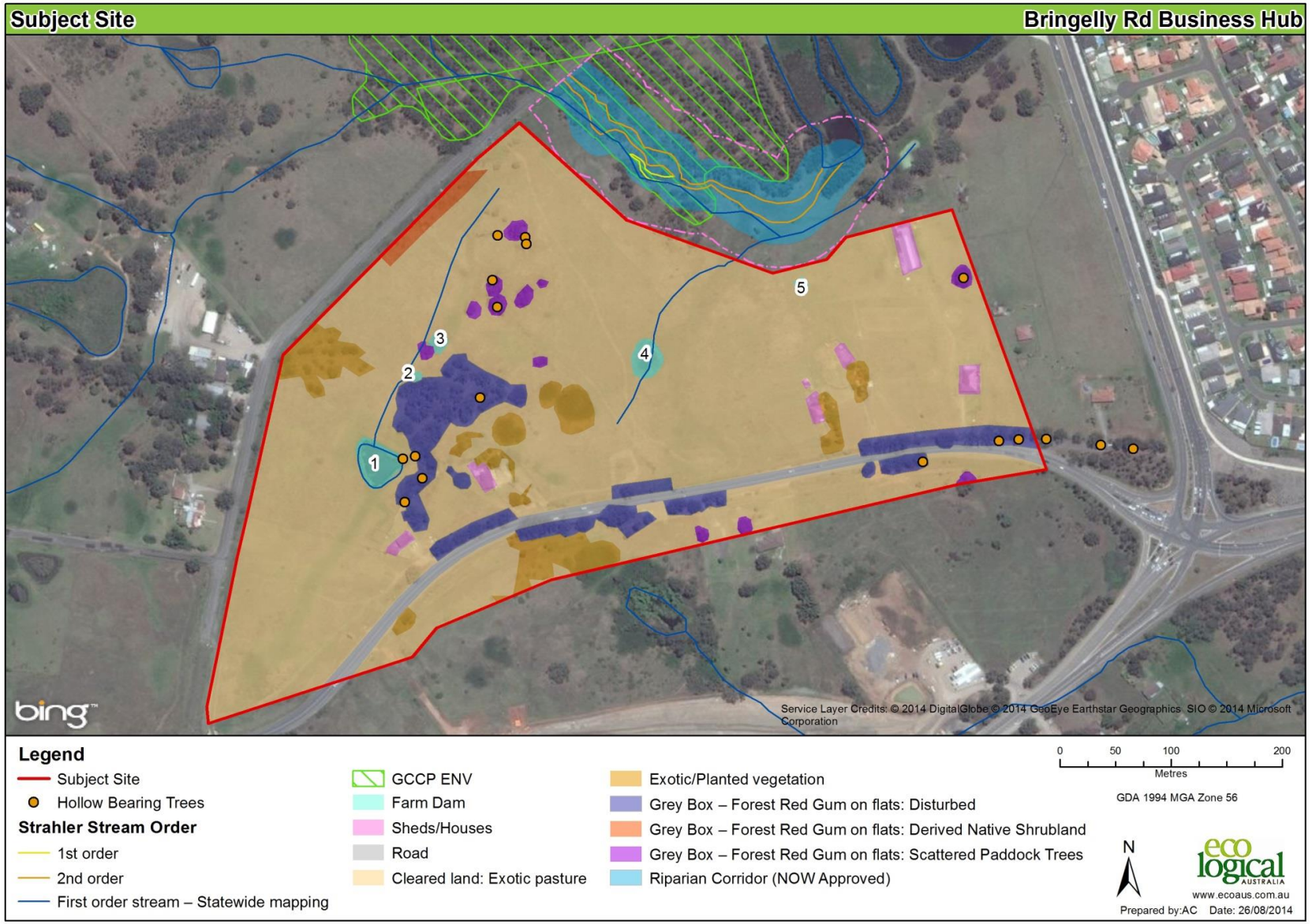

Figure 3: Landuse, vegetation community and fauna habitats mapped on the subject site. Dams are labelled 1–5.

Figure 4: Grey Box - Forest Red Gum Grassy Woodland looking south

Figure 5: Small farm dam in the centre of the study area with thick *Eichhornia crassipes* (Water Hyacinth)

Figure 6: Large farm dam (#1)

Figure 7: Smaller farm dam (#3)

Figure 8: Pasture - exotic grassland lining a creek (upstream of farm dam #1)

Figure 9: Pasture - exotic grass in the subject site, looking north

5 Direct and indirect impacts

This section outlines the anticipated direct and indirect impacts of the development on the ecological values of the study area.

5.1 Direct impacts

5.1.1 Vegetation clearing

The subject site currently contains 1.82 ha of GB – RFG grassy woodland (i.e. CPW) vegetation which varies in condition from disturbed woodland, scattered paddock trees to derived native shrubland (**Table 3**). The proposed development will clear and replace this vegetation as well as approximately 18 ha of exotic pasture and orchard.

5.1.2 Loss of flora habitat

Small areas of potential threatened flora habitat occur within the subject site. Targeted surveys failed to locate any of the threatened flora species with the potential to be present. The absence of these species is likely due to the high level of disturbance and modification of the site.

5.1.3 Loss of fauna habitat

The study area provides potential habitat for a limited range of threatened and non-threatened fauna species. The proposal will remove potential foraging, roosting/sheltering, and breeding habitat for fauna species from the subject site. Following site assessment, threatened and migratory fauna known or considered likely to utilise the subject site are:

- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
- *Mormopterus norfolkensis* (East Coast Freetail Bat)
- *Myotis macropus* (Large-footed Myotis)
- *Ardea alba* (Great Egret)
- *Ardea ibis* (Cattle Egret)
- *Gallinago hardwickii* (Latham's Snipe)

The site contains 13 HBTs, all of which will be removed for the development.

5.2 Indirect impacts

The areas subject to the immediate, short and long term indirect impacts resulting from the proposed development are difficult to quantify. Some impacts may be confined to discrete areas, or can spread for varying distances from a source point (such as artificial light impacts). Other impacts can be of greater intensity at a source point (such as noise), with indirect impacts on surrounding flora or fauna species extending to an undefined distance (flora and fauna species will have species specific responses to various disturbances).

Potential indirect impacts are discussed below. A range of avoidance and mitigation measures are outlined in **Section 7**.

5.2.1 Noise

Noise levels that could discourage microbats and other threatened fauna are likely to increase during the construction phase. Considering that all fauna habitats are to be removed, any noise increase could be advantageous by discouraging these species from using the site before the removal of any fauna habitat.

5.2.2 Weed invasion

The subject site is highly modified and contains large areas of Pasture-exotic Grassland. Eight noxious weed species and six WONS (five of which were also noxious weed species) were included in the 31 exotic species recorded within the subject site. There is potential for the proposal to contribute to the spread of these weeds if not managed appropriately. See recommendations for discussion of mitigation measures (**Section 7.1.3**).

5.2.3 Erosion and sedimentation

Development of the site will expose soils, making them vulnerable to erosion and sedimentation, particularly during moderate to high rainfall events, if not managed appropriately. See recommendations for discussion of mitigation measures (**Section 7.1.3**).

6 Impact assessment

6.1 State listings

Impact assessments in accordance with Guidelines for Threatened Species Assessment for SSD (DEC and DPI 2005) are provided in **Appendix D** for:

- Cumberland Plain Woodland (CPW) in the Sydney Basin Bioregion
- Microchiropteran bat species:
  - *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
  - *Mormopterus norfolkensis* (East Coast Freetail-bat)
  - *Myotis macropus* (Large-footed Myotis)

Avoidance, mitigation and offset measures for these species are considered in **Section 7**.

6.2 Commonwealth listings

Three matters of NES were assessed using the Significant Impact Guidelines 1.1 (DotE 2014) criteria in **Appendix E** for:

- *Ardea alba* (Great Egret)
- *Ardea ibis* (Cattle Egret)
- *Gallinago hardwickii* (Latham's Snipe)

All tests conclude that significant impacts are unlikely to occur to threatened and migratory species due to the proposed works.

7 Avoidance, mitigation and offset requirements

As required by the DGRs, *'steps to be taken to avoid, mitigate or offset any impacts to the environment, threatened species, populations and endangered ecological communities'* must be identified. Further, the DGRs require that *'the NSW offset principles for major projects (SSD & SSI) are to be used in assessing and determining the adequacy of any offsets'* (OEH 2014).

NSW Offset Principle 1 requires proponents to '*offset any impacts that can't be avoided or mitigated against*', and Principle 9 requires that *'offsets must be quantifiable…* and *…should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset*'.

Based on the potential direct and indirect impact of the proposal on the environment, ways to avoid, mitigate and offset potential impacts have been identified below.

7.1 Avoidance and mitigation

Given that any retained vegetation at the subject site would require intensive ongoing management due to the proposed future land use, offsite offset measures in larger consolidated patches are considered the most appropriate mitigation for impacts of the proposal. Whilst avoidance was not considered an appropriate measure, some direct and indirect impacts are able to be avoided through appropriate site management practices and pre-clearance surveys.

As identified in **Section 5**, direct impacts will occur to fauna habitats including, HBTs, farm dams and some fallen timber. It is possible that hollow dependant fauna such as microbats, arboreal mammals and amphibians may be present in HBTs and aquatic and amphibious species may be present in the farm dams, and appropriate pre-clearance protocols should be in place at the time of construction to avoid any harm or injury to these individuals.

7.1.1 Loss of fauna habitat – Pre-clearance protocols

On-site supervision of habitat tree felling and relocation of fauna

An ecologist will be required to be present onsite when felling of the hollow bearing trees to undertaken and inspect hollow(s) once tree is on ground. Any fauna that may be occupying the hollow during felling operation will be removed (where feasible). The ecologist will need to work closely with the plant operators to identify each HBT and to stop work if an animal is observed and requires rescue. The ecologist will encourage any fauna species that may be present to move from site or if alternatively capture, store and actively relocate them to another area. Further, the ecologist will ensure that any injured animals receive the appropriate levels of care. The nearest veterinary clinics will be contacted prior to the works beginning to ensure that they have the capabilities to care for injured native animals.

If any microbats are identified in the hollows, they will be required to be captured, placed in calico bags, stored in a cool, dark, well-ventilated environment and released (after the HBT have been felled) at or adjacent to the site after dusk.

Soft felling operations

We encourage a soft felling process which involves an excavator or bulldozer giving the tree a few 'nudges' before felling, in the hope to dislodge or encourage any fauna that may be present, to move out of their hollows and flee form the tree before it is felled. Once the tree has been felled, the ecologist will

undertake further searches of the tree for any animal that has not fled or is unable to flee. If it proves difficult to remove an animal from a hollow, the log should be left over night to give the species further opportunity to relocate before mulching. Advice on appropriate actions for individuals that continue to utilise habitat of fallen trees should be provided by the onsite ecologist.

Habitat re-emplacement

The loss of hollows should be compensated through the retention of hollow bearing limbs (cut into sections no longer than 1.5 m). These hollow bearing limbs, where safe and practicable, should be reattached to trees in nearby areas of Western Sydney parklands. The removal and retention of any hollow bearing limb should be supervised by a suitably qualified ecologist.

Further, where practicable and under the guidance of an ecologist, hollow bearing sections removed from the HBTs are to be salvaged and either placed in the BOA or in an adjacent section of the WSP that is managed by the Trust.

Dam dewatering supervision

It is likely that farm dams will be occupied by aquatic and amphibious native fauna (e.g. Eels, turtles). Onsite supervision by suitably qualified ecologist should be undertaken at the time of dam dewatering. Further, it is noted that the dams are occupied by Plague Minnow, an exotic fish species listed as a KTP in NSW and appropriate measures should be implemented to avoid any individuals of this species or other exotic species from entering natural waterways, such as filtering of dewatering pumps and/or screening downstream of dams during the dewatering process.

7.1.2 Erosion and sediment control plan

Appropriate erosion and sedimentation controls should be put in place following best practice protocols such as Landcom (2004).

7.1.3 Construction Environmental Management Plan (CEMP)

It is recommended that the above protocols are included in a site specific Construction Environmental Management Plan (CEMP), prior to any construction works taking place. The CEMP will be required to span the pre, during and post-construction period.

7.2 Offsets

Where impacts to vegetation and habitat have not been avoided or mitigated, the NSW offset principles require that: *'offsets must be quantifiable and the impacts and benefits must be reliably estimated… based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset'* (Principle 9). In NSW, the most appropriate methodology for quantifying impacts and benefits reliably is the NSW BioBanking Assessment Methodology (BBAM) (DECC 2008).

The Biobanking methodology utilises 'ecosystem credits' as a surrogate for habitat loss / or gain during the offsetting process. The amount of ecosystem credits required for an offset is determined by both the condition of the development site and the potential to improve the condition of the offset site. A summary of the credits required (using the Biobanking methodology) to offset the impacts of the proposal is included in **Table 7**. Generally, a development site in 'moderate to good condition' will require a larger offset than a site in 'low condition'.

The vegetation at the subject site is found in various conditions, and has been mapped accordingly. ELA have undertaken numerous formal and information calculations of impact assessments for sites in Western Sydney area, and more specifically for CPW (or GB-FRG grassy woodland's). One such assessment that was undertaken for Western Sydney Parklands at Eastern Creek (ELA 2012), and based

on the variation in condition at the site, an estimate of credit requirements is provided in **Table 7**. It is noted that whilst informed by actual BBAM calculations at Eastern Creek, the offset ratio cannot be reliably calculated without the collection of site specific BBAM plot data from the BRBH.

Similarly, ELA have prepared many formal and informal Biobanking calculations for Biobank sites, and have found that vegetation in 'moderate' condition at an offset site will generate ~10 credits / ha based on previous assessments in Western Sydney. As it is likely the BOS will recommend the retirement of ecosystem credits from Biobank site within Western Sydney Parklands, which has a similar range of conditions to those previously assessed, the number of credits that could be generated has been estimated at an average of 10 / ha. The use of this figure provides a relatively accurate estimate of the offset required for the project. For the area and condition of vegetation being impacted, **Table 2** indicates that the retirement of approximately 44ecosystem credits would be an appropriate offset for the development, or an area of ~4.4 ha of the same vegetation would be required under the Biobanking methodology to meet the 'improve or maintain' requirements.

Table 7: Estimate of offset requirement under Biobanking, based on average credits requirements

Vegetation Type	Condition Class	Cleared area (ha)	Credits Required / ha	No. of credits required	Average credit generation / ha	Approx. offset area (ha)
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (GB-FRG)	Moderate to Good	1.82	24	44	10	4.4
Totals		**1.82**	**24**	**44**		**4.4**

8 Conclusions

No threatened flora, fauna or migratory species were recorded within the subject site. An assessment of likelihood of occurrence and subsequent site assessment determined that the threatened Eastern Bentwing Bat, East-coast Freetail Bat and Large-footed Myotis as well as the migratory Great Egret and Latham's Snipe have the potential to use the site. This potential was mainly due to the hollow bearing trees and dense riparian vegetation that was recorded within and adjacent to the subject site. However, at the time of survey there was no evidence of these species inhabiting the site.

Impacts to TECs and threatened flora and fauna species were considered against relevant guidelines in **Appendix B** and **Appendix C**. Due to the small scale of impacts, disturbed nature of the site, high mobility of the three microbat species, snipe and egret, and the number of alternative habitat in the area, the proposed works will not significantly impact upon any threatened or migratory fauna species.

Where impacts could not be avoided, it is a requirement of the DGRs to offset these impacts. An estimate has been provided that approximately 44 Biobanking 'ecosystem credits', or 4.4 ha of vegetation of the same type and condition would be sufficient to meet the requirements of the NSW Offset Principles. A Biodiversity Offset Strategy will be prepared for the residual impacts of 1.82 ha of CPW vegetation to more accurately quantify the appropriate offset requirements.

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Appendix A : Threatened species likelihood of occurrence

Summary of initial assessment to determine the likelihood of occurrence of threatened species, populations and ecological communities in the proposal site.

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

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

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Plants						
Acacia pubescens	Downy Wattle	V	V	*Acacia pubescens* 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 (Benson and McDougall 1996).	No	No
Allocasuarina glareicola			E	*Allocasuarina glareicola* is primarily restricted to the Richmond district on the north-west Cumberland Plain. An outlier population found at Voyager Point.	No	No
Asterolasia elegans			E	*Asterolasia elegans* is restricted to a few localities on the NSW Central Coast north of Sydney. This includes Baulkham Hills, Hawkesbury and Hornsby LGAs. It is generally found in sheltered forests on mid- to lower slopes and valleys as well as in or adjacent to gullies (DECC 2007).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Cryptostylis hunteriana	Leafless-Tongue Orchid	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007). The larger populations typically occur in woodland dominated by Scribbly Gum (*E. sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black She oak (*A. littoralis*) (DECC 2007).	No	No
Cynanchum elegans	White-flowered Wax Plant	E1	E	*Cynanchum elegans* is a climber that flowers between August and May (DEC 2005). It occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest (NPWS 1997). The species has also been found in littoral rainforest; Leptospermum laevigatum – *Banksia integrifolia subsp. integrifolia* coastal scrub; *E. tereticornis* open forest/ woodland; *C. maculata* open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (DEC 2005).	No	No
Dillwynia tenuifolia population at Kemps Creek		E2		This endangered population of *Dillwynia tenuifolia* occurs in the area bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area, Western Sydney.	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Eucalyptus scoparia	Wallangarra White Gum	E1		*Eucalyptus scoparia* is only known to occur in the Tenterfield district. It is regarded as being very uncommon. It prefers rocky hillsides in shrubby woodland close to granite outcrops.	No	No
Genoplesium baueri	Yellow Gnat-orchid		E	*Genoplesium baueri* is 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. It grows in shrubby woodland in open forest on shallow sandy soils.	No	No
Grevillea parviflora subsp. *parviflora*	Small-Flower Grevillea	V	V	*Grevillea parviflora subsp. parviflora* is sporadically distributed throughout the Sydney Basin mainly around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie and Cessnock and Kurri Kurri (DEC 2005).	No	No
Gyrostemon thesioides		E1		Within NSW, *Gyrostemon thesioides* has only been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers; most recently as a single male plant near the Colo River within Wollemi National Park (DEC 2005).	No	No
Haloragis exalata subsp. *exalata*	Wingless Raspwort, Square Raspwort		V	This species is known from a number of populations on the eastern edge of the Northern Tablelands and the adjacent coastal valleys. Plants occur in a range of habitats but are often in disturbed areas.	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Leucopogon exolasius	Woronora Beard-heath	V	V	*Leucopogon exolasius* is found along the upper Georges River area and in Heathcote National Park (DECC 2007). It is associated with Sydney Sandstone Gully Forest on rocky hillsides and creek banks (NPWS 1997).	No	No
Marsdenia viridiflora subsp. *viridiflora* population in the Blacktown & Other Local Govt areas		E2		This Endangered Population of *Marsdenia viridiflora subsp. viridiflora* occurs in the Prospect, Bankstown, Smithfield, Cabramatta Creek and St Mary's areas of Western Sydney. It grows in vine thickets and open shale woodland (DEC 2005).	No	No
Melaleuca deanei	Deane's Melaleuca	V	V	Found in heath on sandstone (DECC 2007), and also associated with woodland on *broad* ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	No	No
Pelargonium sp. Straitellum (G. W. Carr 10345)	Omeo Stork's-bill		E	*Pelargonium* sp. Straitellum (G.W. Carr 10345) is known from the NSW Southern Tablelands (PlantNet 2011). It is also known from the shores of Lake Omeo near Benambra in Victoria (Walsh & Entwisle 1999).	No	No
Persoonia nutans	Nodding Geebung	E	E	*Persoonia nutans* is endemic to the Western Sydney (Benson and McDougall 2000). This species is generally associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland (Benson and McDougall 2000).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Pimelea curviflora var. *curviflora*		V	V	*Pimelea curviflora* var*. curviflora* 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 (DEC 2005).	Potential	No
Pimelea spicata	Spiked Rice Flower	E	E	*Pimelea spicata* occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW). It has been located in disturbed areas of CPW (Ibid.).	Potential	No
Pomaderris brunnea	Rufous Pomaderris	V	V	*Pomaderris brunnea* occurs in a limited area around the Colo, Nepean and Hawkesbury Rivers as well as near Walcha on the Northern Tablelands. It grows in moist woodland or forest on clay or alluvial soils of floodplains and creek lines (DEC 2005).	No	No
Pterostylis gibbosa	Illawarra Greenhood	E	E	*Pterostylis gibbosa* is known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra (DEC 2005).	No	No
Pterostylis nigricans	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).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Pterostylis saxicola	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).	No	No
Pultenaea parviflora		E	V	*Pultenaea parviflora* 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 (DEC 2005). It may also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland (ibid.).	No	No
Pultenaea pedunculata	Matted Bush-pea	E1		In NSW, *Pultenaea pedunculata* is known from three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. It grows in woodland vegetation but plants have also been found on road batters and coastal cliffs.	No	No
Streblus pendulinus	Siah's backbone		E	*Streblus pendulinus* is a tree or a large shrub. It's distribution covers an area from Cape York Peninsula to southeast NSW. It generally occurs along watercourses in warmer rainforests.	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Thelymitra kangaloonica Formerly *Thelymitra* sp. *Kangaloon* (D. L. jones 18108)	Kangaloon Sun-orchid		CE	This species occurs at three locations near Robertson in the Southern Highlands of NSW. It grows in seasonally swampy sedge-lands at altitudes of 600 to 700m above sea level (DoE 2014b)	No	No
Fish						
Macquaria australasica	Macquarie Perch	E (under FM Act)	E	Habitat for the Macquarie Perch is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation.	No	No
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River southwards through NSW, VIC and TAS. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat.	No	No
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). It is associated with semi-permanent to ephemeral sand or rock based streams, where the soil is soft and sandy so that burrows can be constructed (Ehmann 1997).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Litoria aurea	Green and Golden Bell Frog	E	V	The Green and Golden Bell Frog uses a variety of waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). The species prefers shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (Gambusia holbrooki) (DECC 2007).	Potential	No
Litoria littlejohni	Littlejohn's Frog		V	Littlejohn's Frog is restricted to sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000). Littlejohn's Tree Frog 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 2007). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops (DECC 2007).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Litoria raniformis	Southern Bell Frog	E	V	Southern Bell Frogs prefer relatively still or slow-flowing billabongs, ponds, lakes or farm dams, especially where bulrushes (Typha sp., Eleocharis sp. and Phragmites sp.) are present (Ehmann 1997). The Southern Bell Frog occurs in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (DECC 2007).	No	No
Reptiles						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Broad-headed Snake uses exposed sandstone outcrops and benching in woodlands, open woodlands and/or in heath on Triassic sandstone of the Sydney Basin (DECC 2007). They use rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998).	No	No
Diurnal Birds						
Anthochaera Phrygia (aka Xanthomyza phrygia)	Regent Honeyeater	E	E & M	The Regent Honeyeater is 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 (*Casuarina cunninghamiana*).	Unlikely	No
Botaurus poiciloptilus	Australasian Bittern	V	E	The Australia Bittern uses terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993).	Unlikely	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Burhinus grallarius	Bush Stone-curlew	E1		Bush Stone-curlew is associated with dry open woodland with grassy areas, dune scrubs, in savannah areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). It forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Marchant & Higgins 1993).	No	No
Chthonicola sagittata	Speckled Warbler	V		Speckled Warbler occupies a wide range of eucalypt dominated communities with a grassy understorey, often on rocky ridges or in gullies (DECC 2007). Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DECC 2007). Large, relatively undisturbed remnants are required for the species to persist in an area (DECC 2007).	No	No
Circus assimilis	Spotted Harrier	V	-	The Spotted Harrier is found in mainland Australia and Indonesia. The Spotted Harrier is found in open wooded country in tropical and temperate Australia, particularly in arid and semi-arid areas.	No	No
Daphoenositta chrysoptera	Varied Sittella	V	-	The Varied Sittella has a distribution that 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.	Unlikely	No
Dasyornis	Eastern Bristlebird	E	E	Habitat is characterised by dense, low vegetation	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
brachypterus				including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussock grass understorey; all of these vegetation types are fire prone.		
Hieraaetus morphnoides	Little Eagle	V	-	Little Eagle utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. This species uses tall trees for nesting, with a large stick nest being built. This species preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion.	Potential	Unlikely
Falco subniger	Black Falcon	V		The Black Falcon has broad but patchy distribution across inland regions New South Wales, where it has a sparse distributed. In NSW it 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).	No	No
Lathamus discolor	Swift Parrot	E	E	Swift Parrot breed in Tasmania between September and January and then migrates to the mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986). This species will occur in NSW during the autumn and winter eucalypt flowering period (DECC 2007).	Unlikely	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Petroica phoenicea	Flame Robin	V	-	Flame Robin breed in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, often on ridges and slopes, in NSW. This species prefers clearings or areas with open understorey, and grassy ground-layer for breeding habitat.	Potential	No
Rostratula australis (also R. benghalensis)	Painted Snipe (Australian subspecies)	E	E	Painted Snipe prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). It nests on the ground among 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).	No	No
Mammals (excluding bats)						
Dasyurus maculatus *Dasyurus maculatus maculatus*	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), 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)., one record	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Brush-tailed Rock-wallaby uses rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Elridge et al. 2008).	No	No
Phascolarctos cinereus	Koala (combined populations of Qld, NSW and the ACT)	V	V	The koala is generally 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	Unlikely	No
Potorous tridactylus *Potorous tridactylus tridactylus*	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V -	- V	The Long-nosed Potoroo is generally associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst and Knight 2010).	No	No
Pseudomys novaehollandiae	New Holland Mouse	-	V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. It 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 species peaks in abundance during early to mid-stages of vegetation succession typically induced by fire (DoE 2014)	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Mammals (bats)						
Chalinolobus dwyeri	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 2008; 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 2008; DECC 2007).	Unlikely	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	The Eastern False Pipistrelle prefers moist habitats with trees taller than 20m (DECC 2007). It roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	Potential	Unlikely
Miniopterus schreibersii oceanensis	Eastern Bentwing 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 2008). It forages above and below the tree canopy on small insects (Hall and Hall 2008)). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Potential	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Mormopterus norfolkensis	East Coast Freetail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 2008). 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 & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Hoye and Richards 2008).	Potential	Potential
Myotis macropus (formerly *M. adversus*)	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 2008). This species forages over streams and pools catching insects and small fish by raking their feet across the water surface (Richards et al 2008)	Potential	Potential
Pteropus poliocephalus	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 2008, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 2008).	Unlikely	No
Scoteanax rueppellii	Greater Broad-nosed	V	-	Associated with moist gullies in mature coastal forest,	Unlikely	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
	Bat			or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). 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 1998).		
Invertebrates						
Meridolum corneovirens	Cumberland (Large) Land Snail	E	-	Associated with open eucalypt forests, particularly Cumberland Plain Woodland. 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). Urban waste may also form suitable habitat (NSW NPWS 1997).	Potential	No
Migratory (terrestrial species)						
Apus pacificus	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).	Unlikely	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, 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).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Hirundapus caudacutus	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).	No	No
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). 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*).	No	No
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	No	No
Monarcha trivirgatus	Spectacled Monarch	-	M	Associated with drier eucalypt forests, absent from rainforests (Blakers et al. 1984), open forests, often at height (Simpson & Day 1999).	No	No
Myiagra cyanoleuca	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	No	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Rhipidura rufifrons	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).	No	No
Migratory (wetland species)						
Ardea alba	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). The Great Egret 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 1990; Martínez-Vilalta & Motis 1992).	Potential	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence	
					Before surveys	Post surveys
Ardea ibis	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). 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).	Potential	Potential
Gallinago hardwickii	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). 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 (Fielding 1979; Frith et al. 1977; Lane & Jessop 1985; Naarding 1982, 1983).	Potential	Potential
Rostratula australis (also R. benghalensis)	Painted Snipe		E & M	See *Rostratula australis (R. benghalensis)* in threatened species list above.	No	No

Disclaimer: Data extracted from the Atlas of NSW Wildlife and DoE 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 DoE 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. Please note that all obligate marine species were not included.

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

Appendix B Flora species recorded at the site

Family	Species name	Common	Native/exotic	Growth form
Adiantaceae	*Cheilanthes sieberi*		Native	fern
Alliaceae	*Nothoscordum borbonicum*	Onion Weed	Exotic	Herb
Apocynaceae	*Araujia sericifera*	Moth Vine	Exotic	Vine
Asparagaceae	*Asparagus aethiopicus*	Asparagus	Exotic	Herb
Asteraceae	*Bidens pilosa*	Cobblers Pegs	Exotic	Herb
Asteraceae	*Cirsium vulgare*	Thistle	Exotic	Herb
Asteraceae	*Conyza* sp.	Fleabane	Exotic	Herb
Asteraceae	*Senecio madagascariensis*	Fireweed	Exotic	Herb
Asteraceae	*Taraxacum officinale*	Dandelion	Exotic	Herb
Cactaceae	*Opuntia stricta*	Common Prickly Pear	Exotic	Cactus
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	Native	Herb
Convolvulaceae	*Dichondra repens*	Kidney Weed	Native	Herb
Cyperaceae	*Carex* sp.		Native	Sedge
Fabaceae	Senna sp.	Senna	Exotic	Shrub
Fabaceae	*Hardenbergia* sp.		Native	Vine
Fabaceae - Faboideae	*Jacksonia scoparia*	Dogwood	Native	Shrub
Fabaceae - Faboideae	*Desmodium varians*	Slender Tick-trefoil	Native	Herb
Fabaceae - Faboideae	*Glycine clandestina*		Native	Vine
Fabaceae - Faboideae	*Glycine tabacina*		Native	Vine
Fabaceae - Mimosoideae	*Acacia parramattensis*	Parramatta Wattle	Native	Shrub
Geraniaceae	*Geranium homeanum*		Native	Herb
Juncaceae	*Juncus acutus*		Exotic	Sedge
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	Exotic	Shrub
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	Native	Tree
Myrtaceae	*Eucalyptus moluccana*	Grey Box	Native	Tree
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	Native	Tree
Myrtaceae	*Melaleuca decora*		Native	tree

Family	Species name	Common	Native/exotic	Growth form
Oleaceae	*Ligustrum lucidum*	Large Leaved Privet	Exotic	Shrub
Oleaceae	*Olea europaea* subsp. *cuspidata*	Olive	Exotic	Shrub
Oxalidaceae	*Oxalis perennans*		Native	Herb
Oxalidaceae	*Oxalis* sp.		Exotic	Herb
Pittosporaceae	*Bursaria spinosa* subsp. *spinosa*	Native Blackthorn	Native	Shrub
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongue	Exotic	Herb
Poaceae	*Aristida vagans*	Three-awn Speargrass	Native	Grass
Poaceae	*Briza minor*	Quaking Grass	Exotic	Grass
Poaceae	*Chloris ventricosa*	Plump Windmill Grass	Native	Grass
Poaceae	*Cortaderia selloana*	Pampas Grass	Exotic	Grass
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	Exotic	Grass
Poaceae	*Eragrostis curvula*	African Lovegrass	Exotic	Grass
Poaceae	*Microlaena stipoides*	Weeping Grass	Native	Grass
Poaceae	*Paspalum dilatatum*	Paspalum	Exotic	Grass
Poaceae	*Pennisetum clandestinum*	Kikuyu	Exotic	Grass
Poaceae	*Sporobolus creber*	Western Rat-tail Grass	Native	Grass
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	Native	Herb
Polygonaceae	*Rumex* sp.		Native	Herb
Pontederiaceae	*Eichhornia crassipes*	Water Hyacinth	Exotic	Herb
Proteaceae	*Hakea sericea*		Native	Shrub
Rosaceae	*Rubus fruticosus*	Blackberry	Exotic	Shrub
Rosaceae	*Cotoneaster* sp.	Cotoneaster	Exotic	Shrub
Rosaceae	*Malus* sp.	Apple Tree	Exotic	Shrub
Solanaceae	*Lycium ferocissimum*	African Boxthorn	Exotic	shrub
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter	Exotic	Herb
Verbenaceae	*Lantana camara*	Lantana	Exotic	Shrub
Verbenaceae	*Verbena* sp.	Purpletop	Exotic	Herb

Appendix C Observed fauna species

Class	Family	Species name	Common name
Amphibia	Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog
Amphibia	Myobatrachidae	*Crinia signifera*	Common Eastern Froglet
Aves	Accipitridae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
Aves	Alcedinidae	*Cracticus torquatus*	Grey Butcherbird
Aves	Columbidae	*Acridotheres tristis*	Common Myna
Aves	Cuculidae	*Egretta novaehollandiae*	White-faced Heron
Aves	Cuculidae	*Egretta novaehollandiae*	Intermediate Heron
Aves	Cuculidae	*Elanus axillaris*	Black-shouldered Kite
Aves	Maluridae	*Ocyphaps lophotes*	Crested Pigeon
Aves	Psittacidae	*Platycercus elegans*	Crimson Rosella
Aves	Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot
Osteichthyes (bony fish)	Poeciliidae	*Gambusia holbrooki*	Plague Minnow or Mosquito Fish
Reptilia	Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake

Appendix D : Impact assessments (TSC Act listed species)

An assessment of the impacts of the proposal on species, populations and ecological communities listed under Schedules 1 and 2 of the TSC Act has been completed. The Project will be assessed under Part 4.1 of the EP&A Act (provisions for SSD) and consequently this impact assessment was undertaken in accordance with the *Guidelines for threatened species assessment* (DEC and DPI 2005).

The study area supports areas of native vegetation including EECs and potential and known habitat for a number of threatened fauna species. A full list of species recorded within a 10 km radius of the study area is found in Appendix A; however, not all of these species or their habitat is likely to be impacted. Potentially impacted species are listed below. Each flora and fauna species has been assessed for potential impacts that may result.

Threatened Ecological Community

- Cumberland Plain Woodland

Threatened Fauna

- Miniopterus schreibersii oceanensis (Eastern Bentwing Bat)
- Mormopterus norfolkensis (East Coast Freetail Bat)
- Myotis macropus (Large-footed Myotis)

Migratory species

- *Ardea alba* (Great Egret)
- *Ardea alba* (Cattle Egret)
- *Gallinago hardwickii* (Latham's Snipe)

Cumberland Plain Woodland

Cumberland Plain Woodland is an Endangered Ecological Community (EEC) occurring on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Before European settlement, CPW was extensive across the Cumberland Plain, Western Sydney. DECC (2008f) estimated that only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain.

Grey box – Forest Red Gum Forest is the Biometric equivalent to Shale Plains Woodland, which is a sub-community of Cumberland Plain Woodland.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable – CPW is not a threatened species and/or population

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal will result in the permanent removal of 1.82 ha of CPW. The vegetation within the subject site consists of a canopy dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*). The shrub layer over large parts of the study area has been and has been previously subject to grazing and has recently been modified. Native Blackthorn (*Bursaria spinosa* subsp. *spinosa*) is one of the more common shrub layer species throughout the study area. Groundcover vegetation is typically dominated by a mixture of native and exotic grasses and herbs. Native groundcover was mostly dominated by the native grasses *E. leptostachya* (Paddock Lovegrass), *M. stipoides* (Weeping Rye Grass), and the exotic Panic Ehrharta erecta (Veldt Grass), *Setaria parviflora*, with the native herb *Dichondra repens* (Kidney Weed), and the exotic *Bidens pilosa* () and *Conyza* spp. (Fleabane).

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Not applicable – CPW is not a threatened species and/or population

How is the proposal likely to affect current disturbance regimes?

The majority of the subject and adjoining areas are already highly modified from previous agricultural practices and residential developments. The disturbance regimes that are apparent at the site include weed invasion, soil disturbance, habitat modification and the impacts cause by agriculture and grazing.

How is the proposal likely to affect habitat connectivity?

These CPW patches are isolated from each other and from adjoining area by open exotic grassland. The clearance of these isolated patches is unlikely to significant increase the further these levels of fragmentation of vegetation and habitat onsite.

A larger stand of similar vegetation exists to the north of the subject site that will be protected in Western Sydney Parklands.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat has not been declared for this community.

Microchiropteran Bat species

Due to similarities in foraging, roosting requirements (generally tree hollows) and predicted response the proposed development, the following three microchiropteran bat species have been grouped together for this Assessment of Significance. Where obvious differences are apparent between each species, they are discussed separately.

***Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)**

The species has recently been revised to *Miniopterus orianae oceanensis* (Churchill 2008), recognising the subspecies to full species status. Eastern Bentwing Bat occupies a range of forested environments (including wet and dry sclerophyll forests, monsoon forest, open woodland, *Melaleuca* forests and open grasslands) that occur along the coastal portion of eastern Australia, from Cape York in north Queensland to Castlemaine in Victoria (Churchill 2008).

This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation. Though individuals often use numerous roosts, it congregates in large numbers at a small number of nursery caves to breed and hibernate (breeding or roosting colonies can number from 100 to 150,000 individuals).

This species primary roost in caves but has been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows (Hoye and hall 2008). This species occupies a number of roosts within specific territorial ranges usually within 300 km of the maternity cave, and may travel large distances between roost sites (OEH 2012).

Mormopterus norfolkensis (East Coast Freetail Bat)

The East Coast Freetail-bat occurs in dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 2008). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Hoye et al. 2008). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Hoye et al. 2008).

Myotis macropus (Large-footed Myotis)

The distribution of the Large-footed Myotis is generally restricted to coastal areas and is rarely found more than 100 km inland (Churchill 2008). This species inhabits a variety of habitats, as long as they are near water where this species forages (Churchill 2008). Large-footed Myotis forage along streams and pools, feeding on insects and small fish caught by raking their long feet across the water surface Churchill 2008).

Large-footed Myotis is primarily a cave dweller but will roost in tree hollows, under bridges, in clumps of vegetation, buildings, mine tunnels and stormwater drains (Churchill 2008). Communal roosts are common with groups of 10 - 15 individuals often found roosting together (REFS).

The site provides potential foraging habitat and roosting (tree hollows) to this species.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The site potential provides foraging and some marginal roosting habitat for these microchiropteran bats species. The proposal loss of GB – FRG and HBTs could impact on the life cycle of these species of micro – bat by reducing the amount of foraging habitat available to the species and degrading and fragmenting their habitat.

Removal of GB – FRG woodland could impact on the foraging activities of these species. While in infilling of the dams would directly impact on Large-footed Myotis.

The proposal involves the removal of 13 HBT scattered throughout the site. Each hollow tree has the potential to supporting roosting habits and important lifecycle phases of all three species. The proposal could also impact upon the breeding habitat Eastern False Pipistrelle and Large-footed Myotis given that these two species often breed in hollow trees. However, in contrast, the removal of the trees proposal is less likely to impact on the breeding habitat of the Common Bentwing Bat given the species breeds in maternity caves away from the study area.

Indeed, Gilmore and Parnaby 1994 list land clearing and logging as a major threat to Eastern False Pipistrelle.

However, given the highly mobile each species and in some cases their ability to travel large distances while foraging and migrating. Also, given habitat is widely spread across the adjoining Western Sydney Parklands, it is unlikely that the proposed works will disrupt the life cycle of these species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Vegetation representing foraging habitat for these species is currently located in the north-east, north-west and central portion of the site and are separated from each other by patches of open, exotic-dominated grassland.

The proposal would not impact on preferred roosting or breeding habitat for the species (caves, culverts). The removal of habitat trees, including trees with hollows (potential roosting, but not preferred roosting habitat), will be avoided where possible. However, where the removal of habitat trees is required, a pre-clearance protocol will be developed and implemented to determine if roosts are present in any trees proposed for clearing. An ecologist should be present during clearing to capture and re-release individuals (where appropriate).

These species are highly mobile and would be able to access foraging resources in the locality.

How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been highly modified due to previous grazing and agricultural practices. Current disturbances at the site include weed invasion, soil and vegetation disturbance.

The proposal will result in the removal of the foraging and roosting habitat from the site.

How is the proposal likely to affect habitat connectivity?

The proposed development will permanently removal 1.82 ha of CPW from the subject site. This loss will occur over nine isolated and fragmented patches of CPW. The habitat patches present on site are currently somewhat distinct from each other, separated by stretches of open exotic grassland. Clearance of the 1.82 ha of CPW will not cause further fragmentation of vegetation and habitat onsite. All of these microbat species are highly mobile and alternative habitat is available in the surrounding study areas. Therefore the proposed development is unlikely to affect existing low levels of habitat connectivity.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Appendix E : Impact Assessments (EPBC Act listed species)

The EPBC Act Administrative Significant Impact Guidelines 1.1. set out **'Significant Impact Criteria'** that is used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of having national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Nuclear actions

Specific Significant Impact Criteria are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act. The species subject to the Significant Impact Criteria are:

Migratory Birds

- *Ardea alba* (Great Egret)
- *Ardea ibis* (Cattle Egret)
- *Gallinago hardwickii* (Latham's Snipe)

Matters to be addressed	Impact (Commonwealth legislation)
a. any environmental impact on a World Heritage Property;	No No Commonwealth listed World Heritage Property will be directly or indirectly impacted by the proposed works.
b. any environmental impact on Wetlands of International Importance;	No No RAMSAR or internationally important wetlands will be directly or indirectly affected by the proposed works.
c. any impact on Commonwealth	No.

Matters to be addressed	Impact (Commonwealth legislation)
Listed Critically Endangered or Endangered Species.	No Commonwealth Listed Critically Endangered or Endangered Species will be directly or indirectly affected by the proposed works.
c. any impact on Commonwealth Listed threatened Species.	No. No Commonwealth Listed threatened Species will be directly or indirectly affected by the proposed works.
d. Any impact on Commonwealth Listed Threatened Ecological Communities of Critically Endangered Ecological Community	No. The vegetation onsite did not meet the condition thresholds for Commonwealth listed Critically Endangered Ecological Community, Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest was recorded at the subject site (BVT equivalent veg type is GB-FRG Grassy Woodland).
e. any environmental impact on Commonwealth Listed Migratory Species;	Yes. Two Commonwealth listed migratory species was recorded at the subject site: *Ardea alba* (Great Egret) **Criterion a: substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species** The proposal will not substantially modify, destroy or isolate an area of declared important habitat for these two migratory bird species. This is because: • There are no areas of declared important habitat for these species in the region,there none will be modified (Bamford et al. 2008) • These species is highly mobile and are capable of flying large distances and thus the proposed fragmentation will not isolate habitat for these species. Considerable areas of potential habitat exists for these species that occurs in proximity to the site that will remain unaffected by the propose works. **Criterion b: result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species** The proposal will not introduce or facilitate an invasive species that is harmful to either species in an area of important habitat or otherwise. *Vulpes vulpes* (European Red Fox) are likely to already occur on the site and actions are required to control them. **Criterion c: Seriously disrupt the lifecycle (breeding, feeding, migration or nesting behaviour) of an ecologically significant proportion of the population of the species.** The proposal is unlikely to disrupt the lifecycle of an ecologically significant proportion

Matters to be addressed	Impact (Commonwealth legislation)
	of the population of these species for the following reasons: The proposal involves minor impacts to a small area of habitat for these species. The vegetation to be removed is considered to provide only a portion of foraging habitat for these species.
f. does any part of the Proposal involve a Nuclear Action;	No The project does not include a Nuclear Action.
g. any environmental impact on a Commonwealth Marine Area;	No There are no Commonwealth Marine Areas within the subject site.
h. In addition, any direct or indirect impact on Commonwealth lands	No The project does not directly or indirectly affect Commonwealth land.

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