From: Xuereb Natasha
To: RECORDS
Date: 3/02/2014 12:12:50 PM
Subject: FW: DA13/1405: Eastern Precinct Ecological Report

From: Borg Belinda
Sent: Monday, 3 February 2014 11:46 AM
To: Hore Jenna
Cc: Records Management Business Support
Subject: DA13/1405: Eastern Precinct Ecological Report

Dear Jenna,

Please find attached a copy of the Ecological Assessment for the Eastern Precinct.

Records – Can you please register the document, as it does not seem to have available on ECM or the website. Document was submitted with the original documentation of the Development Application.

Regards,

Belinda Borg
Senior Environmental Planner

E bborg@penrithcity.nsw.gov.au
T (02) 4732 7505 | F (02) 4732 7958 |
PO Box 60, PENRITH NSW 2751
www.penrithishere.com.au
www.penrithcity.nsw.gov.au

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Fernhill

Fernhill Eastern Precinct Subdivision
Ecology Assessment

June 2013

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1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Fernhill to complete an Ecology Assessment to support the Development Application (DA) for the proposed Eastern Precinct development within the Fernhill Estate at Mulgoa, NSW (the proposal). The DA would be submitted to Council for approval under Part 4 of the *Environment Protection and Assessment Act 1979* (EPA Act). This Ecology Assessment is a specialist appendix for inclusion in the DA. It assesses the potential for impacts on ecological values at the site, with particular emphasis on threatened ecological communities, populations and species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1994* (FM Act), and *Matters of National Environmental Significance* (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Recommended mitigation measures to ameliorate potential impacts of the proposal are included in Section 6 of this report.

1.2 Proposal description

The proposal is one of three proposed three development precincts within the Fernhill Estate which are subject to a development application. The proposal comprises a 54 lot Torrens title residential subdivision accessed from Mulgoa Road that incorporates the construction of road and infrastructure services in accordance with relevant standards to service the allotments.

The proposed residential lots range in size between 900m^2 to 27,600m^2 , averaging over 1,000 m^2 and are shaped suitable for detached dwelling houses. The subject site is shown in Figure 1. Refer to the main SEE document for full details of the works to be undertaken.

1.3 Terms and definitions

The following terms are used in this report:

The proposal: The proposed residential subdivision in the Fernhill Eastern Precinct at Mulgoa, NSW that is the subject of the DA.

Subject site: the area to be directly impacted by the proposal (see Figure 1). In this case it comprises the construction footprint of the proposed residential subdivision, including the residential lots, access road, fire trail, surface water management ponds and pumping stations, potential site compounds, batters and table drains.

Study area: the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. In this study it includes the subject site and immediately adjacent areas of native vegetation. Generally this is taken to be 30 metres from the subject site boundary though a broader study area was assessed where native vegetation occurs downslope of the subject site.

Locality: the area within a 10 km radius of the subject site.

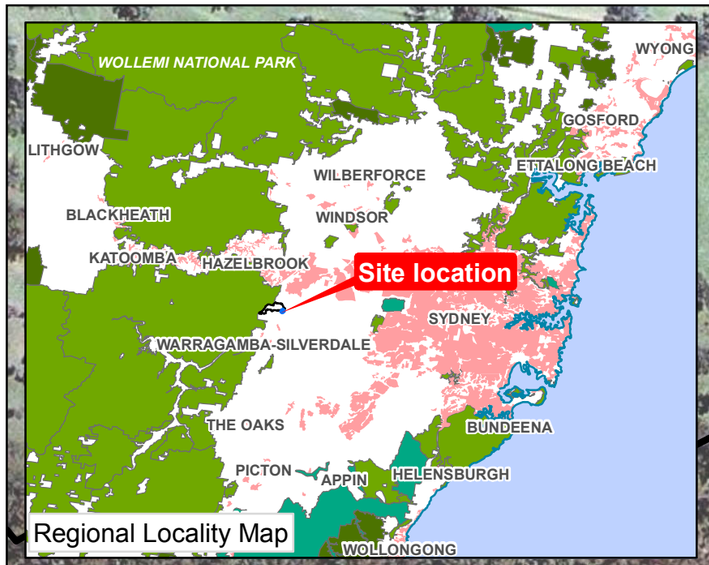
Threatened biota: Threatened species, populations and communities that are listed under the TSC Act, FM Act and/or the EPBC Act.

1.4 Scope of Assessment

The scope of this ecology assessment report is to:

- Describe the existing environment of the study area, including flora species, vegetation communities, fauna habitats and flora and fauna species known or likely to occur.

- Assess the value and conservation significance of native vegetation and habitats in the study area and the likelihood of occurrence of threatened biota based on the habitats present.
- Compile a list of threatened biota previously recorded, or predicted to occur in the locality and an assessment of their potential to occur in the study area and/or be affected by the proposal.
- Assess impacts of the proposal, addressing potential effects on native flora and fauna and particularly threatened biota and their habitats.
- Complete assessments of significance according to s.5A of the EPA Act (the seven part test) for threatened biota known or likely to occur in the study area and/or be affected by the proposal.
- Recommend mitigation measures to reduce impacts on biodiversity values.
- Provide concluding statements regarding the likely significance of impact of the proposed development on threatened biota or EPBC Act Matters of National Environmental Significance or the requirement or otherwise for further assessment or approvals at the State or federal level.



Regional Locality Map

1:3,500 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Study area
- Subject site
- Fernhill site boundary

Fernhill Eastern Precinct
Ecology Assessment

Job Number	22-16646
Revision	B
Date	28 Jun 2013

Subject site location

Figure 1

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: Geoscience Australia: 250k Data - Jan 2011; Tough Mudder: Course Route, Obstacles, Car Parking and Base Area; 2013;ESRI World Imagery: Aerial Imagery, Accessed: 2013; GHD: Vegetation, 20-12-2012. Ecological: Grevillea Locations digitised from hard copy. Created by: NAHANSEN

2. Legislative Context

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on MNES undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, undertaking, proposal or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for Sustainability, Environment, Water, Populations and Communities (the 'Minister').

The EPBC Act identifies MNES as:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

Potential impacts on any MNES must be subject to assessments of significance pursuant to the DSEWPaC *Significant Impact Guidelines* (DEWHA 2009). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister. The subject contains a number of MNES and/or their habitat and so a referral of the proposal will be prepared and submitted to DSEWPAc. The referral will include assessments of significance for MNES considered to have the potential to occur in the study area. These MNES are also listed under the NSW TSC Act and have been included in Section 5A assessments of significance in Appendix D of this report. These assessments concluded that a significant impact is not likely on MNES of relevance to the proposal. Formal assessments of impacts in accordance with the DEWHA (2009) guidelines will be included in the referral.

2.2 NSW legislation

2.2.1 Environmental Planning and Assessment Act 1979 (EPA Act)

The EPA Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to, inter alia, 'encourage the proper management, proposal and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EPA Act and EPA Regulation 2000. The proposal, as an activity that requires consent, is to be determined under Part 4 of the Act and Council is the 'consent authority' for the purposes of the Act.

Section 5A of the EPA Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the TSC Act and the FM Act. The '7-part test' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact

statement (SIS) is required. 7-part tests for threatened biota considered to have the potential to occur in the study area are included in Appendix D. These assessments concluded that a significant impact is not likely.

2.2.2 Threatened Species Conservation Act 1995 (TSC Act)

The TSC Act provides legal status for biota of conservation significance in NSW. The Act aims to, inter alia, 'conserve biological diversity and promote ecologically sustainable proposal'. It contains schedules that list endangered, critically endangered and vulnerable species, populations, ecological communities, and key threatening processes in NSW. Potential impacts on any of these biota must be subject to an impact significance assessment ("7-part test) through the provisions of section 5A of the EPA Act. Seven-part tests have been prepared for threatened biota listed under the TSC Act, and are presented in Appendix C.

If a significant impact on threatened biota is likely, a Species Impact Statement (SIS) must be completed and a licence obtained pursuant to Part 6 of the TSC Act. No significant impacts on threatened biota are anticipated from the proposal, and an SIS is not required.

2.2.3 National Parks and Wildlife Act 1979

The National Parks and Wildlife Act 1974 (NPW Act) provides the basis for the legal protection of native animals and plants in NSW. A wildlife licence is required under the NPW Act to harm or pick protected fauna and flora. All surveys were carried out under a Section 132C scientific licence (SL100146).

2.2.4 Fisheries Management Act 1994 (FM Act)

The FM Act contains schedules that list endangered, critically endangered and vulnerable aquatic species, populations, ecological communities, and key threatening processes of relevance to aquatic environments. As for biota listed under the TSC Act, potential impacts on any of these species must be addressed through 7 part tests in accordance with section 5a of the EPA Act. If a significant impact is likely, an SIS must be completed and a licence obtained pursuant to Part 7a of the FM Act. The proposal is considered unlikely to impact on any threatened biota listed under the FM Act (see Appendix C). The proposal does not involve any dredgeing or reclamation that would require specific consideration under the Act.

2.2.5 Noxious Weeds Act 1993 (NW Act)

The NW Act provides for the declaration of noxious weeds by the Minister for Primary Industries. Noxious weeds may be considered noxious on a National, State, Regional or Local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. As such, if present, noxious weeds on the site should be assessed and controlled.

There are six noxious weed species present in the study area, all of which would require management during construction of the proposal and control once the residential subdivision has been established.

2.3 NSW policies and guidelines

2.3.1 Local Environment Plan

The subject site falls within the *Penrith City Council Local Environment Plan 2010* (the LEP). The subject site is currently zoned as E3 Environmental Management under the LEP. The objectives of the E3 zone include: to protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values; and to provide for a limited range of development that does not have an adverse effect on those values.

The proposal is one of three proposed three development precincts which are subject to development application under Clause 5.10 Heritage Conservation (10) Conservation incentives of the LEP. This clause allows the consent authority to grant consent to development for any purpose of a building that is a heritage item or of the land on which such a building is erected, or for any purpose on an Aboriginal place of heritage significance, even though development for that purpose would otherwise not be allowed by this Plan, if the consent authority is satisfied that:

(a) the conservation of the heritage item or Aboriginal place of heritage significance is facilitated by the granting of consent, and

(b) the proposed development is in accordance with a heritage management document that has been approved by the consent authority, and

(c) the consent to the proposed development would require that all necessary conservation work identified in the heritage management document is carried out, and

(d) the proposed development would not adversely affect the heritage significance of the heritage item, including its setting, or the heritage significance of the Aboriginal place of heritage significance, and

(e) the proposed development would not have any significant adverse effect on the amenity of the surrounding area.

The proposed heritage conservation is described in the Fernhill Working Heritage Masterplan

The general intent of the LEP is to conserve and manage the natural environment of the Penrith LGA. The objectives of the E3 zone, Clause 5.10 and the principals of the LEP have been addressed in this report by the due consideration of the potential for impacts on native biota and the local environment in Section 5, and through impact mitigation and management recommendations provided in Section 7.

3. Methods

3.1 Desktop assessment

A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities listed under the TSC Act and FM Act, and MNES listed under the EPBC Act that may be affected by the proposal. Database records pertaining to the study area and locality (i.e. within a 10 km radius of the study area) were reviewed and included:

- NSW Office of Environment and Heritage (OEH) Wildlife Atlas database for records of threatened species listed under the TSC Act (OEH 2013a; data downloaded on 11 June 2013).
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters Online Search Tool for MNES listed under the EPBC Act and predicted to occur in the locality (DSEWPaC 2013; database queried on 27 February 2013).
- Department of Primary Industries (DPI) Threatened Species Records Viewer (DPI 2013; database queried 11 June 2013) for threatened species listed under the FM Act and recorded within the Sydney Metropolitan catchment.
- NPWS (2002) *Native Vegetation of the Cumberland Plain, Western Sydney* to identify threatened ecological communities mapped as occurring within the locality of the site
- OEH (2013b) *NSW Vegetation Types Database* and DECC (2009) BioBanking operation manual to define vegetation types and condition classes within the study area.
- EcoLogical Australia (2010) *Owston Estate (Fernhill) Ecological Assessment of Proposed Rezoning.*

The habitat resources present at the site (determined during the site inspection) were compared with the known habitat associations/requirements of the threatened and migratory biota highlighted by the desktop review. This was used to determine the likelihood of each threatened ecological community, endangered population and threatened or migratory species occurring within the study area. The results of this assessment are presented in Appendix C.

3.2 Field survey

Field surveys were conducted over three survey periods:

Table 1 Survey effort

Stage	Date	Survey Technique
Stage 1 -preliminary survey	30 May 2013	Broad-scale vegetation survey, vegetation mapping, opportunistic fauna and threatened flora observations.
Stage 2 –ecology assessment survey	6 and 7 June 2013	Four 20 m x 50 m BioBanking plot / transects, random meander searches for threatened plants, 2 x full nights Anabat recording, 2 x 2 hours of walked spotlighting surveys on separate nights, 2 x call playback on separate nights, 2 x diurnal bird surveys on separate mornings, approx. 4 hours of active

		searches for Cumberland Plain Land Snail and herpetofauna within the subject site, habitat assessments, opportunistic fauna observations.
Stage 3 – supplementary Cumberland Plain Land Snail survey	29 June 2013	8 hours of active searches for Cumberland Plain Land Snail within the study area and other areas of snail habitat in the Fernhill estate, habitat assessments, opportunistic fauna observations.

Survey techniques and effort were conducted with reference to DEC (2004) survey guidelines and appropriate to the habitats present and landscape context. The locations of survey sites are shown in Figure 2.

Weather conditions during the field survey are summarised in Table 2 below. Conditions were generally suitable for fauna surveys with mild temperatures, light wind and moderate rain in preceding days and weeks. Conditions were good for detection of native terrestrial and arboreal mammals, birds, many species of frogs and for the Cumberland Plain Land Snail. The cool overnight temperatures and mild day time temperatures would probably have limited microbat and reptile activity.

Table 2 Weather conditions during the field survey.

Stage	Date	Minimum temperature	Maximum temperature	Rainfall in preceding 24 hours	Weather conditions
Stage 1 - preliminary survey	30 May 2013	7.2	21.1	0.2	Warm and cloudy with light north-easterly winds.
Stage 2 –ecology assessment survey	6 June 2013	9.3	13.7	13.2	Cool temperatures, overcast with light south westerly winds and rain.
	7 June 2013	6.1	16.9	0.2	Cool temperatures, overcast with light south westerly winds and rain.
Stage 3 – supplementary Cumberland Plain Land Snail survey	29 June 2013	7.6	19.8	0	Warm and cloudy with light north-easterly winds.

3.2.1 Terrestrial flora survey

The flora survey involved the following techniques, which are described in detail below:

- Vegetation mapping
- Flora sampling through BioBanking plot/transects (DECC, 2008) and systematic traverses
- Targeted threatened flora surveys.

The locations of quadrats sampled during the flora survey are displayed in Figure 2.

Vegetation mapping

Native vegetation within the study area was mapped based on observed species composition and vegetation structure according to the classification of Specht (1970). Intact native vegetation was classified into NSW Vegetation Types (OEH, 2013b). Exotic or planted native vegetation was defined based on structure and species composition. All vegetation communities were then mapped using aerial photographic interpretation within a geographical information system (GIS) as guided by the field survey results.

Vegetation within the study area was assessed against identification criteria for State and Commonwealth listed threatened ecological communities (critically endangered ecological communities (CEECs), endangered ecological communities (EECs) and vulnerable ecological communities (VECs)). Vegetation and habitats was compared with descriptions provided in DEC (2005) and DSEWPC (2012b) profiles.

Flora sampling

Four plot/transect surveys were conducted on site in accordance with the BioBanking methodology (DECC, 2008), comprising:

- Identification of all plant species within a 20 metre x 20 metre plot
- Collection of native plant cover, vegetation structure data and exotic plant cover data along a 50 metre transect
- Counts of the number of hollow-bearing trees and amounts of woody debris within a 50 metre x 20 metre plot.

The condition of native vegetation was measured by assessing ten site condition attributes within plot/transects against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Cover abundance data was also collected for each species within the 20 metre x 20 metre portion of each plot/transect.

Plots were distributed between vegetation types (OEH, 2013b) and broad condition classes identified in the preliminary survey.

A systematic traverse was conducted throughout the subject site and any additional plant species not detected in plot/transects were recorded.

All vascular plants (i.e. not mosses, lichens or fungi) observed were recorded on proforma field data sheets. Each species list was accompanied by a detailed biophysical description, including vegetation structure, soils, geology and geomorphology, habitat and disturbance history. Plant specimens that could not be identified rapidly in the field were collected and subsequently identified using standard botanical texts and/or PlantNet (RBGT, 2013). Plant specimens which were difficult to identify (either insufficient sample collected or buds/fruiting bodies were not available at the time of the survey) were identified to genus level.

Targeted threatened flora surveys

Targeted surveys were undertaken for threatened flora species which could potentially occur within the study area given known distributions, previous records in the locality and habitat requirements for each species. Random meander searches were conducted throughout the subject site.

3.2.2 Terrestrial fauna survey

A variety of techniques were used for fauna surveys within the study area to compile a fauna species list, target threatened fauna species and assess habitat values. Detailed descriptions of survey techniques are outlined below. All observations were recorded on proforma field data sheets. Fauna survey locations are identified in Figure 2.

Fauna habitat assessment

General fauna habitat assessments were undertaken throughout the study area, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Habitat quality was rated as 'good', 'moderate' and 'low', based on the level of breeding, nesting, feeding and roosting resources available and the context of the habitat resources. Good quality habitat was considered to have high densities of habitat resources present, while low quality habitat was considered to have low densities of habitat resources. The quality of habitat resources was also defined based on context, for instance a habitat resource such as a hollow-bearing tree that is in an area of cleared land would be rated as lower value than if it was located in a patch of native vegetation.

Indicative habitat criteria for targeted threatened species (ie those determined as having the potential to occur within the study area following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in OEH and DSEWPC threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists. Habitat assessment assists in the compilation of a comprehensive list of fauna that are predicted within the vicinity of the study area, rather than relying solely on single event surveys that are subject to seasonal limitations and may only represent a snapshot of assemblages present.

Habitat assessments included active searches for the following:

- Trees with bird nests or other potential fauna roosts.
- Rock outcrops or overhangs providing potential shelter sites for fauna.
- Burrows, dens and warrens.
- Distinctive scats or latrine sites (of particular relevance for the Spotted-tailed Quoll), owl white wash and regurgitated pellets under roost sites.
- Tracks or animal remains.
- Evidence of activity such as feeding scars, scratches and diggings.
- Specific food trees and evidence of foraging.

The locations and quantitative descriptions of significant habitat features were captured with a handheld GPS unit and photographed where appropriate.

Hollow-bearing tree assessments

Counts and mapping of hollow-bearing trees were undertaken within the study area. Counts and estimates of sizes of visible hollows were made, and hollows were checked for signs of use (e.g. visible chew marks). The locations of hollow-bearing trees were captured with a handheld GPS unit.

Diurnal bird surveys

Targeted surveys for diurnal birds were undertaken throughout the study area within two hours of dawn. Surveys followed the area search method, and birds were identified by observation with binoculars and/or call identification. Diurnal bird surveys also included searches for signs indicative of particular threatened species, including searching for evidence of feeding (eg *Allocasuarina* chewed cones which are signs of Glossy Black-cockatoo (*Calyptorhynchus lathami*) foraging and signs of bird presence, such as pellets, whitewash, nests etc.

Nocturnal amphibian surveys

Active searches for frogs were performed within the study area focussing on areas of suitable habitat, including small ponds and/or pools of standing water and drainage lines. Frogs were identified by sight and call. Call playback for threatened species was not used, given the lack of specific habitat for these species in the subject site (see Appendix C).

Microchiropteran bat survey

Stationary Anabat recordings were undertaken in four locations (two on each night) within the study area as shown on Figure 2. Recording commenced at least half an hour before dusk and continued until the following morning.

Calls recorded during the field survey were identified using zero-crossing analysis and AnalookW software (version 3.8m, Chris Corben 2010) by visually comparing call traits. The analysis of all bat calls was undertaken by GHD ecologists. No reference calls were collected during the survey. Pennay *et al*. (2004) was used as a guide to call analysis. Due to the high level of variability and overlap in call characteristics, a conservative approach was taken when analysing calls.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency. Pulses separated from another sequence by a period of five seconds were considered to be separate passes. Scattered sequences, where intermittent pulses were not separated by more than five seconds, were recognised as a single pass. Where constant activity was recorded, a single pass was defined as 15 seconds (ie one full display screen comprising as Anabat sequence file). Although this method underestimates the number of bat passes when there is continuous activity, the standard unit of time remains consistent (Law *et al*. 1998; Law *et al*. 1999).

Spotlighting

Spotlight searches were undertaken throughout the study area for nocturnally active mammals, birds and frogs, including dedicated listening periods for fauna vocalisations. Mammals and nocturnal birds were identified by observation under spotlight or by vocalisations heard whilst spotlighting. Transects were conducted on foot within the study area by two ecologists over at least two hours on both nights (a total of eight person-hours).

Call playback

Nocturnal call playback surveys were conducted for the Koala (*Phascolarctos cinereus),* Yellow-bellied Glider (*Petaurus australis*), Barking Owl (*Ninox connivens*), Powerful Owl (*N. strenua*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*T. tenebricosa*) on both nights. Surveys involved an initial listening period of five minutes, followed by call playing for five minutes, followed by a listening period of five minutes (undertaken separately for each species), with a final listening period of approximately 10 minutes. Calls were played through a portable MP3 player connected to a 45-watt megaphone. All potential roost sites in the immediate area were then scanned for 10 minutes using spotlights.

Active searches

Active searches of woody debris and other ground litter were conducted throughout the study area, targeting the Cumberland Plain Land Snail (*Meridolum corneovirens*), frogs and reptiles. Fallen timber and other potential shelter sites such as corrugated iron sheets were carefully turned and inspected. Leaf litter at the base of trees was raked. The edges of water bodies and aquatic plants were systematically scanned.

Snail shells were collected and any live snails were photographed and sent to snail specialists at the Australian Museum to confirm their identity.

Cumberland Plain Land Snails and characteristic shells were found throughout the study area during the June 6-7 ecology assessment survey. Therefore a supplementary Cumberland Plain Land Snail survey was conducted to obtain more information about the distribution and abundance of the local population. The supplementary survey comprised additional active searches over 8 hours within Cumberland Plain Land Snail habitat in other portions of the Fernhill Estate and adjoining road reserves and open space.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. This included a conscious focus on suitable areas of habitat during flora surveys, for instance fallen timber was scanned and/or turned for reptiles and mature trees and dams were scanned for roosting birds.

3.3 Survey Limitations

Given the duration and timing of the field surveys (early winter) it is likely that some species that occur in the study area (permanently, seasonally or transiently) were not detected during the survey. These species are likely to include: flora species that flower at other times of year as well as annual, ephemeral or cryptic species; and frogs which call at other times of year or after heavy rainfall. Some fauna species are also mobile and transient in their use of resources and it is likely that not all species were recorded during the survey period.

The Anabat call recordings collected during the survey were limited, in terms of the number, and duration of calls. This may be a product of weather conditions during the survey.

The desktop assessment provided a list of the native flora and fauna and especially threatened biota that could potentially occur in the study area or be affected by the proposal (including seasonal, transient or cryptic species). The habitat assessment conducted for the site allows for identification of habitat resources for such species. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values on site in order to predict potential impacts of the proposal, with particular emphasis on endangered ecological communities, threatened species and their habitats.

3.4 Staff Qualifications

This report was prepared by Ben Harrington based on field surveys conducted by GHD ecologists. The assessment was peer reviewed by Jayne Tipping. Staff qualifications are presented in Table 3.

Table 3 Staff qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Ben Harrington	Senior Ecologist / site surveys	BSc, MSc (Physical	8+ years

Name	Position / Project Role	Qualifications	Relevant Experience
	and reporting	Geography) BioBanking Assessor Accreditation	
Nicole Hansen	Graduate Ecologist / fauna site surveys, desktop assessments	BSc (Ecology), MSc (Zoology)	1+ years
Jayne Tipping	Principal Ecologist/Technical review	BSc (Ecology), MEnvLaw	20+ years

4. Existing Environment

4.1 Site Context

4.1.1 Location and Land Uses

The Eastern Precinct at Fernhill is a proposed 54 lot subdivision at the subject site (1177-1187 Mulgoa Road Mulgoa | Part Lot No. 6 Plan No. 173159 and 1147-1175 Mulgoa Road Mulgoa Part Lot No. 1 Plan No. 570484). The subject site is located in Penrith Local Government Area (LGA) and currently zoned as E3 Environmental Management under the LEP. It contains exotic pasture and native vegetation currently used for cattle grazing.

The subject site is bounded to the:

- East by a private rural-residential lot, Mulgoa Road and Mulgoa village.
- North and west by woodland and cleared exotic grassland within the Fernhill Estate that has historically been grazed and will be used for grazing, equestrian activities, occasional public events and biodiversity conservation.
- South by Mulgoa primary school and private rural-residential lots.

Access to the subject site is via Mulgoa Road at two separate entry points.

It is located directly to the south of Littlefield Creek. The site is approximately 2.6 km to the east of the Nepean River and lies on the northern edge of the town of Mulgoa and approximately 10 km south of Penrith town centre.

The subject site falls within the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion.

Historical land uses within the site appear to have included grazing, livestock keeping and timber getting. Disturbance areas include exotic grassland and cleared land as well as adjacent to fence lines, farm dams and access tracks through native vegetation in the study area.

4.1.2 Climate

The site has a relatively mild climate, typical of western Sydney. Based on data from the Orchard Hills Treatment Works weather station (number 067084), the site has a mean annual rainfall of 803 mm, mean daily maximum temperature of 23.4°C and a mean daily minimum temperature of 11.6°C. The site does experience regular extremes in temperature, with average ranges of a mean daily maximum temperature of 5.3°C to mean daily maximum temperature of 17.2°C in July, through to a mean daily maximum temperature of 15.5°C to mean daily maximum temperature of 28.5°C in December (BOM, 2013).

4.1.3 Hydrology

The study area is bound to the north by Littlefield Creek, a tributary of Mulgoa Creek which in turn drains to the Nepean River. Littlefield Creek contained water at the time of the site visit, and also supported in stream and riparian vegetation.

The study area contains a large dam in exotic grassland immediately to the west of the subject site and a smaller wetland in an area of river flat forest to the southwest (see figure 2). These water bodies have been created by damming a small tributary of Littlefield Creek. Each contains native aquatic and wetland plants and is bordered by sedges. The extent of such vegetation is limited to the area directly around the water bodies, which are both clearly artificial, and so were not discriminated from the surrounding vegetation communities.

4.1.4 Landscape Context

The site is contained within the Cumberland Plain Mitchell Landscape (DECC, 2008a). This landscape is noted to be approximately 30 – 120 m ASL, and comprises 'low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast' (DECC 2008), with vegetation characterised by 'woodlands and open forest of grey box (*Eucalyptus moluccana*), forest red gum (*Eucalyptus tereticornis*), narrow-leaved ironbark (*Eucalyptus crebra*), thin-leaved stringybark (*Eucalyptus eugenioides*), cabbage gum (*Eucalyptus amplifolia*) and broad-leaved apple (*Angophora subvelutina*). Grassy to shrubby understorey often dominated by Australian boxthorn (*Bursaria spinosa*), poorly drained valley floors, often salt affected with swamp oak (*Casuarina glauca*) and paperbark (*Melaleuca* sp.)' (DECC 2008b).

The geology of the landscape consists of Triassic shales and lithic sandstones, with a small number of volcanic vent intrusions. Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape) partially cover much of the landscape, in addition to Quaternary alluvium along the main watercourses. The soils consist of 'pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys' (DECC 2008b)

According to the Soil Landscapes of the Hawkesbury Nepean 1:250,000 Map Sheet, the majority of the site is part of the erosional soil landscape. The site consists primarily of the Liverpool subgroup of Triassic Wianamatta Shales, which are characterised by shale with some sandstone beds. A very small portion in the east of the site, associated with Fernhill East Creek is characterised by alluvial soils, on Quaternary alluvium gravel, sand, silt and clay. Areas associated with the drainage lines of the site are characterised by colluvial soils.

4.2 Flora

4.2.1 Flora species

One-hundred and ten species of flora from 48 families were recorded within the study area, comprising 69 indigenous native and 51 exotic or non-indigenous native species. The Poaceae (grasses, 23 species, 15 native), Asteraceae (flowering herbs and sub-shrubs, 10 species, 4 native) and Myrtaceae (flowering trees and shrubs, eight species, all native) were the most diverse families recorded. No threatened flora species were recorded. The full list of species recorded is presented in Appendix A. Species recorded are discussed below in relation to the vegetation communities occurring within the study area.

4.2.2 Vegetation communities

Vegetation mapped within the study area is shown on Figure 2 and described below. Four distinct vegetation communities were identified in the subject site based on vegetation types and the broad condition classes defined in the BioBanking methodology (DECC, 2008) and are summarised in Table 4. Data from BioBanking plot/transects are included in Appendix A along with benchmark values for each vegetation type.

Table 4 Vegetation communities in the subject site

Vegetation Community	Condition (DECC, 2008)	Area in Subject Site (ha)	Conservation Significance
Grey Box - Forest Red Gum grassy woodland on flats	Moderate/good	1.23	CEEC listed under the TSC Act and EPBC Act (Cumberland Plain Woodland)
Regrowth (low condition) Grey Box - Forest Red	Low	0.80	CEEC listed under the TSC Act (Cumberland Plain

Vegetation Community	Condition (DECC, 2008)	Area in Subject Site (ha)	Conservation Significance
Gum grassy woodland on flats			Woodland)
Forest Red Gum - Rough-barked Apple grassy woodland	Moderate/good	1.52	EEC listed under the TSC Act (River-Flat Eucalypt Forest)
Cleared land / exotic grassland	Cleared	4.83	
Total		8.37	

Native vegetation within the subject site comprises local occurrences of threatened ecological communities (EECs) listed under the TSC Act as follows:

- Forest Red Gum - Rough-barked Apple grassy woodland comprises the endangered ecological community (EEC) 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' (River-Flat Eucalypt Forest)
- Grey Box - Forest Red Gum grassy woodland comprises the critically endangered ecological community (CEEC) 'Cumberland Plain Woodland in the Sydney Basin Bioregion' (Cumberland Plain Woodland).

Grey Box - Forest Red Gum grassy woodland also comprises a local occurrence of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (also abbreviated as Cumberland Plain Woodland) which is listed as a CEEC under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). All native vegetation communities meet the requirements for inclusion as EECs under the TSC Act, however the vegetation mapped as 'low' condition does not meet the condition thresholds for inclusion as the EPBC Act-listed Cumberland Plain Woodland CEEC.

The most extensive vegetation community in the subject site is exotic grassland. This vegetation qualifies as 'cleared' land because it contains no native over storey or mid storey and less than 50% of the ground cover vegetation is native.

Grey Box - Forest Red Gum grassy woodland occurs as separate communities in moderate/good or low condition respectively and is associated with mid slopes, on shale derived soils. The different condition classes of this vegetation type appear to relate to previous land uses and grazing intensity, as well as potential impacts associated with edge effects, with areas that have been historically cleared and, as a result of easier access for cattle, heavily grazed, now containing regrowth vegetation in low condition.

Grey Box - Forest Red Gum grassy woodland grades into Forest Red Gum - Rough-barked Apple grassy woodland on lower slopes and flats in the south-western portion of the subject site, on alluvium-influenced soils. This vegetation comprises a local occurrence of River-Flat Eucalypt Forest, which is listed as an EEC under the TSC Act.

Exotic plant species are concentrated in areas of exotic grassland and low condition woodland, but are scattered throughout all vegetation types and occasionally occur as dense patches.

There are cleared fence lines and a number of small informal, dirt tracks that have been included in surrounding vegetation communities because they do not comprise a gap in over storey vegetation and they contain partial cover of native understorey vegetation.

There is a large dam immediately to the west of the subject site (mapped as 'open water' on Figure 2). This water body has been formed by the construction of a dyke across a small

drainage line that runs south to north adjacent to the subject site. It is clearly not a natural geomorphic feature and so does not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains'. It contains a moderate diversity and abundance of native wetland plants such as Tall Spike Rush (*Eleocharis sphacelata*) and Frogmouth (*Philydrum lanuginosum)* and aquatic plants such as Water Ribbons (*Triglochin microtuberosa)* and Swamp Lily (*Ottelia ovalifolia*).

The study area has been grazed, and canopy vegetation is likely to have been at least partially cleared or thinned historically. Large patches of canopy vegetation have since re-established across much of the study area, however the age class of the majority of trees present is not advanced enough to support hollows. Mature hollow-bearing trees are also relatively scarce across the broader study area. There are patches of sub-mature regrowth dominated by *Acacia* species with no native over storey.

The distribution, condition and species composition of the four identified vegetation communities is described below.

Grey Box - Forest Red Gum grassy woodland on flats

This community is the NSW vegetation type 'Grey Box - Forest Red Gum grassy woodland on flats' (HN528)(OEH, 2013a), which is consistent with 'Shale Plains Woodland' in the NPWS (2002) vegetation mapping and classification of the Cumberland Plain.

Grey Box - Forest Red Gum grassy woodland occurs on mid slopes of the site. It supports an open canopy ranging up to approximately 20 m in height, dominated by Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Grey Box (*Eucalyptus moluccana*) and Thin-leaved Stringybark (*Eucalyptus eugenioides*). The mid-storey contains Black Thorn (*Bursaria spinosa*), Black Wattle (*Acacia decurrens*) and very sparse Kurrajong (*Brachychiton populneus*) and very scattered exotic Lantana (*Lantana camara*). Groundcover species include Kangaroo Grass (*Themeda australis*), Weeping Meadow Grass (*Microlaena stipoides*), Bordered Panic (*Entolasia marginata*), Kidney Weed (*Dichondra repens*), Australian Basket Grass (*Oplismenus aemulus*), Native Wandering Jew (*Commelina cyanea*), *Lomandra gracilis*, *Glycine clandestina,* Small-leaf Glycine (*G. microphylla*) and Indian Pennywort (*Centella asiatica*).

This community occurs as a simplified, regrowth form where it adjoins exotic grassland with no canopy trees and a very dense mid storey of *Acacia decurrens*.

Exotic species present within the community include the above mentioned Lantana (*Lantana camara*), as well as Paddys Lucerne (*Sida rhombifolia*), Rhodes Grass (*Chloris gayana*), Fireweed (*Senecio madagascariensis*), African Lovegrass (*Eragrostis curvula*) and Lamb's Tongues (*Plantago lanceolata*).

BioBanking habitat attribute data was collected in a plot/transect and confirms that this vegetation is relatively intact and in moderate/good condition. Values for native plant species richness, cover and fallen logs were at or close to benchmark values. There were no hollow-bearing trees recorded within the plot and very few located elsewhere within the community. There were good quantities of leaf litter present. There is moderate to locally severe weed infestation throughout the vegetation community including 78 % exotic ground cover (mainly African Lovegrass) and 15% exotic mid-storey cover (mainly Lantana) in the plot/transect.

Regrowth (low condition) Grey Box - Forest Red Gum grassy woodland on flats

This community is a low condition form of the NSW vegetation type Grey Box - Forest Red Gum grassy woodland (HN528)(OEH, 2013a) comprising native understorey vegetation with occasional sub-mature *Eucalyptus* and/or patches of *Acacia* species.

This community occurs as a thin strip between exotic grassland and intact woodland vegetation in the subject site. The vegetation type lacks a native canopy and mid-storey, instead containing very occasional isolated patches of mid-storey, comprised of Black Thorn (*Bursaria spinosa*) and Black Wattle (*Acacia decurrens*). Groundcover vegetation is dominated by exotic species including Rhodes Grass (*Chloris gayana*), African Lovegrass (*Eragrostis curvula*), Paspalum (*Paspalum dilatatum*), Lamb's Tongues (*Plantago lanceolata*), Paddys Lucerne (*Sida rhombifolia*) and Fireweed (*Senecio madagascariensis*). There are occasional native species in the groundcover, including Kangaroo Grass (*Themeda australis*), Weeping Meadow Grass (*Microlaena stipoides*) and Purple Wiregrass (*Aristida ramosa*).

BioBanking habitat attribute data was collected in a plot/transect and confirms that this vegetation is in a low condition, with well below benchmark values for over storey and mid storey cover, moderate native species richness, moderate native ground cover but 96% exotic ground cover dominated by Rhodes Grass and African Lovegrass.

Forest Red Gum - Rough-barked Apple grassy woodland

This community is the NSW vegetation type Forest Red Gum - Rough-barked Apple grassy woodland (HN526)(OEH, 2013a), which is consistent with Alluvial Woodland in the NPWS (2002) vegetation mapping and classification of the Cumberland Plain.

This community supports an open canopy approximately 15 – 20 m in height, dominated by Rough-barked Apple (*Angophora floribunda*) Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and Cabbage Gum (*Eucalyptus amplifolia*). The mid-storey contains Black Thorn (*Bursaria spinosa*), Black Wattle (*Acacia decurrens*) and scattered Prickly-leaved Tea Tree (*Melaleuca styphelioides*) along with some dense patches of Lantana (*Lantana camara*). Groundcover species include Weeping Meadow Grass (*Microlaena stipoides*), Australian Basket Grass (*Oplismenus aemulus*), Kidney Weed (*Dichondra repens*), Blue Trumpet (*Brunoniella australis*) and Indian Pennywort (*Centella asiatica*).

The southern portion of the subject site contains a simplified, regrowth form of this vegetation community with no canopy trees and a very dense mid storey of *Acacia decurrens*.

Exotic species present within the community include the above mentioned Lantana, as well as Paddy's Lucerne (*Sida rhombifolia*), Common Chickweed (*Stellaria media*), Bridal Creeper (*Asparagus asparagoides*), Fleabane (*Conyza bonariensis*), Sharp Rush (*Juncus acutus*), Paspalum (*Paspalum dilatatum*), Blackberry Nightshade (*Solanum nigrum*), *Cyperus congestus*, Wild Tobacco Bush (*Solanum mauritianum*) and Kikuyu (*Pennisetum clandestinum*).

There is a flooded depression in this community immediately to the south west of the subject site. It is part of the same drainage line that has been modified to create the large dam described above, but is smaller, shallower and has greater cover of wetland plants. It contains a dense reed land of Tall Spike Rush (*Eleocharis sphacelata*) along with aquatic plants such as Water Ribbons (*Triglochin microtuberosa)* and Swamp Lily (*Ottelia ovalifolia*). The margins support dense stands of the native wetland plant *Juncus usitasis* as well as the exotic Sharp Rush (*Juncus acutus*).

BioBanking habitat attribute data was collected in a plot/transect and confirms that this vegetation is in moderate condition, with benchmark values for native plant species richness and over-storey, mid and ground cover. The total length of fallen logs was below benchmark and there were no hollow-bearing trees in the plot and very few across the subject site. There were good quantities of leaf litter. There is moderate to locally severe weed infestation throughout the vegetation community including 28 % exotic ground cover comprising a mix of herbs and grasses and 21.5% exotic mid-storey cover, dominated by Lantana, in the plot/transect.

Cleared land / exotic grassland

This community is dominated by an exotic tussock grassland of Rhodes Grass (*Chloris gayana*), African Lovegrass (*Eragrostis curvula*) and Paspalum (*Paspalum dilatatum*) with exotic herbs and forbs such as Lamb's Tongues (*Plantago lanceolata*), Paddys Lucerne (*Sida rhombifolia*) and Fireweed (*Senecio madagascariensis*). There are very occasional native species in the groundcover including *Juncus usitasis* and Red Leg Grass (*Bothriochloa macra*).

The eastern and south eastern portions of this community contain small patches of planted and opportunistic trees and shrubs including non-indigenous natives such as Silky Oak (*Grevillea robusta*), Brush Box (*Lophostemon confertus*) and White Cedar *(Melia azederachis*) and noxious and environment weeds such as Blackberry (*Rubus fruticosus* sp. agg.), Broad-leaved Privet (*Ligustrum lucidum*) and Madeira Vine (*Anredera cordifolia*).

BioBanking habitat attribute data was collected in a plot/transect and confirms that this vegetation is cleared land with very low native species richness, no overstorey or mid storey cover, 8% native groundcover and close to 100% cover of exotic groundcover species comprising mainly Rhodes Grass and African Lovegrass.

The mapped area of this community includes buildings, fences and hardstand areas such as driveways.

Note: Diurnal bird surveys over two mornings, walked spotlighting transects over two nights, targeted threatened plant surveys, active searches for snails and herpetofauna and habitat assessments were conducted throughout the entire study area.

Q1

Q2

Q3

Q4

MULGOA ROAD

ST THOMAS ROAD

Vegetation Communities

- Cleared land / exotic grassland
- Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Regrowth (low condition) Grey Box - Forest Red Gum grassy woodland on flats (HN528)

1:2,500 (at A3)

0 25 50 75

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Study area
- Fernhill site boundary
- Subject site

Survey Effort

- Anabat recording
- Call playback
- Plot/transect

Fernhill Eastern Precinct
Ecology Assessment

Job Number	22-16646
Revision	B
Date	28 Jun 2013

Vegetation and survey effort

Figure 2

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

4.2.3 Noxious and environmental weeds

The *Noxious Weeds Act 1993* provides for the declaration of noxious weeds in local government areas. Landowners and occupiers must control noxious weeds according to the control category specified in the Act. Public authorities must control noxious weeds according to the control category to the extent necessary to prevent their spread to adjoining land.

The subject site contains six species declared as noxious weeds in the Penrith LGA, as shown in Table 5 below. These noxious species occurred in low densities in woodland and forest throughout the study area and as moderate infestations along drainage lines in the southwest and north of the study area and in the south and southeast where the study area adjoins the village of Mulgoa. The exotic grassland in the central portion of the study area is relatively free of noxious weeds, probably because their growth is suppressed by cattle grazing and competition with pasture species. However the exotic grassland and adjoining areas of regrowth woodland feature severe infestation with environmental weeds such as Rhodes Grass (*Chloris gayana)* and African Love Grass (*Eragrostis curvula*).

The distribution of noxious and environmental weeds in the study area is closely tied to disturbance, with cleared paddocks dominated by exotic plant species and the concentration of weeds greater where the study area adjoins cleared land. Surface water and nutrient flows would also be contributing to the observed weed infestation with forest adjacent to drainage lines featuring heavier infestation with exotic species than drier woodland upslope.

Wetlands and water bodies in the study area appeared to be free of aquatic noxious weeds such as Alligator weed (*Alternanthera philoxeroides*) and Water Hyacinth (*Eichhornia crassipes*).

Table 5 Declared noxious weeds recorded during the field survey

Scientific Name	Common Name	Control category	Legal Requirements
Asparagus asparagoides	Bridal creeper	4	The plant must not be sold propagated or knowingly distributed
*Lantana camara**	Lantana	4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction
*Ligustrum lucidum**	Privet (Broad-leaf)	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its flowering and reproduction
*Ligustrum sinense**	Privet (Narrow-leaf/Chinese)	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its flowering and reproduction
Olea europaea subspecies cuspidata]	African Olive	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed

Scientific Name	Common Name	Control category	Legal Requirements
Rubus fruticosus aggregate species	Blackberry	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed

4.3 Fauna

4.3.1 Fauna species

A total of 62 species of native fauna were recorded during the field surveys, comprising three frog species, 56 bird species, one mammal species, one reptile species and one snail (see Appendix A). Two threatened species were recorded:

- The Cumberland Plain Land Snail *Meridolum corneovirens*) which is listed as an endangered species under the TSC Act
- The Varied Sittella (*Daphoenositta chrysoptera*) which is listed as a vulnerable species under the TSC Act.

The diversity of native fauna species that would occur in the study area is likely to be considerably greater than was recorded in this one off early Winter survey.

A further three exotic fauna species were recorded, comprising a bird and two mammal species.

The fauna species that were recorded, habitat associations and additional species of fauna that may occur based on the habitats present are described below.

Birds

Of the 57 bird species recorded, the majority were common woodland bird species often seen in semi-urban bush remnants around Sydney. This would be a fairly representative sample of the diversity of bird species present in the study area as bird surveys are less restricted by seasonal weather conditions than many other groups of fauna. Bird species diversity and abundance were higher within relatively intact vegetation to the west of the subject site. Exotic grassland and cleared land adjoining Mulgoa Road would have significantly lower habitat value for most native bird species because they contain fewer habitat resources, less shelter and are likely to be more exposed to exotic predators and competitors.

Bird species observed included:

- Large, generalist bird species common in urban areas, including the Sulphur-crested Cockatoo (*Cacatua galerita*), Australian Magpie (*Cracticus tibicen*), Australian Raven (*Corvus coronoides*) and Rainbow Lorikeet (*Trichoglossus haematodus*).
- Birds of open woodlands, including Thornbills (*Acanthiza* spp.), Fairy-wrens (*Malurus* spp.) the Restless Flycatcher (*Myiagra inquieta*), Red-rumped Parrot (*Psephotus haematonotus*) and Jacky Winter (*Microeca fascinans*).
- Birds of denser forests such as the Red-browed Finch (*Neochmia temporalisi)*, Rose Robin (*Petroica rosea*), Golden Whistler (*Pachycephala pectoralis*) and Eastern Yellow Robin (*Eopsaltria australis*).

- Birds of open water and vegetated wetlands such as the Australasian Grebe (*Tachybaptus novaehollandiae*), Eurasian Coot (*Fulica atra*) and Hardhead (*Aythya australis*).
- Birds of vegetated wetlands and wet grassland such as the Cattle Egret (*Ardea ibis*), Purple Swamphen (*Porphyrio porphyrio*) and Straw-necked Ibis (*Threskiornis spinicollis*).
- The exotic Eurasian Blackbird (*Turdus merula*).

The full list of species observed is included in Appendix A.

A group of seven Varied Sitellas were observed foraging in Grey Box – Forest Red Gum grassy woodland in the northern portion of the subject site.

Mammals

Anabat call analysis revealed two 'definite' identifications of microbat species: the Eastern Horseshoe-bat (Rhinolophus megaphyllus) and Undescribed Freetail Bat (Mormopterus "Species 2").

The conditions during the site survey were cold which is likely to have limited bat activity. Anabat recording files were of very poor – moderate quality resulting in the majority of bat calls being probable or belonging to a species group or multiple species. The majority of bat calls only consisted of short sequences with poor – moderate quality pulses making positive call identification difficult. Detailed Anabat call analysis results are presented in Appendix B. The study area is likely to contain a greater diversity of microbat species than were recorded in this early winter survey. Other microbat species of forest and woodland which would also be likely to occur include forest bats (*Vespadelus* species), wattled bats (*Chalinolobus* species) and the White-striped Freetail-bat (*Tadarida australis*). The study area may also contain hollow-roosting threatened microbats such as the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), and Eastern Freetail-bat (*Mormopterus norfolkensis*) or the Large-eared Pied Bat (*Chalinolobus dwyeri*), which would roost in sandstone escarpment country to the west but may forage in the study area.

Up to seven Eastern Grey Kangaroos (*Macropus giganteus*) were observed foraging in exotic grassland in the subject site. This species would also forage in native woodland and forest and would favour these habitats for shelter. A number of macropod scats were noted throughout the field surveys and not positively identified but are likely to indicate the presence of wallabies (*Wallabia* spp.) in addition to Eastern Grey Kangaroos.

Common Brushtail Possums (*Trichosurus vulpecula*) were observed foraging in the study area and it is likely that other common arboreal mammal species such as Common Ringtail Possums (*Pseudocheirus peregrinus*) would occur.

European Cattle (*Bos taurus*) and the feral, exotic herbivore Rusa deer (*Cervus timorensis*) were recorded in the subject site. There are domestic and feral populations of a variety of other mammal species on the Fernhill Estate that would also occur in the subject site on occasion.

Frogs and reptiles

Dams, drainage lines and depressions all contained surface water during the survey, from which Common Eastern Froglets (*Crinia signifera*), Brown-striped Frogs (*Limnodynastes peronii*) and Verreaux's Tree Frog (subsp) (*Litoria verreauxii verreauxii*) were heard calling. One reptile, an Eastern Water-skink (*Eulamprus quoyii*), was recorded sheltering beneath sheet metal. The limited diversity of frogs and limited diversity and abundance of reptiles that were recorded probably reflects the cool conditions during the survey rather than indicating poor habitat quality. The subject site is likely to support a considerably greater number of frogs and reptiles associated with forest, woodland and the margins of wetlands.

Cumberland Plain Land Snail

Invertebrate fauna in general were not a subject of the field survey. Survey effort included specific searches for the Cumberland Plain Land Snail (*Meridolum corneovirens*) because it is listed as an endangered species under the TSC Act. Individual Cumberland Plain Land Snails or their shells were recorded throughout the study area, including five within the subject site (see Figure 3). Cumberland Plain Land Snails were recorded sheltering beneath woody debris, sheet metal or leaf litter in Grey Box – Forest red Gum woodland on flats (i.e. Cumberland Plain Woodland). The Cumberland Plain Land Snail is closely associated with this ecological community and is generally considered to be restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney and also along the fringes of River Flat Forest, especially where it meets Cumberland Plain Woodland (NPWS, 2000). The supplementary snail survey revealed a further 28 individual Cumberland Plain Land Snails or their shells throughout the study area and other portions of the Fernhill Estate (see Figure 4).

4.3.2 Fauna habitats

Three broad fauna habitat types were recorded within the study area:

- Exotic grassland and cleared areas.
- Native woodland and forest.
- Drainage line and wetland habitats.

The suitability of these habitats for native fauna are discussed below, with particular emphasis on habitat resources of relevance to threatened fauna.

Exotic grassland and cleared areas

The majority of the subject site contains exotic grassland within fenced cattle grazing land and a rural residential property adjoining Mulgoa road to the east, Mulgoa primary school to the south and native woodland to the west and north. As discussed in Section 4.2.2, these areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture.

Exotic grassland and cleared land are subject to high noise levels and light spill and contain few habitat resources of relevance to most native species. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna including birds such as the Australian Magpie and Galah and mammals such as the Eastern Grey Kangaroo.

Regrowth trees and shrubs would provide some foraging resources for native woodland birds such as Thornbills and Red-browed Finches which were observed in these areas during the survey. Some native reptile and frog species would also forage, shelter or bask in areas of exotic grassland particularly where they adjoin woodland or water bodies. Most of these species would use these areas as an adjunct to the higher quality, more extensive areas of suitable habitat available to the west in the Fernhill Estate and other rural residential blocks with limited clearing and it is unlikely that any local populations of native fauna would be reliant on the exotic grassland on the subject site for their survival.

These areas contain no habitat features of relevance to threatened fauna. The Cumberland Plain Land Snail and several species of threatened birds and microbats would be considered likely to occur in adjacent habitats within native woodland or shrubland (see below) but would be unlikely to occur within areas of exotic grassland or cleared areas. The Cumberland Plain Land Snail can occur in disturbed environments provided that ground cover of woody debris or rubbish is available (NPWS, 2000). Exotic grassland in the study area does not contain suitable shelter sites and is unlikely to be occupied by the species.

Native woodland and forest

Native woodland and forest in the subject site and the broader study provide good quality fauna habitats. Habitat resources include: mature canopy trees and associated nectar, fruits and leaves as well as foraging substrate; abundant woody debris and leaf litter; patches of dense understorey shrubs; a range of fruiting and flowering small trees and shrubs; and connectivity with wetland and aquatic habitat. As discussed in Section 4.1.4, this vegetation also has good connectivity with extensive patches of native vegetation in rural residential land and eventually with large protected areas within the Blue Mountains National Park (see Figure 4). There is some noise and light disturbance, associated with Mulgoa village and Mulgoa road. Based on these attributes this vegetation would be expected to support a diverse suite of native fauna, including a number of threatened species.

The subject site and broader study area contains relatively few pre-European age trees and limited numbers of hollow bearing habitat trees and stags. A total of six habitat trees, including hollow-bearing trees, were recorded in the study area as shown on Figure 3. The subject site contains a mature, hollow-bearing Rough-barked Apple (*Angophora floribunda*) with a single trunk hollow around 5 cm diameter located in an isolated paddock tree surrounded by exotic grassland. This hollow appeared to be in use, as bark around the entrance was worn, however no resident fauna were observed. It may provide a nest site for a parrot such as the Rainbow Lorikeet (*Trichoglossus haematodus*) or potentially hollow-roosting threatened microbats such as the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), and Eastern Freetail-bat (*Mormopterus norfolkensis*). Given the size and location of this hollow it would be highly unlikely to be occupied by a Yellow-bellied Glider (*Petaurus australis*) or threatened species of forest owl which are likely to be more reliant upon large, mature hollow-bearing trees located in more extensive patches of vegetation (Gibbons and Lindenmayer, 2002). The other habitat trees shown on Figure 3 are stags or large trees with fissures and abundant loose bark. These trees may provide roost or nest sites for birds or diurnal roosts for micro bats, potentially including threatened species.

Eucalypts in the study area represent known or preferred feed trees for a number of fauna species, including threatened birds, the Koala and the Grey-headed Flying-fox. The canopy species Coastal Grey Box and Forest Red Gum are nectar and seed-bearing and would provide a food resource for native fauna, including the Grey-headed Flying Fox and arboreal mammals. *Eucalyptus* species may also provide seasonal nectar resources for migratory species, including the Regent Honeyeater (*Anthochaera phrygia*). Eucalypt species in the study area are summer and autumn-flowering (Brooker and Koenig, 2006) and so would not provide winter foraging resources for the Swift Parrot (*Lathamus discolor*). Winter-flowering acacias at the site would help provide year-round foraging resources for a range of native birds, bats and mammals. Arboreal mammal species are also likely to feed on the sap of these Acacias. The subject site is continuous with an extensive patch of vegetation which contains large, mature trees in an intact corridor and so would provide good concentrations of these foraging resources in a context that is suitable for migratory use. Forest Red Gum is Koala food tree listed under Schedule 2 of SEPP 44 and is a regional primary food trees identified in the Koala Recovery Plan.

Woodland and forest at the site contains good quantities of woody debris and thick leaf litter which would provide shelter and foraging substrate for native reptiles, frogs and invertebrates including the Cumberland Plain Land Snail.

Drainage line and wetland habitats

Littlefield Creek is a small, second order drainage line running through the study area to the north of the subject site. This drainage line features near-intact geomorphology and good in stream and riparian vegetation but moderate to severe weed infestation and some evidence of degradation by cattle such as grazing, bank erosion, increased turbidity and probably also

nutrient enrichment from waste. Littlefield Creek contained pools of surface water up to 30 cm deep. Given the slight slope and heavy clay soil, the creek is likely to be intermittent with scattered semi-permanent pools of water. This type of drainage line would provide habitat for native fish and aquatic invertebrates and breeding habitat for a number of stream breeding frogs, including the Leaf-green Tree Frog (*Litoria phyllochroa*) and Leseur's Frog (*Litora lesueri*). Littlefield Creek is not suitable habitat for any of the threatened frogs with the potential to occur in the locality.

There is a large dam and a flooded depression in forest immediately to the west of the subject site which contain healthy populations of native wetland plant and aquatic plants. These wetlands contained a high diversity and abundance of native waterfowl, waders and other wetland birds during the site survey and may provide foraging habitat for threatened wetland birds such as the Australasian Bittern (*Botaurus poiciloptilus*) or Australian Painted Snipe (*Rostratula australis*) on occasion. These wetlands would provide habitat for native fish and aquatic invertebrates and potential breeding habitat for a number of pool breeding frogs, potentially including the Green and Golden Bell Frog (*Litoria aurea*). The potential for the Green and Golden Bell Frog and other native frog species to occur and breed at the site may be limited by the presence of predatory fish and/or Chytrid fungus. These wetlands contained common, generalist frogs and reptiles during the field survey such as the Common Eastern Froglet, Brown-striped Frog and Eastern Water Skink and would also be likely to provide habitat for additional reptile species such as the Red-bellied Black-snake (*Pseudechis porphyriacus*) and Eastern Snake-necked Turtle (*Chelodonia longicollis*).

Other habitat resources

The study area is composed of shale-derived colluvium and alluvial sediments on lower slopes and flats. There are no caves, cliffs, rock outcrops or surface rock fragments in the subject site or the broader study area. The study area would not support fauna that rely on rocky substrate for shelter. There are a number of threatened reptile and frog species known or predicted to occur in the locality (OEH, 2013a; DSEWPAC, 2013), including the Broad-headed Snake (*Hoplocephalus bungaroides*), Giant Burrowing Frog (*Heleioporus australiacus),* and Littlejohns Treefrog (*Litoria littlejohni*). Records of these species within the locality are from Hawkesbury Sandstone substrates at higher elevations. These species depend on specific habitat resources from these environments (OEH, 2013c; Ehman, 1997) and would not occur in the subject site.

There are significant cave and cliff formations in the extensive Blue Mountains National Park, located approximately 6 km to the west of the site. Cave-roosting microbats such as the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensisi)* and Large-eared Pied Bat (*Chalinolobus dwyeri*) may roost and breed in these areas but would only use aerial foraging habitat in the study area.

Patch size and connectivity

The subject site contains fragmented patches of habitat with high edge to area ratios. As shown on Figure 2 this habitat adjoins exotic grassland or cleared land with little value for many species of native fauna and the majority of threatened fauna. The subject site is affected by noise and light spill from Mulgoa village and there would be a relatively high risk of predation by feral and domestic predators and vehicle collisions. This context reduces the value of the habitat within the subject site in comparison with equivalent habitat in more extensive patches of native vegetation, that are remote from cleared or developed land.

There are extensive areas of habitat in the locality, particularly to the west of the study area in the central portion of the Fernhill Estate and in the Blue Mountains National Park. As shown on Figure 4 the study area is connected to this habitat by vegetated riparian corridors and remnant patches of forest and woodland. This vegetated corridor is likely to have regional significance as

a link between higher elevation forest in the Blue Mountains and lowland grassy woodlands of the Cumberland Plain. The Nepean River passes through this vegetated corridor and so it would also have value as a link connecting aquatic and riparian habitats with terrestrial vegetation and with similar habitat up and downstream. The study area is at the terminal end of this network of habitat with connectivity severed to the south east, by Mulgoa Road and extensively cleared rural residential land and to the south by Mulgoa Village. Fauna movement and other ecological processes would occur around the subject site via the vegetated riparian corridor to the north. Patch-size dependant species of fauna such as threatened woodland birds and the Spotted-tailed Quoll could use these vegetated corridors to access habitat within the study area, but would be more likely to frequent less fragmented areas of habitat, in better condition, that are located farther to the west.

4.4 Conservation significance

4.4.1 Overview

Based on the desktop assessment the following threatened biota and MNES are known or predicted to occur in the locality:

- 28 threatened ecological communities (TECs).
- 28 threatened flora species.
- 51 threatened fauna species, comprising six frogs, 25 birds, three fish, three invertebrates, 13 mammals and one reptile
- One endangered population.
- 15 migratory species.
- One National and World Heritage Place.
- One Ramsar wetland.

This list does not include marine threatened and migratory species or shorebirds which were highlighted by the database searches because the locality does not contain any marine or estuarine habitats.

The status of these threatened biota and MNES within the subject site and study area is described below.

4.4.2 Threatened biota (TSC Act and FM Act)

The database searches identified 28 threatened flora species, 51 threatened fauna species and 28 TECs listed under the TSC Act as having been previously recorded or predicted to occur in the locality (see Appendix C).

Three fish and two invertebrates listed under the FM Act have been previously recorded or are predicted to occur in the locality of the study area (see Appendix C).

Threatened ecological communities

The two native vegetation types at the site are consistent with TECs listed under the TSC Act:

- Forest Red Gum - Rough-barked Apple grassy woodland; consistent with River-Flat Eucalypt Forest on Coastal Floodplains (EEC); and
- Grey Box - Forest Red Gum grassy woodland; consistent with Cumberland Plain Woodland (CEEC).

Cumberland Plain Woodland is also listed as a CEEC under the Commonwealth EPBC Act.

The Grey Box - Forest Red Gum grassy woodland occurs as near intact moderate/good condition vegetation and as regrowth low condition vegetation. Both condition classes comprise Cumberland Plain Woodland under the TSC Act.

The distribution of these TECs in the study area is shown in Figure 3.

No other threatened ecological communities are present in the study area.

Threatened flora species

No threatened flora species were recorded during the field surveys.

Of the 11 threatened flora species previously recorded in the locality, seven can be discounted as having nil chance of occurring in the study area or being affected by the proposal. These species are associated with specific habitat types that are not present in the study area, as described in Appendix B. Notably there are a number of plant species associated with tertiary gravel habitats of the Castlereagh forests, or sandstone habitats of higher elevations which are present within the locality but can be reliably excluded from occurring in the Wianamatta Shale and alluvial habitats within the study area.

There is broadly suitable habitat for four threatened plant species within the study area and they are known from the locality:

- Camden White Gum (*Eucalyptus benthamii*) (vulnerable, TSC Act; vulnerable, EPBC Act)
- *Marsdenia viridiflora viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas (*Marsdenia viridiflora* subsp*. viridiflora*) (endangered Population, TSC Act)
- Juniper-leaved Grevillea (*Grevillea juniperina juniperina*) (vulnerable, TSC Act; vulnerable, EPBC Act)
- Spiked Rice-flower (*Pimelea spicata*) (endangered, TSC Act; endangered, EPBC Act).

Camden White Gum, *Marsdenia viridiflora viridiflora* and Juniper-leaved Grevillea can be reliably discounted as occurring based on the field survey effort undertaken. These three species are a tree, a climber and shrub respectively. They are not cryptic nor do they require seasonal surveys. It is unlikely that they would not have been detected if they were present.

The Spiked Rice-flower is known to be difficult to detect when not flowering. This species flowers sporadically and targeted surveys are generally timed to coincide with flowering of a known reference population. This survey approach was not part of the current assessment and so a precautionary approach has been undertaken and the study area is assumed to comprise habitat for a local population of the Spiked Rice-flower.

Threatened fauna species

Two threatened fauna species were recorded within the site during the field survey:

- Varied sittella (*Daphoenositta chrysoptera*) which is listed as a vulnerable species under the TSC Act.
- Cumberland Plain Land Snail (*Meridolum corneovirens*) which is listed as an endangered species under the TSC Act.

These species were recorded within Grey Box - Forest Red Gum grassy woodland and Forest Red Gum - Rough-barked Apple grassy woodland as shown in Figure 3.

The Varied Sittella would forage and probably also breed locally in native grassy woodland and forest vegetation types in the study area, the Fernhill estate and throughout the locality. There

are a total of 18 records of the Varied Sitella within the locality (OEH 2013a) and it has previously been recorded within study area (Birdata 2013).

A total of five live individuals or shells were recorded in the subject site in loose leaf litter or under woody debris or rubbish. Additional Cumberland Plain Land Snails are likely to be present, buried in loose soil or leaf litter. The 2.75 hectares of woodland and forest within the subject site is contiguous with a large area of habitat to the north and west. A further 28 live individuals or shells were recorded in the study area and nearby areas in the supplementary Cumberland Plain Land Snail survey. These areas contained good quantities of habitat resources such as woody debris and leaf litter. The local population of the Cumberland Plain Land Snail occurs in relatively extensive patches of Cumberland Plain Woodland in the locality, including elsewhere in the Fernhill estate (pers. obs.; EcoLogical, 2010), in the vicinity of numerous BioNet records to the east of Mulgoa road (OEH, 2013b) and in Mulgoa Nature reserve (DECC, 2008b). There are 72 previous records of the species in the locality (OEH, 2013a) and around 2100 hectares of suitable habitat in shale woodlands or forest based on Tozer (2010) mapping.

There are a number of records of threatened fauna from Mulgoa Nature Reserve to the north east of the subject site and the Blue Mountains National Park to the west, including large forest owls, microchiropteran bats and woodland birds (OEH, 2013b). Mulgoa Nature Reserve contains similar vegetation types and habitat resources to the study area and has been subject to relatively intensive survey and assessment (DECC, 2008b): “seven animal species listed as vulnerable under the TSC Act have been recorded in the reserve: the masked owl (*Tyto novaehollandiae*), barking owl (*Ninox connivens*), grey-headed flying-fox (*Pteropus poliocephalus*), eastern freetail bat (*Mormopterus norfolkensis*), large-eared pied bat (*Chalinolobus dwyeri*), eastern bentwing bat (*Miniopterus australis*) and large-footed myotis (*Myotis adversus*). In addition, the reserve contains the endangered Cumberland Plain land snail (*Meridolum corneovirens*). Other threatened species occurring in the local area, and that may from time to time occur in the reserve, are the spotted-tailed quoll (*Dasyurus maculatus*), turquoise parrot (*Neophema pulchella*), glossy black cockatoo (*Calyptorhynchus lathami*), powerful owl (*Ninox strenua*), square tailed kite (*Lophoictinia isura*), swamp harrier (*Circus approximans*)”(sic – not a threatened species) “red-crowned toadlet (*Pseudophryne australis*) and greater broad-nosed bat (*Scoteanax rueppellii*).”

There is potential for a number of these and other threatened fauna species to occur within the subject site, given the presence of suitable habitat and previous records within the locality. There are no on-site records or specific habitat resources that suggest that permanent local populations of any of these threatened fauna are present in the study area. Individual threatened fauna may utilise habitat in the subject site and/or study area on a transitory or opportunistic basis. Those fauna that may occur in the study area and be affected by the proposal are listed in Table 6.

Table 6 Threatened fauna that may occur in the study area and be affected by the proposal

Scientific name	Common Name	TSC Act	EPBC Act	Notes
Anthochaera phrygia	Regent Honeyeater	CE	E	Suitable foraging habitat present within the subject site and study area
Botaurus poiciloptilus	Australasian Bittern	E	E	Suitable foraging and roosting habitat present within the study area
Burhinus grallarius	Bush Stone-curlew	E		Suitable foraging and nesting habitat present within the subject site and study area

Scientific name	Common Name	TSC Act	EPBC Act	Notes
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Suitable foraging habitat present within the subject site and study area
Chthonicola sagittata	Speckled Warbler	V		Suitable foraging and nesting habitat present within the subject site and study area
Glossopsitta pusilla	Little Lorikeet	V		Suitable foraging habitat present within the subject site and study area
Ixobrychus flavicollis	Black Bittern	V		Suitable foraging and nesting habitat present within the subject site and study area
Lathamus discolor	Swift Parrot	E	E	Suitable foraging habitat present within the subject site and study area
Limosa limosa	Black-tailed Godwit	V	M; C,J,K	Suitable foraging and nesting habitat present within the study area
Lophoictinia isura	Square-tailed Kite	V		Suitable foraging and nesting habitat present within the subject site and study area
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Suitable foraging and nesting habitat present within the subject site and study area
Neophema pulchella	Turquoise Parrot	V		Suitable foraging and nesting habitat present within the subject site and study area
Ninox connivens	Barking Owl	V		Suitable foraging habitat in the subject site and study area
Ninox strenua	Powerful Owl	V		Suitable foraging habitat in the subject site and study area
Petroica boodang	Scarlet Robin	V		Suitable foraging and nesting habitat present within the subject site and study area
Petroica phoenicea	Flame Robin	V		Suitable foraging habitat present within the subject site and study area
Rostratula australis	Australian Painted Snipe	E	V,M	Suitable foraging and roosting habitat present within the study area
Stagonopleura guttata	Diamond Firetail	V		Suitable foraging and nesting habitat present within the subject site and study area
Tyto novaehollandiae	Masked Owl	V		Suitable foraging habitat in the subject site and study area
Tyto tenebricosa	Sooty Owl	V		Suitable foraging habitat in the subject site and study area
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Suitable foraging habitat in the subject site and study area
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Suitable foraging habitat in the subject site and study area
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Suitable foraging habitat in the subject site and study area
Mormopterus norfolkensis	Eastern Freetail-bat	V		Suitable foraging habitat and potential roost sites in the subject site and study area

Scientific name	Common Name	TSC Act	EPBC Act	Notes
Myotis macropus	Southern Myotis	V		Suitable foraging habitat and potential roost sites in the subject site and study area
Phascolarctos cinereus	Koala	V	V	Suitable foraging habitat in the subject site and study area
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Suitable foraging habitat in the subject site and study area
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Suitable foraging habitat and potential roost sites in the subject site and study area
Litoria aurea	Green and Golden Bell Frog	E	V	Suitable foraging habitat and potential breeding habitat in the study area

The remainder of the threatened fauna species that are known or predicted to occur in the locality have a close association with specific habitat resources that are not present in the study area. Notably there are a number of fauna species that are associated with shrubby, sclerophyll vegetation types on sandstone substrates or rocky escarpments that would not occur in the grassy woodlands on flat, shale landscapes that characterise the study area.

The desktop review revealed two threatened fish species (Macquarie Perch *Macquaria australasica* and Australian Grayling *Prototroctes mairaena*) and two aquatic invertebrates Adam's Emerald Dragonfly (*Archaeophya adamsi* and Sydney Hawk Dragonfly *Austrocordulia leonardi)* which are predicted to occur in the locality of the site. Each of these species is associated with clear, deep streams with rocky or gravel substrates whereas the aquatic habitats in the study area are shallow and turbid with clay substrate. A review of the specific habitat requirements of these species and the habitat present led to the conclusion that these aquatic species are unlikely to occur in the study area or to be affected by the proposal (Appendix B).

4.4.3 EPBC Act MNES

The database searches identified 17 threatened ecological communities, 24 threatened flora species, 20 threatened fauna species and 1 migratory species listed under the EPBC Act as potentially occurring in the study area (see Appendix B). One additional MNES, The Greater Blue Mountains Area, was identified as occurring within the locality.

Threatened ecological communities

Cumberland Plain Woodland is also listed as a CEEC under the Commonwealth EPBC Act. Grey Box - Forest Red Gum grassy woodland occurs in the subject site as near intact moderate/good condition vegetation and as regrowth low condition vegetation. While both condition classes on site comprise the Cumberland Plain Woodland CEEC listed under the TSC Act the low condition woodland does not meet the condition thresholds for inclusion as the EPBC Act-listed CEEC.

The distribution of vegetation that is consistent with the EPBC Act-listed form of Cumberland Plain Woodland in the study area is shown in Figure 3.

No other threatened ecological communities listed under the EPBC Act are present in the study area.

Threatened flora

No threatened flora species listed under the EPBC Act were recorded within the study area. Based on the site surveys and habitat assessments conducted one threatened flora species may occur in the study area and/or be affected by the proposal: the Spiked Rice-flower (see Section 4.4.2).

Threatened fauna

No threatened fauna species listed under the EPBC Act were recorded within the study area. Based on the site surveys and habitat assessments conducted a total of nine threatened fauna species may occur in the study area and/or be affected by the proposal. These fauna species are also listed under the TSC Act and are listed in Table 6 and discussed in Section 4.4.2 above.

Migratory and marine fauna

Three marine bird species, four wetland birds (two of which are also listed as marine species) and seven 'terrestrial' bird species were identified by the EPBC Online Protected Matters Search Tool results (DSEWPaC 2012a), comprising:

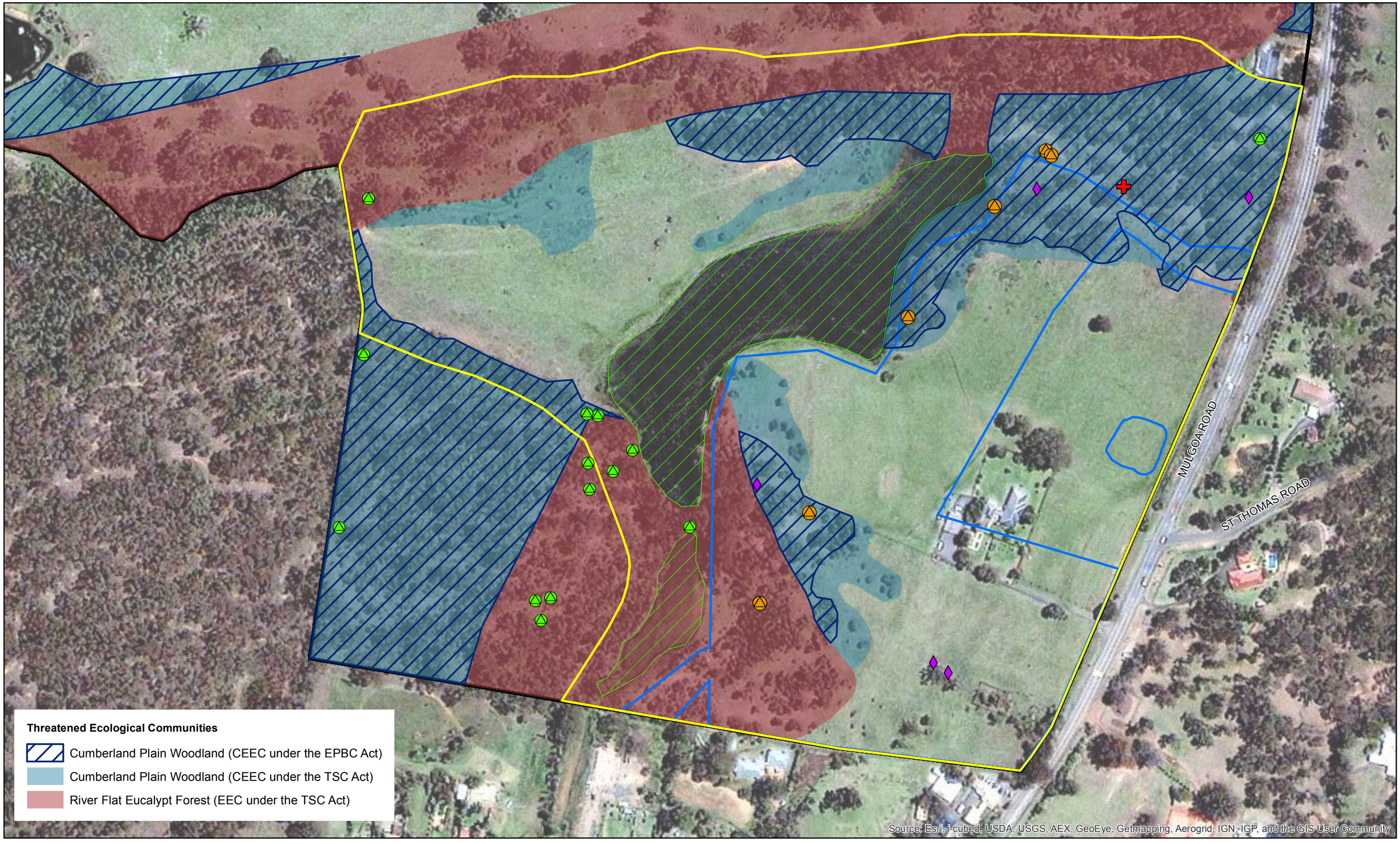
- Wetland species:
  - Great Egret (*Ardea alba*; also listed as marine)
  - Cattle Egret (*Ardea ibis*; also listed as marine)
  - Latham's Snipe (*Gallinago hardwickii*)
  - Painted Snipe (*Rostratula benghalensis*)
- 'Terrestrial' species
  - White-bellied Sea-eagle (*Haliaeetus leucogaster*)
  - White-throated Needletail (*Hirundapus caudacutus*)
  - Rainbow Bee-eater (*Merops ornatus*)
  - Black-faced Monarch (*Monarcha melanopsis*)
  - Satin Flycatcher (*Myiagra cyanoleuca*)
  - Rufous Fantail (*Rhipidura rufifrons*)
  - Regent Honeyeater (*Xanthomyza phrygia*)
- 'Marine' species
  - Fork-tailed Swift (*Apus pacificus*)

One of these migratory bird species was recorded during field surveys: the Cattle Egret (*Ardea ibis*) which was observed foraging in moist grassland adjacent to the large dam in the west of the study area. Each of the predicted species listed above may occur in the study area on occasion.

The EPBC Act lists migratory species listed under international agreements, as well as families of birds (such as ducks, waders, eagles and hawks) that are also known to be migratory but are not listed under international agreements. A range of waterfowl and waders were recorded in the study area as described in Section 4.3.1. Other seasonally migratory or nomadic species would also be likely to utilise habitats within the study area on occasion.

Additional MNES

The protected matters search (DSEWPC 2013a) identified ‘The Greater Blue Mountains Area’ which is listed as a declared World Heritage Property and a National Heritage Place under the EPBC Act. The Greater Blue Mountains Area is located around 5 km to the west of the study area and is separated from the subject site by native vegetation, agricultural land and the Nepean River. There is no risk of direct or indirect impacts of the proposal on the Greater Blue Mountains Area.



1:2,500 (at A3)

0 5 10 20 30 40 50
Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

Legend

- Subject site
- Study area
- Fernhill site boundary

Threatened biota and habitat features (GHD 2013)

- Cumberland Plain Land Snail (pending ID)
- Cumberland Plain Land Snail
- Habitat tree
- Varied Sitella
- Wetland

Fernhill Eastern Precinct
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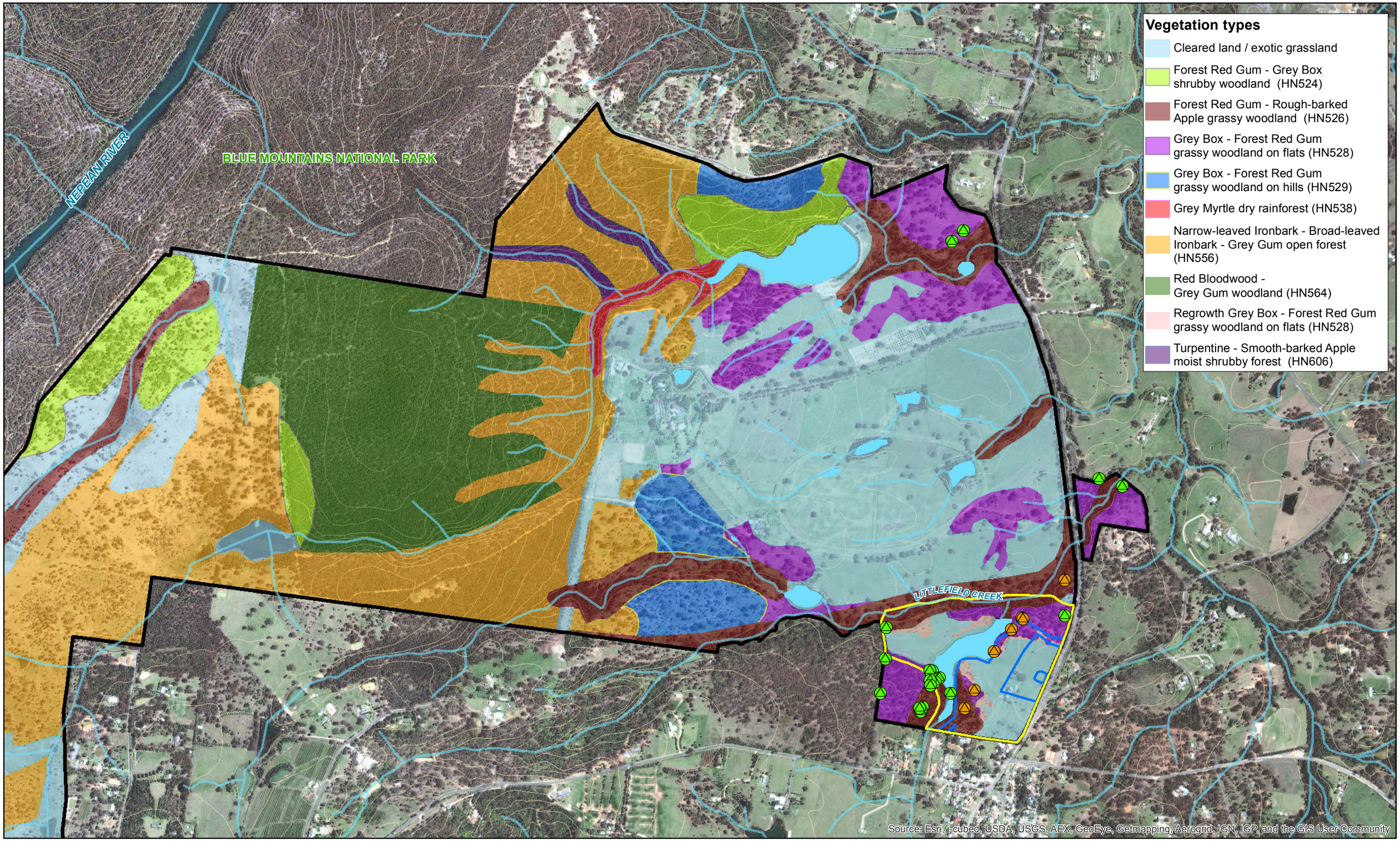
Threatened biota and habitat resources

Figure 3

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Subject site
- Study area
- Fernhill Site Boundary

Threatened biota and habitat features (GHD survey 2013)

- Cumberland Plain Land Snail (pending ID)
- Cumberland Plain Land Snail
- Watercourse
- Contour

Fernhill Eastern Precinct
Ecology Assessment

Job Number	22-16689
Revision	C
Date	28 Jun 2013

Vegetation types and Cumberland Plain Land Snail records

Figure 4

Data Source: Geoscience Australia: 250k Data - Jan 2011; Tough Mudder: Course Route, Obstacles, Car Parking and Base Area; 2013;ESRI World Imagery: Aerial Imagery, Accessed: 2013; GHD: Vegetation, 20-12-2012. Ecological: Grevillea Locations digitised from hard copy. Created by: NAHANSEN

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5. Potential Impacts

5.1 Direct impacts

5.1.1 Vegetation clearing and habitat removal

The proposal would result in the removal or modification of about 3.55 hectares of native vegetation within an overall subject site of 8.37 hectares as shown on Figure 2. Impacts would include clearing for the permanent infrastructure components of the proposal such as residential lots, access roads, fire trails, surface water management ponds and pumps and all associated earthworks. It is assumed that construction site compounds, temporary sediment management structures and any other ancillary structures would be entirely contained within the subject site. There may be scope to retain native trees and some understorey vegetation within the relatively large residential lots that are part of the proposal. However, for the purposes of impact assessment calculations the precautionary principal has been applied and it is assumed that there would be permanent removal of vegetation and habitat within the entire subject site.

The extent of clearing of vegetation and habitats within the proposal is summarised in Table 7 below. A maximum of 2.03 hectares of Cumberland Plain Woodland would be removed, which is approximately 0.14 % of the total estimated area of that vegetation community in the locality (around 1480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the TEC in the locality or the region. The local population of Cumberland Plain Woodland includes around 65 hectares within the Fernhill Estate and 74 hectares within the Mulgoa biobank (GHD, 2012) that would be set aside for conservation. There is around 200 hectares of Cumberland Plain Woodland and related TECs within Mulgoa Nature reserve that is already under secure tenure (NPWS, 2008). Section 7.2 and Appendix D provide a detailed assessment of significance of impacts on Cumberland Plain Woodland. The 2.03 hectares of Cumberland Woodland to be removed includes 1.23 hectares of better condition vegetation that is comensurate with the EPBC Act-listed form of the community.

A maximum of 1.52 hectares of River Flat Eucalypt Forest would be removed, which is approximately 0.24 % of the total estimated area of that vegetation community in the locality (around 621 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the TEC in the locality or the region. The local population of River Flat Eucalypt Forest includes around 47 hectares within the Fernhill Estate and 20 hectares within the Mulgoa biobank (GHD, 2012) that would be set aside for conservation. River Flat Eucalypt Forest is also present within Mulgoa Nature reserve that is already under secure tenure (NPWS, 2008). Section 7.2 and Appendix D provide a detailed assessment of significance of impacts on River Flat Eucalypt Forest.

The clearing of 3.55 hectares of native vegetation would involve removal of a moderately diverse range of non-threatened native plants, including a small number of mature trees. Mature trees have value within plant populations as sources of pollen and seed. There are extensive areas of these vegetation communities and species in the locality. The total area of native vegetation to be removed (3.55 hectares) is around 0.03 % of the estimated area of native vegetation in the locality (around 13,714 hectares, based on Tozer (2010) vegetation mapping). This very minor reduction in the extent of native vegetation would not threaten the persistence of local populations of native plants. Flora populations would persist within adjoining areas of alternative habitat beyond the study area.

The majority of the disturbance footprint is disturbed, cleared land containing exotic pasture species or environmental weeds. These areas contain little native vegetation cover and have limited habitat value for native plants. Any vegetation clearing required in these areas would

remove a small number of individuals of non-threatened native plants and noxious and environmental weeds. Provided the weed management measures proposed in Section 6 are adopted, the proposal may result in positive impacts on retained native vegetation adjoining the subject site by reducing the area of weeds in the study area. The residential subdivision is likely to be dominated by exotic plants however these properties would be managed by landowners and are unlikely to contain noxious or environmental weeds. This would remove a source of weed propagules that are currently threatening adjoining areas of intact native vegetation.

Table 7 Extent of clearing of vegetation and TECs* within the subject site

Vegetation community	TSC Act Status	EPBC Act Status	Area within subject site (hectares)	Area within locality[a] (hectares)	Percentage in locality to be cleared
Grey Box - Forest Red Gum grassy woodland on flats	CEEC	CEEC	1.23[b]	14833[c]	0.08%
Grey Box - Forest Red Gum grassy woodland on flats and Regrowth (low condition) Grey Box - Forest Red Gum grassy woodland on flats	CEEC		2.03	14804[d]	0.14%
Forest Red Gum - Rough-barked Apple grassy woodland	EEC		1.52	6215[e]	0.24%
Cleared land / exotic grassland			4.83		
Total Native Vegetation			**3.55**	**13,714**	**0.03%**
Total All Vegetation			**8.37**		

Notes

*** Threatened Ecological Community**

a = based on NPWS (2002) vegetation mapping.

b = The extent of intact Grey Box - Forest Red Gum grassy woodland on flats has been calculated separately to allow quantification of impacts on better condition Cumberland Plain Woodland that is listed as a CEEC under the EPBC Act. This area is not counted in the total area of vegetation removal because it has been included in the total area of Cumberland Plain Woodland that is listed as a CEEC under the TSC Act along with Regrowth (low condition) Grey Box - Forest Red Gum grassy woodland on flats.

c = Cumberland Shale Hills Woodland and Cumberland Shale Plains Woodland Cumberland map units (Tozer, 2010).

d = Castlereagh Shale-Gravel Transition Forest, Cumberland Shale Hills Woodland and Cumberland Shale Plains Woodland map units (Tozer, 2010).

e = River Flat Forest map unit (Tozer, 2010).

The vegetation that would be removed provides habitat resources for native fauna species, including threatened species of fauna. The proposal would result in direct impacts on known local populations of two threatened fauna species, the Varied Sittella and Cumberland Plain Land Snail. The proposal would remove habitat resources for these two species and for a variety of other threatened fauna, including around:

- 2.75 hectares of suitable forest and woodland habitat for the Cumberland Plain Land Snail

- 3.55 hectares of foraging and nesting habitat for threatened woodland birds such as the the Varied Sittella, Speckled Warbler (*Chthonicola sagittata*) and Scarlet Robin (*Petroica boodang*)
- 2.75 hectares of foraging habitat, including four identified potential roost trees for tree-roosting microbats such as the Eastern Freetail-bat (*Mormopterus norfolkensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- 2.75 hectares of foraging habitat, but no potential hollow-bearing nest trees for forest owls such as the Barking Owl (*Ninox connivens*) or cockatoos such as the Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- 2.75 hectares of foraging habitat for migratory nectar feeders such as the Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*)
- 2.75 hectares of foraging habitat for large mammals such as the Spotted-tailed Quoll (*Dasyurus maculatus*) and Koala (*Phascolarctos cinereus*).

The clearing of 2.75 hectares of native woodland and forest would include the removal of a number of mature trees. Mature trees have value for fauna populations as sources of foraging resources such as leaves, nectar, sap or seed and substrate for invertebrate prey. The proposal would remove a very small proportion of available foraging resources for local populations of native fauna: 0.03% of the extent of vegetation map units likely to contain similar foraging habitat in the locality (around 13,714 hectares based on Tozer, 2010 vegetation mapping).

The subject site includes four identified habitat trees as shown on Figure 3, including one hollow-bearing tree. Given the position of these trees and the size and orientation of hollows they are not potential roost sites for forest owls, cockatoos or threatened gliders. They may be utilised as a roost or nest site by hollow-roosting microbats or smaller bird species.

The broader study area contains suitable foraging habitat and potential breeding habitat for wetland-dependant fauna such as the Australasian Bittern (*Botaurus poiciloptilus*), Australian Painted Snipe (*Rostratula australis*) and Green and Golden Bell Frog (*Litoria aurea*). There is no wetland habitat for these species in the subject site. These species may use the subject site as occasional foraging habitat or while travelling between preferred wetland habitats.

As described in Section 4.3.2 the subject site contains fragmented patches of habitat with less value than equivalent habitat in more extensive patches of native vegetation, that are remote from cleared or developed land. There are extensive areas of such undisturbed habitat in the locality, particularly to the west of the study area in the central portion of the Fernhill Estate and in the Blue Mountains National Park. Overall, the subject site is likely to make a minor contribution to the maintenance of local populations of native species and threatened biota. Similar habitat that is part of larger vegetated patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for local populations. The removal of habitat resources within the subject site is likely to have a relatively minor impact on local populations of threatened biota.

5.1.2 Aquatic habitats

There are no wetland, riparian and aquatic habitats in the subject site. There are aquatic habitats in the same catchment as the subject site that may be sensitive to indirect impacts, including two wetlands downslope to the west and Littlefield Creek, downslope to the north. Potential indirect impacts on these aquatic habitats are assed in Section 5.2.2.

5.1.3 Fauna injury and mortality

As described above, the subject site provides habitat resources for native fauna species, including threatened fauna. More mobile native fauna such as adult birds, microbats, terrestrial and arboreal mammals are highly unlikely to be affected by construction activities. Construction may result in the injury or mortality of small terrestrial fauna that may be sheltering in vegetation within the subject site, such as the Cumberland Land Snail or the opportunistic frogs and reptiles described above. The frog and reptile species that are known or likely to occur in the subject site are widespread and abundant and so the potential injury or mortality of individuals within a maximum of 8.37 hectares of habitat (comprising all vegetation, including native and exotic, to be removed) is highly unlikely to affect an ecologically significant proportion of any local populations.

The Cumberland Land Snail is small, sedentary and closely affiliated with native vegetation communities within the subject site and so specific mitigation measures will be required to reduce the risk of injury or mortality of this endangered species. Targeted pre-clearing surveys and relocation of individuals and habitat resources are likely to reduce the risk of harm to acceptable levels (see Section 6.2). Even allowing for the possibility that these mitigation measures may not be effective the proposal would be highly unlikely to result in harm to an ecologically significant proportion of the local population of the species. The proposal would risk harm to snails within 2.75 hectares of Cumberland Land Snail habitat out of around 112 hectares of equivalent habitat in the Fernhill Estate and over 2000 hectares in the locality (Tozer, 2010).

Nesting birds and roosting microbats may be vulnerable to injury or mortality if present during clearing of trees within the subject site. Notably, these less mobile fauna may be resident in the four identified habitat trees. Pre-clearing fauna surveys will be undertaken as part of the Construction Environmental Management Plan (CEMP) to reduce the risk of injury or mortality to native fauna and especially tree-dwelling fauna. These surveys will involve the inspection of trees for resident fauna as a precautionary measure prior to felling. The CEMP will also contain protocols for the felling of habitat trees and measures for the safe management of native fauna if detected in trees or on site generally during construction (see Section 6).

The proposal would increase the extent of developed land in the study area and locality and may result in a minor increase in the volume of traffic. This would have a negligible effect on the risk of vehicle collisions with native fauna given the existing volume of traffic on Mulgoa Road and because the subject site is at the terminal end of a vegetated corridor (see Section 4.3.2).

5.2 Indirect impacts

5.2.1 Habitat fragmentation

The subject site is at the terminal end of a vegetated corridor (see Section 4.3.2 and Figure 4. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat.

Vegetation in the Blue Mountains National Park and the Nepean River riparian strip to the west of the subject site is an important habitat corridor as described in Section 4.3.2. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The majority of the subject site is low, exotic vegetation that would have very little value as fauna movement habitat. Fauna movement, pollination and seed fall of plants and other ecological processes would occur around, rather than through, the subject site.

The proposal involves construction of structures that may obstruct movement of fauna attempting to travel through the study area, such as fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa

road to the east, and would not significantly increase the degree to which fauna movement is disrupted. Fauna movement and ecological processes would continue to function around the subject site via the vegetated riparian corridor to the north.

In this context, the proposal would not have an adverse effect on fauna movement or habitat connectivity.

5.2.2 Erosion, sedimentation or contamination

There are potential sensitive receptors for indirect impacts on aquatic habitats in the study area including Littlefield Creek to the north of the subject site and wetlands to the west. Potential impacts that could cause the decline in aquatic habitat value include:

- Alterations to riparian and floodplain geomorphology
- Alterations to catchment hydrology
- Reduced water quality through hydrocarbon contamination or through increased nutrient or sediment inputs.

The hydrology and water quality of the study area is already substantially modified by clearing, damming of the drainage line to the west of the subject site and livestock access. The proposal would result in a minor increase in the proportion of hardstand surfaces in the study area and may also modify drainage through drains and other engineered structures. Given the extent of existing modifications to the local catchment the proposal would comprise a minor change to hydrology and would be highly unlikely to adversely affect any aquatic habitats.

The potential for hydrocarbon contamination or increased nutrient or sediment inputs can be avoided or minimised through the implementation of appropriate mitigation measures as outlined in Section 6.

5.2.3 Weed invasion and edge effects

'Edge effects' refers to changed environmental conditions at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from clearing of vegetation within the subject site and then continue to affect vegetation and habitats adjoining the subject site for the life of the proposal.

Construction may increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water) and via workers shoes and clothing and through construction vehicles. The risk of introduction of weeds would continue during operation of the proposal through wind or water transmisiion of proagules from gardens and/or as property owners or their pets may enter adjoining vegetation.

The proposal involves widening an existing area of disturbed, cleared land and would therefore not constitute a novel impact. Within the majority of the study area the severity of impacts arising from edge effects and weed invasion would be limited by the presence of existing disturbance. The entire eastern and southern edges of vegetation within the subject site already adjoin cleared land dominated by exotic plants. Areas vulnerable to novel edge effects include along the western and northern edge of the subject site where it adjoins native woodland and forest.

A Vegetation Management Plan is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site (refer Section 6). Given these mitigation measures and the extent of existing weed infestation

and disturbance in the study area the proposal would result in a minor increase in weed infestation and other edge effects.

5.2.4 Pests and pathogens

Construction activities within the subject site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) throughout the study area through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can wipe out entire populations once introduced into an area.

The potential for impacts associated with these pathogens is low, given the disturbed nature and high visitation rates to the subject site, and lack of intact native vegetation along most of the route. As a precautionary measure a 'clean on entry, clean on exit' policy should be implemented during construction activities as outlined under the CEMP (detailed further in Section 6) to prevent the introduction or spread of these pathogens.

5.3 Operational impacts

5.3.1 Noise, light and vibration

The subject site is located directly adjacent to a relatively busy regional road (Mulgoa Road) with relatively high traffic volumes and immediately adjoins Mulgoa Village. Habitats adjacent to the subject site therefore already experience high noise, light and vibration disturbance. The proposal may increase traffic flow due to the additional dwellings, in the village of Mulgoa though this is likely to have a minor impact given the current population and volume of through traffic. There would be a minor increase in light spill associated with the proposed dwellings. Light spill is likely to be low intensity and restricted to human waking hours. This would not be a novel impact and is likely to have a minor effect on native fauna in habitat adjoining the subject site.

5.4 Cumulative impacts

The proposal is a direct expansion of the village of Mulgoa. There would be cumulative impacts associated with a shift from partially cleared rural residential land to completely cleared, low density residential land. The majority of the subject site contains grazed exotic grassland with minimal habitat resources for native fauna and negligible value as a movement corridor. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed 'green field' site. The proposal includes the removal of 3.55 hectares of native vegetation and so would contribute to cumulative impacts on native biota in the locality.

Potential cumulative impacts arising from the proposal include:

- An increase in the degree of vegetation clearing in the study area.
- A minor increase in the degree of fragmentation of habitat as the proposal will affect only fragmented extensions of vegetated corrdiors.
- An increase in the magnitude of edge effects on remnant native vegetation and the imposition of novel edge effects on some areas of vegetation.
- A minor increase in noise and light disturbance and the risk of predation of native fauna by domestic pets

- A minor increase in the risk of vehicle collisions due to increased vehicle traffic.

Mitigation measures are proposed to ameliorate each of these potential cumulative impacts and are included as Section 6. Notably pre-construction treatment of weed infestations, vegetation management during construction and post-construction monitoring of native vegetation and treatment of weeds are proposed to mitigate against additional degradation of intact native vegetation in the study area.

The subject site is located at the terminal end of a vegetated corridor, on the edge of Mulgoa village and would comprise a relatively minor increase in the degree of habitat fragmentation or indirect effects. The proposal would not sever any import vegetated links or isolate any areas of habitat.

Cumulative impacts arising from the proposal are unlikely to cross any critical threshold for impacts that would have a significant adverse affect on local populations of any native biota.

5.5 Key threatening processes

A key threatening process (KTP) is defined in the TSC Act (OEH 2011c) as an action, activity or proposal that:

- Adversely affects two or more threatened species, populations or ecological communities.
- Could cause species, populations or ecological communities that are not currently threatened to become threatened.

KTPs are listed under the TSC Act, the FM Act and also under the EPBC Act. A number of KTPs are listed under more than one Act. Those potentially relevant to this proposal are discussed in Table 8 below. Mitigation measures to limit the impacts of these KTPs are discussed in Section 6.

Table 8 Key threatening processes

KTP	Status	Comment
Clearing of native vegetation	TSC Act; EPBC Act	Clearing of native vegetation has occurred historically within and around the study area. The proposal would result in the clearing of 3.55 hectares of native vegetation. The vegetation to be removed is in moderate to low condition due to weed infestation and other edge effects. The clearing of this vegetation is not likely to significantly affect any threatened biota. The implementation of a Vegetation Management Plan is recommended to minimise impacts on native vegetation. The proposal would result in a minor increase in the operation of this KTP.
Clearing of hollow-bearing trees	TSC Act	Two hollow-bearing trees were recorded within the subject site. The proposal would result in a minor increase in the operation of this KTP.
Removal of dead wood and dead trees	TSC Act	There are moderate quantities of dead wood and two identified dead habitat trees in the subject site that would provide habitat resources for native fauna. The CEMP would include measures for the salvage and reinstatement of woody debris which would partially mitigate against the operation of this KTP. The proposal would result in a minor increase in the operation of this KTP.
Invasion of plant communities by perennial exotic grasses	TSC Act	The subject site features moderate to severe infestation with perennial exotic grasses. Adjoining areas of native vegetation also feature localised

KTP	Status	Comment
		moderate infestation. There is the potential for perennial exotic grasses to further invade native vegetation through disturbance during construction of the proposal and a shift of the disturbed edge west and north into intact native vegetation. A Vegetation Management Plan is recommended, which would include measures to limit the spread of weeds. These mitigation measures are likely to effectively limit the operation of this KTP.
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act; FM Act	The hydrology of the study area is already substantially modified by damming of the drainage line to the west of the subject site, clearing for agriculture and surrounding suburban development. There is no aquatic habitat within the subject site and the proposal would have a minor, localised effect on the hydrology of the study area and the surrounding catchment. The proposal is unlikely to increase the operation of this KTP.
Infection of native plants by Phytophthora cinnamomi	TSC Act; EPBC Act	Construction activities have the potential to introduce the root-rot fungus Phytophthora cinnamomi into the study area, which could lead to dieback of vegetation. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Construction activities have the potential to introduce Myrtle Rust to the study area. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	TSC Act; EPBC Act	Construction activities have the potential to introduce amphibian chytrid to the study area, which could lead to death of local frogs. The implementation of a Fauna Management Plan is recommended to limit impacts on fauna and their habitats. The proposal is unlikely to increase the operation of this KTP.

6. Mitigation Measures

The proposal would result in direct impacts on native biota and their habitats within the subject site. There is also the potential for impacts on habitat outside the disturbance area during construction and during the longer-term use of the subject site for residential dwellings. Specific mitigation measures are recommended to minimise such impacts on the natural environment.

The proposal would result in some unavoidable residual adverse impacts imposed upon some elements of the natural environment, including removal of native vegetation and imposition of edge effects on adjoining areas of native vegetation. These residual impacts are not expected to impose a significant negative effect on any local populations of native biota, including threatened biota and their habitats which occur in the study area.

Biodiversity offsets in the form of targeted weed management and bush regeneration may be appropriate to address these residual adverse impacts to achieve an overall 'maintain or improve' outcome for biodiversity conservation.

The following sections detail the avoidance of impacts, mitigation measures and offset contributions recommended for the proposal.

6.1 Avoidance of impacts

The proposal is a direct expansion of the village of Mulgoa. The majority of the subject site falls within land which is extensively modified by existing activities. The subject site is located at the terminal end of a vegetated corridor and would comprise a relatively minor increase in the degree of habitat fragmentation or indirect effects. The proposal would not sever any import vegetated links or isolate any areas of habitat. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed 'green field' site. On this basis the proposal has successfully avoided impacts on native biota by selecting a site with lower conservation value.

A previous residential subdivision proposed for the study area included up to 76 residential lots and associated access roads and infrastructure within a subject site that extended to the west of the large dam (EcoLogical, 2010). This previous proposal would have been likely to result in greater impacts than the current design including:

- Removal of a much greater area of regrowth Cumberland Plain Woodland in partially cleared land to the west of the large dam
- Greater potential for edge effects and other indirect impacts on wetland habitat and on adjoining native woodland and forest.
- Impacts have been further avoided through the preliminary design phase including:
- Maintenance of a minimum 10 metre buffer around the large dam and associated wetland habitat to the west of the subject site.
- Placement of surface water management infrastructure in locations with lower ecological value, including exotic grassland in the east and centre of the subject site and an area of poorer condition River Flat Eucalypt Forest in the southeast of the subject site, that is dominated by *Acacia* regrowth.

6.2 Mitigation of impacts

6.2.1 Pre-construction phase

Detailed Design Phase

During the detailed design process, the impact of the proposal on areas with high biodiversity values should be minimised wherever possible by:

- Minimising the area of native vegetation and especially intact Cumberland Plain Woodland to be cleared and maintenance within vegetated portions of residential lots wherever possible.
- Avoidance of identified habitat trees and maintenance within vegetated portions of residential lots wherever possible.

6.2.2 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures including the procedures outlined below. The CEMP should be prepared and implemented by the contractor. The proposed measures would include environmental safeguards for protection of downstream properties and waterways in accordance with relevant policy documentation and Government guidelines.

The CEMP would be required to address the following as a minimum:

- An erosion and sediment control plan, which would require:
  - Installation of erosion and sediment control measures prior to construction
  - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality
  - Stockpiles to be restricted to identified construction compounds, in areas of cleared land and exotic grassland and managed to ensure no offsite impacts of dust generation or sedimentation
  - Separate erosion controls for individual house sites will be established to support the building stage of the development.
  - The development site would include landscaped open space as part of the finalisation process for each allotment in accordance with detailed landscaping plans prepared for the development. Open space would be landscaped as soon as practicable after construction of dwellings to minimise the time that bare earth is exposed to erosion.
- A vegetation management plan (VMP), which should include (but not be limited to) the following:
  - Delineation and protection of exclusion zones around native vegetation to be retained
  - Communication with construction personnel of the conservation value of surrounding habitats and their responsibilities with regards to protecting these habitats during construction
  - Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation
- A weed management sub-plan to the VMP, including a description of:

  - Type and location of weeds of concern (including noxious weeds) within the subject site
  - Sensitive receivers (such as native vegetation and waterways) within or adjacent to the subject site
  - Measures to prevent the spread of weeds, including hygiene procedures for equipment, footwear and clothing
  - Proposed weed control methods and targeted areas
  - Weed disposal protocols
- A landscaping plan for areas outside of building envelopes. This should include:
  - Progressive landscaping of disturbed areas during construction to minimise soil erosion and weed establishment
  - Retention of large trees wherever possible within design constraints
  - Use of native flora species of local provenance where possible
- A fauna management plan, including (but not limited to) the following:
  - Clearing of mature trees should be minimised where possible
  - A Cumberland Plain Land Snail protocol, including pre-clearing surveys for snails and salvage and relocation of any snails and/or suitable shelter sites that are detected in the subject site into areas of adjoining suitable habitat.
  - A fauna management protocol, including pre-clearing surveys for nests or sheltering terrestrial fauna and rescue and salvage of fauna where possible
  - Protocols to prevent introduction or spread of chytrid fungus should be implemented following OEH Hygiene protocol for the control of disease in frogs (DECCW, 2008c).

Pre-clearance surveys

Pre-clearance surveys should be undertaken by a qualified ecologist, and the required methodology and targeted species should be developed as part of the CEMP. Surveys should include:

- Clear marking/erection of exclusion fencing around protected vegetation areas and delineation of ‘no-go’ areas
- Targeted pre-clearing surveys in accordance with the Cumberland Plain Land Snail protocol. Pre-clearing surveys would include targeted searches of the subject site for snails and salvage and relocation of any snails and/or suitable shelter sites that are detected. Snails and/or suitable shelter sites would be relocated to appropriate Cumberland Plain Land Snail habitat in the study area, to the north and west of the subject site. Snail collection and relocation would need to be conducted by appropriately experienced ecologists under a Licence obtained under Section 91 of the TSC Act.
- Inspections of native vegetation for other resident fauna and/or nests or other signs of fauna occupancy
- Deferral of vegetation removal and associated construction activity in areas occupied by more mobile threatened fauna until the fauna has vacated the subject site
- Capture and relocation or captive rearing of less mobile fauna (such as roosting microbats, nestling birds or any injured fauna) by a trained fauna handler and with assistance from Wildlife Information Rescue and Education Service (WIRES) as required
- Inspection and identification/marking of hollow-bearing trees adjacent to construction footprints to help ensure against accidental impacts.

6.2.3 Construction phase

The following principals should be followed throughout the construction phase:

- All works should be undertaken in accordance with the CEMP
- Clearing surveys must be undertaken by a suitably qualified ecologist during any construction stages that involve removal of native vegetation. Clearing methods and presence/fate of any resident fauna must be documented
- Wildlife should not be handled wherever possible. Construction staff should only handle wildlife in an emergency situation. Uninjured wildlife should be gently encouraged to leave the site by the ecologist/ wildlife specialist. Injured wildlife would be taken to a local WIRES carer or veterinarian for treatment and care if necessary
- All equipment must be refuelled at least 20 metres away from drainage lines or wetlands and all fuel and chemical storages should be bunded.

7. Assessments of Significance

7.1 Identification of affected threatened biota

The desktop assessment, field surveys and habitat assessments described above have been used to identify the suite of threatened biota that may be affected by the proposal, through either direct or indirect impacts. If threatened biota is potentially affected by a proposed activity then the significance of impacts must be assessed through Section 5A of the EPA Act (the seven part test) and/or the *Matters of National Environmental Significance –Assessment of significance guidelines* (DEWHA, 2009).

The DECC (2007) *Threatened species assessment guidelines - the assessment of significance and* DEWHA (2009) guidelines require proponents to compile a list of threatened biota which may be affected by the proposal and which require an assessment of significance. Threatened biota do not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species (DECC, 2007):

- Does not occur in the study area, or
- Will not use on-site habitats, even on occasion, or
- Will not be influenced by off-site impacts of the proposal.

The suite of threatened biota potentially relevant to this assessment is presented in Appendix C, along with the nature of any previous records in the locality and an assessment of the likelihood of occurrence in the study area. Based on the targeted surveys and habitat assessments undertaken, a number of the threatened biota presented in Appendix C do not occur in the study area. Given the limited scale and magnitude of impacts arising from the proposal and impact mitigation and environmental management measures described in Section 6, no additional threatened biota outside of the study area are likely to be affected by off-site impacts of the proposal.

Table 9 lists the threatened ecological communities and species that are known or likely to be present in the study area and are considered affected threatened biota for the proposal and which require specific assessments of significance of impacts. Affected threatened species have been grouped in guilds (i.e. species that have similar ecology and/or shared habitat requirements). The results of the assessments of significance for guilds of affected threatened biota are described below.

Table 9 Threatened biota that are known or likely to occur in the study area and to be affected by the proposal

Common Name	Scientific name	TSC Act	EPBC Act
River-Flat Eucalypt Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	
Cumberland Plain Woodland	'Cumberland Plain Woodland in the Sydney Basin Bioregion'(TSC Act) and 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (EPBC Act)	CEEC	CEEC

Common Name	Scientific name	TSC Act	EPBC Act
Spiked Rice-flower	*Pimelea spicata*	E	E
Cumberland Plain Land Snail	*Meridolum corneovirens*	E	
Woodland birds			
Varied Sitella	*Daphoenositta guttata*	V	
Bush Stone-curlew	*Burhinus grallarius*	E	
Diamond Firetail	*Stagonopleura guttata*	V	
Flame Robin	*Petroica phoenicea*	V	
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	
Scarlet Robin	*Petroica boodang*	V	
Speckled Warbler	*Chthonicola sagittata*	V	
Turquoise Parrot	*Neophema pulchella*	V	
Migratory or nomadic birds			
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	
Little Lorikeet	*Glossopsitta pusilla*	V	
Regent Honeyeater	*Anthochaera phrygia*	CE	E
Swift Parrot	*Lathamus discolor*	E	E
Large predatory birds			
Barking Owl	*Ninox connivens*	V	
Masked Owl	*Tyto novaehollandiae*	V	
Powerful Owl	*Ninox strenua*	V	
Sooty Owl	*Tyto tenebricosa*	V	
Square-tailed Kite	*Lophoictinia isura*	V	
Wetland species			
Australasian Bittern	*Botaurus poiciloptilus*	E	E
Australian Painted Snipe	*Rostratula australis*	E	V,M
Black Bittern	*Ixobrychus flavicollis*	V	
Black-tailed Godwit	*Limosa limosa*	V	M; C,J,K

Common Name	Scientific name	TSC Act	EPBC Act
Green and Golden Bell Frog	Litoria aurea	E	V
Tree-roosting microbats			
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	
Southern Myotis	*Myotis macropus*	V	
Cave roosting microbats			
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
Mammals of forest and woodland			
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Koala	*Phascolarctos cinereus*	V	V
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E

7.2 Threatened ecological communities recorded on site

7.2.1 Cumberland Plain Woodland

An assessment of significance of impacts on the Cumberland Plain Woodland have been prepared pursuant to s.5A of the EPA Act (see Appendix D). The outcome of this assessment is that the proposal would not have a significant impact on Cumberland plain Woodland, given:

- The proposal would remove around 0.14 % of the total estimated area of the TEC in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in extent would not threaten the viability or persistence of the TEC in the locality or the region.
- A maximum of 2.03 hectares of moderate quality habitat for Cumberland Plain Woodland, including low-condition regrowth and fragmented patches, would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of the TEC.

7.2.2 River Flat Eucalypt Forest

An assessment of significance of impacts on the local occurrence of River Flat Eucalypt Forest has been prepared pursuant to s.5A of the EPA Act and is included in Appendix D. The

outcome of this assessment of significance is that the proposal is not likely to have a significant impact on the local occurrence of River Flat Eucalypt Forest, given:

- The proposal would remove around 0.24 % of the total estimated area of that vegetation community in the locality of the TEC in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in extent would not threaten the viability of the local population of the TEC.
- A maximum of 1.52 hectares of habitat for River Flat Eucalypt Forest would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of the TEC.

7.3 Threatened flora species that may potentially occur

7.3.1 Spiked Rice-flower

An assessment of significance of impacts on the Spiked Rice-flower has been prepared pursuant to s.5A of the EPA Act (see Appendix D). The outcome of this assessment is that the proposal would not have a significant impact on the Spiked Rice-flower, given:

- Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of habitat and potentially plants (if present) within the 2.03 hectares of habitat for the species in the subject site.
- The proposal would affect around 0.14 % of the total estimated area of potential habitat for the Spiked Rice-flower in shale woodlands in the locality (based on Tozer (2010) vegetation mapping). The minor magnitude of impacts on any individual plants that may occur in the subject site or on potential habitat would not threaten the viability or persistence of the species in the locality or the region.
- A maximum of 2.03 hectares of habitat for the Spiked Rice-flower would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given the ongoing grazing and that the species has not been recorded in the study area or its vicinity.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of the Spiked Rice-flower.

7.4 Threatened fauna

7.4.1 Cumberland Plain Land Snail

An assessment of significance of impacts on the Cumberland Plain Land Snail has been prepared pursuant to s.5A of the EPA Act (see Appendix D). The outcome of this assessment is that the proposal would not have a significant impact on the Spiked Rice-flower, given:

- Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of habitat and potentially snails (if present) within the 2.75 hectares of habitat for the species in the subject site.
- The proposal would affect around 0.14 % of the total estimated area of potential habitat for the species in shale woodlands in the locality (based on Tozer (2010) vegetation mapping). The minor magnitude of impacts on any individual snails that may occur in the

subject site or on potential habitat would not threaten the viability or persistence of the species in the locality or the region.

- The proposal would not isolate or fragment any significant areas of habitat.
- The proposed construction would include a pre-clearing survey including salvage of any snails or woody debris in construction footprints and placement in adjacent areas of retained vegetation. This would partially mitigate impacts on local populations.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of the Cumberland Plain Land Snail.

7.4.2 Woodland birds

Assessments of significance of impacts on the local populations of threatened woodland birds (Varied Sittella, Bush Stone-curlew, Diamond Firetail, Flame Robin, Hooded Robin, Scarlet Robin, Speckled Warbler and Turquoise Parrot) has been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on the local populations of these threatened woodland birds given:

- Potential impacts of the proposal on the life cycle of these woodland bird species would be restricted to the removal of edge habitat and potential injury or mortality of birds within the 3.54 hectares of potential foraging or nesting habitat for these species in the subject site (comprising intact and regrowth woodland and forest).
- The proposal would affect around 0.14 % of the total estimated area of potential habitat for these woodland birds in grassy woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor magnitude of impacts on any individual birds that may be resident in the subject site or on nest sites or other potential habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of edge habitat between native vegetation and cleared land for these woodland bird species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these woodland bird species.

7.4.3 Migratory or nomadic birds

Assessments of significance of impacts on the local populations of threatened migratory or nomadic birds (Gang-gang Cockatoo, Little Lorikeet, Regent Honeyeater and Swift Parrot) have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on these threatened migratory or nomadic birds given:

- That potential impacts of the proposal on the life cycle of these migratory or nomadic bird species would be restricted to the removal of 2.75 hectares of potential foraging habitat for these species in the subject site (comprising intact woodland and forest; these species are highly unlikely to roost or nest in the subject site and there is little risk of injury or mortality of these birds).

- The proposal would affect around 0.02 % of the total estimated area of potential foraging habitat for these migratory or nomadic birds in nectar or seed bearing woodland and sclerophyll forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in foraging resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of edge habitat between native vegetation and cleared land would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these migratory or nomadic bird species.

7.4.4 Large predatory birds

Assessments of significance of impacts on the local populations of threatened large, predatory birds (Barking Owl, Masked Owl, Powerful Owl, Sooty Owl and Square-tailed Kite) have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on the local populations of these large predatory bird species given:

- That potential impacts of the proposal on the life cycle of these large predatory bird species would be restricted to the removal of 2.75 hectares of potential foraging habitat for these species in the subject site (comprising intact woodland and forest; these species are highly unlikely to roost or nest in the subject site and there is little risk of injury or mortality of these birds).
- The proposal would affect around 0.02 % of the total estimated area of potential foraging habitat for these large predatory bird species in woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in foraging resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of foraging habitat for these large predatory bird species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these large predatory bird species.

7.4.5 Wetland species

Assessments of significance of impacts on the local populations of threatened wetland species (Australasian Bittern, Australian Painted Snipe, Black Bittern, Black-tailed Godwit and Green and Golden Bell Frog) have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on these wetland species given:

- There is no wetland habitat in the subject site. Potential impacts of the proposal on the life cycle of these wetland species would be restricted to minor, indirect effects on potential breeding, foraging or roosting habitat in the broader study area and removal of a maximum of 8.37 hectares of less suitable grassland, woodland or forest habitat that may be used by these species as occasional foraging habitat or while travelling between preferred wetland habitats.

- That given the small scale of the proposal and proposed mitigation measures it would be unlikely to result in any substantial indirect impacts on any breeding, foraging or roosting habitat for these species in wetlands in the study area.
- A maximum of 8.37 hectares of occasional foraging or movement habitat for these wetland species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has very low value given its attributes, condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these wetland species.

7.4.6 Tree-roosting microbats

Assessments of significance of impacts on the local populations of threatened tree-roosting microbats (Eastern Freetail-bat, Greater Broad-nosed Bat, Southern Myotis) have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on local populations of these threatened tree-roosting microbats given:

- That potential impacts of the proposal on the life cycle of these threatened tree-roosting microbats would be restricted to the removal of 3.55 hectares of potential foraging and roosting habitat for these species in the subject site (comprising intact and regrowth woodland and forest and four potential roost trees with hollows, fissures or decorticating bark; microbats would also use aerial foraging habitat above cleared land and exotic grassland in the subject site however the final proposal footprint would have equivalent value).
- The proposal would affect around 0.02 % of the total estimated area of equivalent foraging and roosting habitat for tree-roosting microbats in woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of foraging habitat and four potential roost trees for these species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these tree-roosting microbats.

7.4.7 Cave roosting microbats

Assessments of significance of impacts on the local populations of threatened cave-roosting microbats (Eastern Bentwing-bat, Large-eared Pied Bat) have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on local populations of these threatened cave-roosting microbats given:

- That potential impacts of the proposal on the life cycle of these threatened cave-roosting microbats would be restricted to the removal of 3.55 hectares of potential foraging habitat for these species in the subject site (comprising intact and regrowth woodland; there are no caves, cliff lines or other potential roost sites in the study area; microbats would also

use aerial foraging habitat above cleared land and exotic grassland in the subject site however the final proposal footprint would have equivalent value).

- The proposal would affect around 0.02 % of the total estimated area of equivalent foraging and habitat for cave-roosting microbats in woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in habitat resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of foraging habitat and four potential roost trees for these species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these cave-roosting microbats.

7.4.8 Mammals of forest and woodland

Assessments of significance of impacts on the local populations of the Grey-headed Flying-fox, Koala and Spotted-tailed Quoll have been prepared pursuant to s.5A of the EPA Act and are included in Appendix D. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on the local populations of the Grey-headed Flying-fox, Koala and Spotted-tailed Quoll given:

- That potential impacts of the proposal on the life cycle of these large, mobile mammals of forest and woodland would be restricted to the removal of 2.75 hectares of potential foraging habitat in the subject site (comprising intact woodland and forest; there are no Grey-headed Flying-fox roost camps in the study area or locality; there are no potential Spotted-tailed Quoll den sites in the study area; there is little risk of injury or mortality of these large, mobile species).
- The proposal would affect around 0.02 % of the total estimated area of potential foraging habitat for these species in woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor reduction in foraging resources would not threaten the viability or persistence of the local population of these species.
- A maximum of 3.55 hectares of foraging habitat for these species would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has only moderate value given its condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of the Grey-headed Flying-fox, Koala or Spotted-tailed Quoll.

7.5 Migratory fauna

One migratory bird species was recorded during field surveys: the Cattle Egret (*Ardea ibis*) which was observed foraging in moist grassland adjacent to the large dam in the west of the study area. A range of waterfowl and waders as described in Section 4.3.1 and other seasonally migratory or nomadic species would also be likely to utilise habitats within the study area on occasion.

The EPBC Act requires an assessment of the significance of potential impacts of a proposal on migratory species with reference to the criteria specified in the *Matters of National Environmental Significance –Assessment of significance guidelines* (DEWHA 2009).

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will (DEWHA, 2009):

- Substantially modify, destroy or isolate an area of important habitat for a migratory species

  An area of 'important habitat' for a migratory species is: habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or; habitat that is of critical importance to the species at particular life-cycle stages, and/or; habitat utilised by a migratory species which is at the limit of the species range, and/or; habitat within an area where the species is declining (DEWHA, 2009).

  As described in Section 4.4.2 the subject site would have little value for migratory species and does not comprise 'important habitat'. Impacts would be restricted to the subject site and its immediate vicinity and so the proposal would not substantially modify any important habitat.

- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

  As described above the subject site does not comprise 'important habitat'. Impacts would be restricted to the subject site and its immediate vicinity and so the proposal would not result in an invasive species becoming established in important habitat.

- Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

  Given the limited scale of the proposal and quality of habitat for migratory species only a small number of individuals of the Cattle Egret or any other migratory species would ever occupy habitat within the area potentially subject to impacts. The risk of injury or mortality of any of these individuals is very slight. The subject site contains a small proportion of the habitat resources available for migratory species in the study area and the locality. As described in Section 5.2.1, the proposal would not significantly increase the degree of fragmentation or isolation of habitat in the locality. Therefore the proposal would not seriously disrupt the lifecycle of an ecologically significant proportion of the population of any migratory species.

Based on the consideration of the criteria contained in the *Matters of National Environmental Significance –Assessment of significance guidelines* (DEWHA 2009), the proposal would not be likely to have a significant impact on any migratory species.

7.6 Additional MNES

'The Greater Blue Mountains Area' is listed as a declared World Heritage Property and a National Heritage Place under the EPBC Act. The Greater Blue Mountains Area is located around 5 km to the west of the study area and is separated from the subject site by native vegetation, agricultural land and the Nepean River. Impacts of the proposal would be restricted to the subject site and immediately adjoining areas. Given the location, scale and magnitude of impacts arising from the proposal there is no risk of direct or indirect impacts of the proposal on the Greater Blue Mountains Area.

8. Conclusions

The subject site is dominated by cleared land and exotic grassland but also contains intact and regrowth native vegetation including TECs and habitat for threatened species. Native vegetation and habitat within the subject site is in moderate condition and features impacts from edge effects and grazing. Away from these disturbed areas the native vegetation in the study area is generally in good condition and is connected to extensive areas of habitat via vegetated corridors.

Based on the desktop assessment, field surveys and habitat assessments undertaken the following affected threatened biota for the proposal were identified:

- River-Flat Eucalypt Forest, which is present in the subject site
- Cumberland Plain Woodland, which is present in the subject site
- The Spiked Rice-flower, which may be present in potential habitat in the the subject site
- The Cumberland Plain Land Snail, which was recorded in the subject site and elsewhere in the study area and locality
- Woodland birds, including the Varied Sitella which was recorded in the subject site and the Bush Stone-curlew, Diamond Firetail, Flame Robin, Hooded Robin (south-eastern form), Scarlet Robin, Speckled Warbler and Turquoise Parrot, which may occasionally occur in the subject site based on the habitat present
- Migratory or nomadic birds including the Gang-gang Cockatoo, Little Lorikeet, Regent Honeyeater and Swift Parrot , which may occasionally occur in the subject site based on the habitat present
- Large predatory birds including the Barking Owl, Masked Owl, Powerful Owl, Sooty Owl and Square-tailed Kite , which may occasionally occur in the subject site based on the habitat present
- Wetland species including the Australasian Bittern, Australian Painted Snipe, Black Bittern, Black-tailed Godwit and Green and Golden Bell Frog , which may occasionally occur in the subject site based on the habitat present in the adjoining study area
- Microbats including the Eastern Freetail-bat, Greater Broad-nosed Bat, Southern Myotis, Eastern Bentwing-bat and Large-eared Pied Bat , which may occasionally occur in the subject site based on the habitat present
- Mammals of forest and woodland including the Grey-headed Flying-fox, Koala and Spotted-tailed Quoll which may occasionally occur in the subject site based on the habitat present.

Assessments of significance of impacts on the local populations of these threatened biota have been prepared pursuant to s.5A of the EPA Act. The outcome of these assessments of significance is that the proposal is not likely to have a significant impact on the local populations of any threatened biota given:

- That potential impacts of the proposal would be restricted to a maximum 8.37 hectare subject site containing 3.55 hectares of native vegetation and habitat for threatened biota, which would affect a very small proportion of local populations and their habitat.
- That given the small scale of the proposal and proposed mitigation measures it would be unlikely to result in any substantial indirect impacts on any habitat beyond the immediate disturbance footprint within the subject site.

- A maximum of 8.37 hectares of habitat for these threatened biota would be removed, the proposal would not isolate or fragment any significant areas of habitat, and the habitat to be removed has very low value given its attributes, condition and context.
- The proposal would not result in a significant increase in the operation of any KTPs nor have any effects that would substantially interfere with the maintenance or recovery of local populations of these wetland species.

A Species Impact Statement is not required for the proposal.

The subject contains a number of MNES and/or their habitat and so a referral of the proposal will be prepared and submitted to DSEWPaC. Based on the impact assessments and Section 5A assessments of significance included in this report the proposal is not likely to have a significant impact on any MNES. Formal assessments of impacts in accordance with the DEWHA (2009) guidelines will be included in the referral.

9. Disclaimer

This report: has been prepared by GHD for Fernhill and *may only be used and relied on by Fernhill for the purpose agreed between GHD and the Fernhill as set out in Section 1.4 of this report.*

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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Appendices

Appendix A – Field survey data

Appendix Table 1 Flora species recorded

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Acanthaceae		*Brunoniella australis*	Blue Trumpet						1		×	
Adiantaceae		*Cheilanthes sieberi subsp. sieberi*	Rock Fern				2		2			
Amaranthaceae		*Alternanthera denticulata*	Lesser Joyweed				1					
Anacardiaceae	*	*Schinus spp.*								×		
Apiaceae		*Centella asiatica*	Indian Pennywort									×
Apocynaceae	*	*Araujia sericifera*	Moth Vine									×
Asparagaceae	*	*Asparagus asparagoides*	Bridal Creeper							×		×
Asphodelaceae	*	*Aloe spp.*								×		
Asteraceae	*	*Senecio madagascariensis*	Fireweed			2	2	2	2			
Asteraceae	*	*Sonchus oleraceus*	Common Sowthistle						1	×	×	
Asteraceae	*	*Taraxacum officinale*	Dandelion				1		1	×		
Asteraceae		*Vernonia cinerea var. cinerea*					2					
Asteraceae		*Glossocardia bidens*	Cobbler's Tack				2					
Asteraceae	*	*Bidens pilosa*	Cobbler's Pegs						1		×	
Asteraceae		*Ozothamnus diosmifolius*	White Dogwood						1		×	
Asteraceae	*	*Conyza sumatrensis*	Tall fleabane								×	×
Asteraceae		*Euchiton gymnocephalus*	Creeping Cudweed								×	

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Asteraceae	*	*Gamochaeta spp.*						1				
Basellaceae	*	*Anredera cordifolia*	Madeira Vine							×		
Bignoniaceae	*	*Jacaranda mimosifolia*	Jacaranda							×		
Caprifoliaceae	*	*Lonicera japonica*	Japanese Honeysuckle							×		×
Caryophyllaceae	*	*Stellaria media*	Common Chickweed									×
Chenopodiaceae		*Einadia hastata*	Berry Saltbush				1			×		×
Clusiaceae		*Hypericum gramineum*	Small St John's Wort					2				
Commelinaceae	*	*Tradescantia fluminensis*	Wandering Jew									×
Convolvulaceae		*Dichondra repens*	Kidney Weed							×	×	×
Convolvulaceae		*Calystegia sepium subsp. roseata*										×
Cyperaceae		*Gahnia aspera*	Rough Saw-sedge						1			
Cyperaceae		*Eleocharis sphacelata*	Tall Spike Rush									×
Dilleniaceae		*Hibbertia diffusa*	Wedge Guinea Flower						2		×	
Ericaceae		*Lissanthe strigosa*	Peach Heath				2					
Ericaceae		*Melichrus urceolatus*	Urn Heath					2				
Fabaceae (Faboideae)		*Daviesia ulicifolia*	Gorse Bitter Pea				2	2				
Fabaceae (Faboideae)		*Glycine clandestina*	Twining glycine				1					×
Fabaceae		*Glycine microphylla*	Small-leaf				1					

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
(Faboideae)			Glycine									
Fabaceae (Faboideae)		*Glycine tabacina*	Variable Glycine						2		×	
Fabaceae (Faboideae)		*Desmodium varians*	Slender Tick-trefoil								×	
Fabaceae (Mimosoideae)		*Acacia decurrens*	Black Wattle				3		2	×		
Fabaceae (Mimosoideae)		*Acacia implexa*	Hickory Wattle				1	2		×		
Fabaceae (Mimosoideae)		*Acacia parramattensis*	Parramatta Wattle				2	1				
Goodeniaceae		*Goodenia hederacea*	Ivy Goodenia				2	2				
Juncaceae		*Juncus usitatus*				1						×
Juncaceae	*	*Juncus acutus subsp. acutus*	Sharp Rush									×
Juncaginaceae		*Triglochin microtuberosa*										×
Lauraceae	*	*Cinnamomum camphora*	Camphor Laurel									×
Lomandraceae		*Lomandra gracilis*					3	2	2			
Lomandraceae		*Lomandra micrantha subsp. tuberculata*	Small-flowered Mat-rush				1					
Lomandraceae		*Lomandra filiformis subsp. filiformis*							1			
Luzuriagaceae		*Eustrephus latifolius*	Wombat Berry									×
Malaceae	*	*Cotoneaster spp.*								×		
Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne				1	1	1	×		
Meliaceae	*	*Melia azedarach*	White Cedar									×

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Myrsinaceae	*	*Anagallis arvensis*	Scarlet Pimpernel									×
Myrtaceae		*Angophora floribunda*	Rough-barked Apple							×		
Myrtaceae		*Eucalyptus fibrosa*	Red Ironbark				4			×		
Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum					1	5	×		
Myrtaceae		*Lophostemon confertus*	Brush Box							×		
Myrtaceae		*Callistemon salignus*	Willow Bottlebrush							×		
Myrtaceae		*Eucalyptus eugenioides*	Thin-leaved Stringybark				3					
Myrtaceae		*Eucalyptus crebra*	Narrow-leaved Ironbark								×	
Myrtaceae		*Eucalyptus moluccana*	Grey Box								×	
Oleaceae	*	*Ligustrum sinense*	Small-leaved Privet							×	×	×
Oleaceae	*	*Olea europaea subsp. cuspidata*	African Olive							×		×
Oxalidaceae		*Oxalis perennans*							1	×	×	
Passifloraceae		*Passiflora herbertiana*										×
Philydraceae		*Philydrum lanuginosum*	Frogsmouth									
Phyllanthaceae		*Poranthera microphylla*	Small Poranthera						2			
Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush									×
Pittosporaceae		*Bursaria spinosa*	Native Blackthorn				3	3	3			

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues			1		1				
Plantaginaceae		*Veronica plebeia*	Trailing Speedwell						2		×	
Poaceae	*	*Chloris gayana*	Rhodes Grass			6		2				×
Poaceae		*Cynodon dactylon*	Common Couch			1		3				
Poaceae	*	*Eragrostis curvula*	African Lovegrass			3	5	5				
Poaceae	*	*Paspalum dilatatum*	Paspalum			2		2				
Poaceae	*	*Pennisetum clandestinum*	Kikuyu Grass			2						
Poaceae	*	*Setaria spp.*				2						
Poaceae	*	*Andropogon virginicus*	Whisky Grass							×		×
Poaceae		*Bothriochloa macra*	Red Grass			2		2			×	
Poaceae	*	*Sporobolus fertilis*	Giant Parramatta Grass			3						
Poaceae		*Microlaena stipoides*	Weeping Grass				2		4	×		
Poaceae		*Eragrostis leptostachya*	Paddock Lovegrass				2	2	2			
Poaceae		*Aristida ramosa*	Purple Wiregrass				2	2				
Poaceae		*Panicum effusum*	Hairy Panic				2					
Poaceae		*Themeda australis*	Kangaroo Grass				3	3	2			
Poaceae		*Entolasia stricta*	Wiry Panic				1					
Poaceae		*Aristida vagans*	Threeawn Speargrass				1		2			

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Poaceae		*Oplismenus aemulus*						1			×	
Poaceae		*Sporobolus creber*	Slender Rat's Tail Grass					2			×	
Poaceae		*Dichelachne micrantha*	Shorthair Plumegrass					1			×	
Poaceae		*Echinopogon caespitosus*	Bushy Hedgehog-grass					1	2			
Poaceae	*	*Setaria parviflora*						1				
Poaceae		*Entolasia marginata*	Bordered Panic						3			
Poaceae		*Digitaria parviflora*	Small-flowered Finger Grass						1			
Polygonaceae		*Persicaria decipiens*	Slender Knotweed									×
Proteaceae	*	*Grevillea robusta*	Silky Oak							×		×
Proteaceae		*Hakea sericea*	Needlebush									×
Ranunculaceae		*Clematis aristata*	Old Man's Beard									×
Rosaceae	*	*Rubus fruticosus sp. agg.*	Blackberry complex							×	×	
Rosaceae		*Rubus parvifolius*	Native Raspberry						1			
Santalaceae		*Exocarpus cupressiformis*	ry Ballart, Native Cherry				1					
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade				1					×
Solanaceae		*Solanum prinophyllum*	Forest Nightshade						1		×	
Solanaceae	*	*Solanum spp.*										×
Solanaceae	*	*Solanum mauritianum*	Wild Tobacco Bush									×

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cleared	HN528-Moderate/Good	HN528 - Low	HN526-moderate/good	Additional species (cleared)	Additional species (HN528-Moderate/Good)	Additional species (HN526-moderate/good)
Solanaceae	*	*Solanum pseudocapsicum*	Madeira Winter Cherry									×
Sterculiaceae		*Brachychiton populneus*	Kurrajong							×		
Sterculiaceae	*	*Brachychiton discolor*	Lacebark Tree							×		
Verbenaceae	*	*Lantana camara*	Lantana				2		2	×		
Verbenaceae	*	*Verbena bonariensis*	Purpletop			2	2	1				
Vitaceae		*Cayratia clematidea*	Native Grape									×

* = exotic

1 – Cover abundance rankings within each survey area: **1** Foliage sparsely or very sparsely present, cover less than 5%; **2** 1-5% Plentiful, foliage cover 1-5 %; **3** 5-25% foliage cover; **4** 26-50% foliage cover; **5** 51-75% foliage cover; **6** 76-100% foliage cover; **x** – opportunistic record, relative abundance not recorded.

Appendix Table 2 BioBanking plot/transect data and benchmark values for each vegetation type

Plot ID	Vegetation Type	Vegetation Type ID	Condition	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing
1	n/a	n/a	Cleared	3	0	0	8	0	0	100	0	0	0	282632.64	6253815.48
Benchmark	Grey Box - Forest Red Gum grassy woodland on flats	HN528	Benchmark	29	20.5-25.5	25.5-30.5	26.8-30.8	0-5	14.8-18.8	0	> = 0	1	> = 0		
2	Grey Box - Forest Red Gum grassy woodland on flats	HN528	Moderate / good	26	34	22.5	26	14	36	78	0	1	14	282701.62	6253982.95
3	Grey Box - Forest Red Gum grassy woodland on flats	HN528	Low	18	0.5	10.5	30	10	24	96	0	1	6	282779.18	6253936.75
Benchmark	Forest Red Gum - Rough-barked Apple grassy woodland	HN526	Benchmark	24	27.5-32.5	21-31	24.45-30.45	0-10	24.45-30.45	0	> = 1	1	> = 50		
4	Forest Red Gum - Rough-barked Apple grassy woodland	HN526	Moderate / good	23	41.5	37.5	80	18	14	28	0	1	33	282495.40	6253696.77

Appendix Table 3 Fauna species recorded

Class	Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Observation Type
Aves	Podicipedidae		*Tachybaptus novaehollandiae*	Australasian Grebe			O
Aves	Psittacidae		*Alisterus scapularis*	Australian King-Parrot			O
Aves	Artamidae		*Cracticus tibicen*	Australian Magpie			W
Aves	Corvidae		*Corvus coronoides*	Australian Raven			W
Aves	Alcedinidae		*Ceyx azureus*	Azure Kingfisher			O
Aves	Meliphagidae		*Manorina melanophrys*	Bell Miner			W
Aves	Phasianidae		*Coturnix ypsilophora*	Brown Quail			O
Aves	Acanthizidae		*Acanthiza pusilla*	Brown Thornbill			OW
Amphibia	Myobatrachidae		*Limnodynastes peronii*	Brown-striped Frog			W
Aves	Ardeidae		*Ardea ibis*	Cattle Egret			O
Amphibia	Myobatrachidae		*Crinia signifera*	Common Eastern Froglet			W
Aves	Psittacidae		*Platycercus elegans*	Crimson Rosella			OW
Gastropoda	Camaenidae		*Meridolum corneovirens*	Cumberland Plain Land Snail	E1		O
Aves	Estrildidae		*Taeniopygia bichenovii*	Double-barred Finch			O
Aves	Rallidae		*Gallinula tenebrosa*	Dusky Moorhen			O
Mammalia	Macropodidae		*Macropus giganteus*	Eastern Grey Kangaroo			O
Reptilia	Scincidae		*Eulamprus quoyii*	Eastern Water-skink			W
Aves	Psophodidae		*Psophodes olivaceus*	Eastern Whipbird			W
Aves	Petroicidae		*Eopsaltria australis*	Eastern Yellow Robin			O
Aves	Turdidae	*	*Turdus merula*	Eurasian Blackbird			O
Aves	Rallidae		*Fulica atra*	Eurasian Coot			W
Aves	Cacatuidae		*Eolophus roseicapillus*	Galah			O
Aves	Pachycephalidae		*Pachycephala pectoralis*	Golden Whistler			OW

Class	Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Observation Type
Aves	Artamidae		*Cracticus torquatus*	Grey Butcherbird			W
Aves	Rhipiduridae		*Rhipidura albiscapa*	Grey Fantail			O
Aves	Pachycephalidae		*Colluricincla harmonica*	Grey Shrike-thrush			W
Aves	Anatidae		*Aythya australis*	Hardhead			O
Aves	Petroicidae		*Microeca fascinans*	Jacky Winter			O
Aves	Monarchidae		*Myiagra rubecula*	Leaden Flycatcher			W
Aves	Cacatuidae		*Cacatua sanguinea*	Little Corella			O
Aves	Phalacrocoracidae		*Microcarbo melanoleucos*	Little Pied Cormorant			O
Aves	Monarchidae		*Grallina cyanoleuca*	Magpie-lark			W
Aves	Charadriidae		*Vanellus miles*	Masked Lapwing			W
Aves	Meliphagidae		*Manorina melanocephala*	Noisy Miner			W
Aves	Oriolidae		*Oriolus sagittatus*	Olive-backed Oriole			OW
Aves	Anatidae		*Anas superciliosa*	Pacific Black Duck			O
Aves	Artamidae		*Strepera graculina*	Pied Currawong			O
Aves	Rallidae		*Porphyrio porphyrio*	Purple Swamphen			W
Aves	Psittacidae		*Trichoglossus haematodus*	Rainbow Lorikeet			W
Aves	Meliphagidae		*Anthochaera carunculata*	Red Wattlebird			W
Aves	Estrildidae		*Neochmia temporalis*	Red-browed Finch			W
Aves	Psittacidae		*Psephotus haematonotus*	Red-rumped Parrot			OW
Aves	Monarchidae		*Myiagra inquieta*	Restless Flycatcher			W
Aves	Petroicidae		*Petroica rosea*	Rose Robin			O
Mammalia	Cervidae	*	*Cervus timorensis*	Rusa deer			O
Aves	Ptilonorhynchidae		*Ptilonorhynchus violaceus*	Satin Bowerbird			O
Aves	Timaliidae		*Zosterops lateralis*	Silvereye			O
Aves	Pardalotidae		*Pardalotus punctatus*	Spotted Pardalote			W

Class	Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Observation Type
Aves	Threskiornithidae		*Threskiornis spinicollis*	Straw-necked Ibis			O
Aves	Pardalotidae		*Pardalotus striatus*	Striated Pardalote			W
Aves	Pardalotidae		*Pardalotus striatus*	Striated Pardalote			W
Aves	Acanthizidae		*Acanthiza lineata*	Striated Thornbill			W
Aves	Cacatuidae		*Cacatua galerita*	Sulphur-crested Cockatoo			W
Aves	Maluridae		*Malurus cyaneus*	Superb Fairy-wren			W
Aves	Neosittidae		*Daphoenositta chrysoptera*	Varied Sittella	V		O
Aves	Acanthizidae		*Smicrornis brevirostris*	Weebill			O
Aves	Hirundinidae		*Hirundo neoxena*	Welcome Swallow			O
Aves	Meliphagidae		*Melithreptus lunatus*	White-naped Honeyeater			W
Aves	Ardeidae		*Ardea pacifica*	White-necked Heron			O
Aves	Meliphagidae		*Lichenostomus penicillatus*	White-plumed Honeyeater			OW
Aves	Rhipiduridae		*Rhipidura leucophrys*	Willie wagtail			O
Aves	Acanthizidae		*Acanthiza nana*	Yellow Thornbill			O
Aves	Meliphagidae		*Lichenostomus chrysops*	Yellow-faced Honeyeater			OW
Mammalia	Bovidae	*	*Bos taurus*	European cattle			O
Amphibia	Hylidae		*Litoria verreauxii verreauxii*	Verreaux's Tree Frog (subsp)			O, W
Mammalia	Rhinolophidae		*Rhinolophus megaphyllus*	Eastern Horseshoe-bat			W
Mammalia	Molossidae		*Mormopterus "Species 2"*	Undescribed Freetail Bat			W

Key: E – endangered, M – migratory, V – vulnerable. B – burrow; F – tracks, H – skin, K – dead, O – observed, P – scat, W - heard

Appendix B - Anabat Call Analysis Results

Analysis Method

Craig Grabham (GHD) completed analysis of all bat calls.

Bat calls were recorded during field surveys using Anabat detectors (Titley Scientific Brisbane). Data from each detector was downloaded via the CF card using CFCread (version 4.3s Corben 2011). Calls were identified using zero-crossing analysis and AnalookW software (version 3.8v, Chris Corben 2012) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from published guidelines.

The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay et al 2011; Churchill 2008; van Dyck and Strahan 2008) and records from the Atlas of NSW Wildlife (OEH 2012). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of four or more consecutive pulses of similar frequency. Calls with less than four defined pulses were excluded from the analysis. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in Table 1. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows Pennay et al (2011), then van Dyck and Strahan (2008).

Table 10 Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. Chalinolobus gouldii /M. Mormopterus sp. Nyctophilus spp. The calls of Nyctophilus geoffroyi and N. gouldi cannot be distinguished during the analysis process and are therefore lumped together.

Results

Remote Anabat surveys were completed at two (2) locations for two nights each during June 2013 within the study area.

Two species were positively (Definite) identified (Table 2). No threatened species were recorded.

Table 11 Summary of Anabat analysis for SD1 and SD2 for each night deployed

	Unit and date				
	SD1	SD1	SD2	SD2	
Species / Confidence rating	5.6.13	6.6.13	5.6.13	6.6.13	Total
Chalinolobus gouldii PR	0	1	0	0	1
Chalinolobus gouldii/ Mormopterus sp.	1	2	0	0	3
Miniopterus schreibersii oceanensis (v)/ Vespadelus species	1	0	0	0	1
Mormopterus species 2 D	3	0	0	0	3
Mormopterus species 2/ 3/ norfolkensis	1	8	0	3	12
Rhinolophus megaphyllus D	2	6	0	0	8
Vespadelus darlingtoni PR	0	1	0	0	1
Vespadelus darlingtoni/ regulus	0	1	0	0	1
Vespadelus vulturnus/ pumilus	0	0	2	0	2
Other bat	0	1	0	1	2
No. bat calls	8	20	2	4	34
No. Anabat sequence files	31	48	5	24	108
Other	23	28	3	20	74
Approx. survey effort (hrs:min)	11.5	11.5	11	11	45
Start – finish time	1814-0832	1808-0829	**	**	.
Bat activity	1848-0442	1853-0727	**	**	.
Total Definite (D) species	2	1	0		2
Total Probable (Pr) species	0	2	0		2

Notes for Table 2:

Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes Nyctophilus sp. where recorded.

Confidence rating (see table 1). D = Definite or PR = Probable

0 = not recorded.

**: internal clock error. Time and/or date not recorded/incorrect.

ce, e, v - species listed under the NSW *Threatened Species Conservation Act 1996*.

CE, E, VU – species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

Other bat calls: the number of Anabat sequence files that could not be identified as D or Pr. Mostly consist of files with poor quality calls and sometimes multiple species within the same sequence file.

No. Anabat sequence files: total number of Anabat sequence files recorded for each night and survey period.

No. bat calls: approximate number of Anabat sequence files identified as a bat call of some description recorded for each night and survey period (includes all definite, probably, species group and other bat calls).

Other – number of other Anabat sequence files with other types of ultrasound (e.g. insect activity, miscellaneous non-bat noise) recorded for each night and survey period.

Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection.

Start – finish: approximate time detector recorded first ultrasound and last ultrasound (e.g. bat or insect noise).

Bat activity: approximate time of first identified bat call and last identified bat call for that survey period.

Appendix C - Threatened and Migratory Biota

Endangered Ecological Communities (EECs) known or predicted from the locality, habitat association and suitable habitat present at the subject site.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Agnes Banks Woodland in the Sydney Basin Bioregion	Agnes Banks Woodland in the Sydney Basin Bioregion	EEC		Most remnants occur near Agnes Banks in Penrith LGA, on eastern bank of the Hawkesbury River. Occurs on aeolian sands overlaying Tertiary alluviums. Structure varies from low woodland on higher ridges to sedgeland in low-lying depressions. Characteristic species include Eucalyptus sclerophylla, Angophora bakeri and Banksia serrata.	Known within 10km (OEH 2013a)	Not present	
Blue Gum High Forest in the Sydney Basin Bioregion	Blue Gum High Forest in the Sydney Basin Bioregion	CEEC	CEEC	Occurs on the Hornsby Plateau, north eastern edge of the Cumberland Plain with most remnants in Hornsby, Ku-ring-gai and Baulkham Hills LGAs. Typically occurs in high rainfall areas on fertile soils derived from Wianamatta shale. Grades into Sydney Turpentine-Ironbark Forest at lower rainfall areas. Moist, tall open forest characterised by Eucalyptus saligna and E. pilularis. Usually has small tree layer of Pittosporum undulatum, Elaeocarpos reticulatus and Allocasuarina torulosa over a low, open shrub layer and an understorey of grasses, herbs and ferns.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion	Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion	EEC	CEEC	Found on deep fertile soils formed on Wianamatta Shale, on moist sheltered sites at lower to middle altitudes of the Blue Mountains and Wollemi areas. Extensive occurrences of shale are at Springwood, Berambing to Kurrajong Heights, Mountain Lagoon and Colo Heights. Characteristic tree species of this ecological community are Eucalyptus deanei, E. cypellocarpa and Syncarpia glomulifera. The structure of the community was originally tall open forest to open forest, depending on site conditions and history, but as a result of partial clearance may now exist as woodland or as groups of remnant trees.	Known within 10km (OEH 2013a)	Not present	
Blue Mountains Swamps in the Sydney Basin Bioregion	Blue Mountains Swamps in the Sydney Basin Bioregion	VEEC	EEC	Occurs on the Hornsby Plateau, north eastern edge of the Cumberland Plain with most remnants in Hornsby, Ku-ring-gai and Baulkham Hills LGAs. Typically occurs in high rainfall areas on fertile soils derived from Wianamatta shale. Grades into Sydney Turpentine-Ironbark Forest at lower rainfall areas. Moist, tall open forest characterised by Eucalyptus saligna and E. pilularis. Usually has small tree layer of Pittosporum undulatum, Elaeocarpos reticulatus and Allocasuarina torulosa over a low, open shrub layer and an understorey of grasses, herbs and ferns.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEEC		Occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium, with known occurrences in the Bankstown, Blacktown, Campbelltown, Hawkesbury, Liverpool and Penrith LGAs. Typically on sandy soils and on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest (Tozer 2003). Dominated by Eucalyptus parramattensis subsp. parramattensis, Angophora bakeri and E. sclerophylla. A small tree stratum of Melaleuca decora is sometimes present, generally in areas with poorer drainage. It has a well-developed sclerophyllous shrub stratum over a diverse range of forbs.	Known within 10km (OEH 2013a)	Not present	
Castlereagh Swamp Woodland Community	Castlereagh Swamp Woodland Community	EEC		Occurs Castlereagh and Holsworthy areas on the Cumberland Plain on alluvial soils, often in poorly drained depressions. Low woodland characterised by dense stands of Melaleuca decora along with other canopy trees, such as Eucalyptus parramattensis ssp parramattensis. Poorly developed shrub layer of juvenile melaleucas over waterlogging tolerant groundcover species such as Centella asiatica, Juncus usitatus and Goodenia paniculata.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	EEC		Occurs on the Cumberland Plain with the most extensive stands in Castlereagh and Holsworthy areas. Smaller remnants in Kemps Creek area and eastern section of the Cumberland Plain. Ranges from open forest to low woodland, with a canopy dominated by Eucalyptus fibrosa and Melaleuca decora along with other species of eucalypt. Dense shrubby understorey of Melaleuca nodosa, Lissanthe strigosa and Fabaceae sp over sparse ground layer of grasses and herbs.	Known within 10km (OEH 2013a)	Not present	
Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (federal listing)		Component EECs listed separately	CEEC	Grassy woodlands and forests of the shale hills and plains of the Cumberland Plain and associated transitional communities on shale-gravel soils. Canopy typically dominated by Eucalyptus moluccana, E. tereticornis and/or E. fibrosa. Sparse small tree stratum of young eucalypts and Acacia species and/or shrub layer dominated by Bursaria spinosa may be present. Understorey comprises perennial native grasses, grasslike and non-woody plants.	Known within 10km (OEH 2013a); Community likely to occur within area (DSEWPAC 2013)	Present	
Cumberland Plain Woodland in the Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	EEC	May qualify as CEEC	Grassy woodland/forest endemic to the hills and plains of the Cumberland Plain. Canopy typically dominated by Eucalyptus moluccana and E. tereticornis, with E. crebra, Corymbia maculata and E. eugenoides occurring less frequently. Shrub layer dominated	Known within 10km (OEH 2013a)	Present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				by Bursaria spinosa, and grasses such as Themeda australis and Microlaena stipoides var stipoides.			
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Occurs in coastal areas subject to periodic flooding with standing fresh water for at least part of the year. Typically on silts, muds or humic loams below 20 m elevation in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes. Structure and composition varies spatially and temporally depending on the water regime, though is usually dominated by herbaceous plants and has few woody species.	Known within 10km (OEH 2013a)	Not present	
Moist Shale Woodland in the Sydney Basin Bioregion	Moist Shale Woodland in the Sydney Basin Bioregion	EEC	May qualify as CEEC	Occurs on clay soils from Wianamatta Shale in the southern half of the Cumberland Plain, and is intermediate between Cumberland Plain Woodland and Western Sydney Dry Rainforest. Similar to Cumberland Plain Woodland but with more mesic shrub understorey. Dominant canopy trees include Forest Red Gum Eucalyptus tereticornis, Grey Box E. moluccana, Narrow-leaved Ironbark E. crebra and Spotted Gum Corymbia maculata. Small trees, such as Hickory Wattle Acacia implexa and Sydney Green Wattle A. parramattensis ssp	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				parramattensis are also common. The shrub layer includes Breynia oblongifolia, Hairy Clerodendrum Clerodendrum tomentosum and Indian Weed Siegesbeckia orientalis ssp orientalis.			
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	EEC	EEC	Occurs above 4-500m asl on undulating tablelands and plateaus, typically on basic volcanic , fine grained sedimentary substrates or occasionally granite. Associated with accumulations of peaty or organic mineral sediments on poorly drained flats in stream headwaters. Dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. Only type of wetland that may contain more than trace amounts of mosses (Sphagnum spp.). Small trees may be absent, or present as scattered emergent.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Mount Gibraltar Forest in the Sydney Basin Bioregion	Mount Gibraltar Forest in the Sydney Basin Bioregion	EEC	EEC	Confined to a small number of pockets in the Southern Highlands region mainly near Bowral and Mittagong. Occurs in the Wingecarribee LGA, but may occur elsewhere in the Sydney Basin Bioregion. Restricted to clay soils on microsyenite intrusions in the central parts of the Southern Highlands. Occurs on gentle to steep slopes with correspondingly deep and shallow soils respectively; combined with aspect, these factors contribute to the variability evident in the floral composition of this community (OEH 2013).	Known within 10km (OEH 2013a)	Not present	
Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion	Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion	EEC	EEC	Recorded from the local government areas of Lithgow and Blue Mountains City. The community is characteristically dominated by shrubs, with a variable cover of sedges. Shrubs have a dense to open cover, and include Baeckea linifolia, Grevillea acanthifolia subsp. acanthifolia, Epacris paludosa and Leptospermum species. The cover of sedges varies inversely with shrub cover. Floristic composition varies locally in relation to soil moisture gradients within the swamps. With decreasing altitude, Newnes Plateau Shrub Swamp grades into Blue Mountains sedge swamp communities. The transition occurs around Bell and Clarence at approximately 850-950 m above sea level. Blue Mountains sedge swamps	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				typically have less cover of shrubs and a greater cover of sedges (particularly Gymnoschoenus sphaerocephalus) than Newnes Plateau Shrub Swamp. Occurrences on peat may be included in the EPBC Act listed Temperate highland Peat Swamps on Sandstone EEC.			
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Occurs on flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and soils generally rich in silt, lack deep humic layers and have little or no saline (salt) influence. Occurs south from Port Stephens in the NSW North Coast, Sydney Basin and South East Corner bioregions. Characterised by a tall open canopy layer of eucalypts with variable species composition.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion	Robertson Basalt Tall Open-forest in the Sydney Basin Bioregion	EEC	EEC	Typically restricted to occurrences of Robertson Basalt in the southern highlands, also on Cambewarra range to the south. Grows on highly fertile soils derived from basalt, on the slopes of rolling hills in areas of 1000-1600 mm annual rainfall. Open forest or woodland to 30 m tall with a sparse to moderately dense shrub layer and a dense herbaceous ground layer. Dominant tree species include Eucalyptus fastigata, E. viminalis, E. radiata and E. cypellocarpa. Acacia melanoxylon is a common small tree species in this community.	Known within 10km (OEH 2013a)	Not present	
Shale gravel Transition Forest in the Sydney Basin Bioregion	Shale gravel Transition Forest in the Sydney Basin Bioregion	EEC	CEEC	"Primarily in the northern section of the Cumberland Plain, also found in Liverpool/;Holsworthy, Bankstown, Yennora, Villawood and Kemps Creek areas. Occurs primarily where shallow deposits from ancient river systems overlay shale soils, but also associated with localised concentrations of iron-hardened gravel. Open forest with canopy dominated by Eucalyptus fibrosa, E. moluccana and E. tereticornis, often with small tree layer of Melaleuca decora over a sparse shrub layer. Grades into Cumberland Plain Woodland where the influence of gravel soil declines, and into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Shale/Sandstone Transition Forest	Shale/Sandstone Transition Forest	EEC	EEC	Primarily in the northern section of the Cumberland Plain, also found in Liverpool/;Holsworthy, Bankstown, Yennora, Villawood and Kemps Creek areas. Occurs primarily where shallow deposits from ancient river systems overlay shale soils, but also associated with localised concentrations of iron-hardened gravel. Open forest with canopy dominated by Eucalyptus fibrosa, E. moluccana and E. tereticornis, often with small tree layer of Melaleuca decora over a sparse shrub layer. Grades into Cumberland Plain Woodland where the influence of gravel soil declines, and into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick.	Known within 10km (OEH 2013a); Community likely to occur within area (DSEWPAC 2013)	Not present	
Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	EEC		Confined to a small area in the Wingecarribee LGA, between the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. Occurs on clay soils on Wianamatta Shale, between approx. 60-800 m asl. Typically woodland but also tall open forest, grassy woodland and scrub. Dominant canopy species vary across the range. Shrub layer generally open although may have dense patches and groundlayer typically comprises diverse native grasses and herbs.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	EEC		Restricted to sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates in an area bounded by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. Open forest dominated by Angophora costata, Eucalyptus piperita and occasional E. pilularis over scattered subcanopy trees, a diverse shrub layer and well-developed groundcover of ferns, forbs, grasses and graminoids. Variable species composition.	Known within 10km (OEH 2013a)	Not present	
Sun Valley Cabbage Gum Forest in the Sydney Basin Bioregion	Sun Valley Cabbage Gum Forest in the Sydney Basin Bioregion	EEC		Occurs in the Sun Valley in the Blue Mountains City Council local government area; within about 15 hectares. Occurs on soils formed from diatremes (pipes of volcanic material) at Sun Valley. Other diatreme substrates in the area support different dominant tree species and do not have Eucalyptus amplifolia (OEH 2011).	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Typically occurs below 20m asl on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes on coastal floodplains of NSW. Associated with grey-black clay-loams and sandy loams, saline or sub-saline groundwater. Structure variable from open forests to scrubs or reedlands with scattered trees. Canopy dominated by Casuarina glauca (north of Bermagui) or Melaleuca ericifolia (south of Bermagui). Understorey characterised by frequent occurrences of vines, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.	Known within 10km (OEH 2013a)	Not present	
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	EEC		Occurs on plateaus and tablelands between 600-900m asl with loam or clay soils derived primarily from basalt, but may also be derived from mudstones, granites, alluvium and other substrates. Known from Bathurst Regional, Goulburn Mulwaree, Oberon, Palerang, Shoalhaven, Upper Lachlan and Wingecarribee LGAs. Open, variable canopy which may include Ribbon Gum, Narrow-leaved Peppermint, Mountain Gum and Snow Gum, over a sparse shrub layer and dense groundcover of herbs and grass. Community also includes derived native grasslands where trees have been removed.	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Temperate Highland Peat Swamps on Sandstone	Temperate Highland Peat Swamps on Sandstone		EEC	Occurs on sandstone in temperate highland regions from around 600–1100 m above sea level. Known from the Blue Mountains, Lithgow, Southern Highlands, and Bombala regions. Swamps occurring across a range of locations in the landscape, from hanging swamps to depressions in the landscape, or along watercourses. Wetter parts are occupied by sphagnum bogs and fens, with sedge and shrub associations in the drier parts.	Community known to occur within locality (DEWPAC 2013)	Not present	
Upland Basalt Sydney Eucalypt Forests of the Sydney Basin Bioregion			EEC	Generally confined to the Sydney Basin IBRA Bioregion although some occurrences may extend outside the Sydney Basin Bioregion boundary, e.g. the southern extent at Sassafras, east of Nerriga NSW, and patches on the Boyd Plateau and Mt Werong. Generally tall open eucalypt forests found on igneous rock (predominately Tertiary basalt and microsyenite) in, or adjacent to, the Sydney Basin Bioregion.	Community likely to occur within locality (DEWPAC 2013)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Western Sydney Dry Rainforest and Moist Woodland on Shale	Western Sydney Dry Rainforest and Moist Woodland on Shale	Component EECs listed separately	CEEC	Occurs is generally gullies, sheltered slopes and rugged terrain in isolated patches, largely on the edges of the Cumberland Plain in NSW, with some patches on undulating terrain in the central parts of the Cumberland Plain (DSEWPAC 2013).The dry rainforest occupies the lower slopes and gullies where conditions are more favourable for the development of a rainforest canopy layer. The ecological community grades into the moist woodland form, generally on the upper slopes, also extending onto more gently, undulating terrain. The ecological community may be associated with riparian vegetation (e.g. at Little Wheeny Creek and Redbank creek near Kurrajong and Grose Vale) and creeks and/or drainage lines may cut through the ecological community.	Community likely to occur within locality (DEWPAC 2013)	Not present	
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	Western Sydney Dry Rainforest in the Sydney Basin Bioregion	EEC	Components may qualify as CEEC	Restricted to hilly country where it occurs on clay soils derived from Wianamatta shale on sheltered lower slopes and gullies. Very restricted and occurs mostly in the Razorback Range near Picton. Outlying occurrences at Grose Vale and Cattai. Canopy trees include Melaleuca styphelioides, Acacia implexa and Alectryon subcinereus. Shrub layer includes rainforest species Notolaea longifolia, Clerodendrum tomentosum and Pittosporum revolutum. The shrub	Known within 10km (OEH 2013a)	Not present	

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				layer combines with vines to form dense thickets in sheltered locations.			
White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	EEC	CEEC	Occurs on the tablelands and western slopes of NSW, on moderate to highly fertile soils. Found in areas with annual rainfall between 400 - 1200 mm, at altitudes between 170 - 1200 m asl. Open woodland/forest, characterised by Eucalyptus albens, E. melliodora and E. blakelyi. Intact sites are rare, but contain a high species diversity of trees, shrubs, climbers, grasses and particularly herbs. The NSW listing includes sites with/without canopy layer and areas with predominately exotic groundlayer, whereas to meet the federal listing criteria areas must have either intact tree layer and predominately native groundlayer, or an intact ground layer with high species diversity but no remaining tree layer.	Predicted within 10km (DSEWPAC 2013)	Not present	

Threatened flora known or predicted from the locality, habitat association and likelihood of occurring at the subject site.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Acacia bynoeana	Bynoe's Wattle	E	V	This species is endemic to central eastern NSW, and is currently known from only 34 locations, many of which are only 1-5 plants. This species occurs mainly in heath and dry sclerophyll forest on sandy soils, seeming to prefer open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. This species flowers from September to March, and fruit matures in November.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Acacia gordonii		E	E	Disjunct populations in the lower Blue Mountains and the South Maroota/Glenorie areas, within the Hawkesbury, The Hills and Blue Mountains LGAs. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Allocasuarina glareicola		E	E	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Ancistrachne maidenii		V		Restricted to 2 disjunct areas: N Sydney within the St Albans, Mt White to Berowra area and in the Shannon Creek area near Grafton, with only 7 known populations. Occurs in dry sclerophyll forest on sandstone derived soils at the transition between Hawkesbury and Watagan soil landscapes.	1 record within 10km (OEH 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Asterolasia elegans		E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Cryptostylis subulata and the Cryptostylis erecta. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Cynanchum elegans	White-flowered Wax Plant	E	E	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Typical vegetation associations not present and not previosuly recorded in the locality.
Dillwynia tenuifolia		V	V	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	5 records within 10km (OEH 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Eucalyptus benthamii	Camden White Gum	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). 2 major subpopulations: in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep.	13 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013)	Unlikely	Broadly suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Eucalyptus nicholii	Narrow-leaved Peppermint, Narrow-leaved Black Peppermint	V	V	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Predicted to occur within 10km (DSEWPAC 2013a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V		Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	15 records within 10km (OEH 2013a) including a substantial population in the western precinct of the Fernhill estate (EcoLogical, 2010).	Unlikely	Suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	15 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.
Melaleuca deanei	Deane's Paperbark	V	V	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	3 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	E	E	Omeo Storksbill Pelargonium sp. (G.W. Carr 10345), syn. P. striatellum, is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Predicted to occur within 10km (DSEWPAC 2013a)	Nil	Suitable soil types and geomorphology not present and outside of known range.
Persoonia acerosa	Needle Geebung	V	V	Recorded on central coast and in Blue Mountains, from Mt Tomah to Hill Top (though now believed extinct in Hill Top). Mainly in Katoomba, Wentworth Falls and Springwood areas. Inhabits dry sclerophyll forest, scrubby low woodland and heath on sandstone. Occurs in well-drained soils including sands, laterite and gravels between 550- 1000m asl. May occur in disturbed areas eg roadsides.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Persoonia hirsuta	Hairy Geebung	E	E	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	2 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013)	Unlikely	Suitable soil types and geomorphology not present.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Pimelea curviflora var. curviflora		V	V	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Pimelea spicata	Spiked Rice-flower	E	E	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (OEH 2013).	2 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013).	Possible	Suitable habitat present and a small, cryptic species that may not have been detected in field surveys

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Pomaderris brunnea	Rufous Pomaderris	V	V	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by E. amplifolia with Allocasuarina sp. and Bursaria sp. understorey, or on alluvial flats with eucalypts including E. elata, E. piperita and E. punctata (Sutter 2011).	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable habitat present, but a large and readily detectable species that may be reliably excluded based on survey effort conducted.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Pultenaea glabra	Smooth Bush-pea, Swamp Bush-pea	V	V	In NSW restricted to higher Blue Mountains in the Katoomba-Hazelbrook and Mt Victoria areas. Unconfirmed sightings in Mt Wilson and Mt Irvine areas. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	Predicted to occur within 10km (DSEWPAC 2013a)	Nil	Suitable soil types and geomorphology not present and outside of known range.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Pultenaea parviflora		E	V	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	26 records within 10km (OEH 2013); Predicted within 10km (DSEWPAC 2013).	Unlikely	Suitable soil types and geomorphology not present.
Pultenaea villifera	Pultenaea villifera Sieber ex DC. population in the Blue Mountains local government area	E		Patchy distribution across NSW. The known population of P. vilifera occurs in the Blue Mountains LGA from a few small sites in the Springwood-Woodford Area including the Blue Mountains National Park (OEH 2013). Grows in dry sclerophyll forest and woodlands on sandy soil, preferring sheltered spots (OEH 2013).	1 record within 10km (OEH 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Rhizanthella slateri	Eastern Underground Orchid	V	E	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available (OEH 2013). Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Flowers during October and November (Harden 1993).	Predicted to occur within 10km (DSEWPAC 2013a)	Possible	Suitable habitat present and a small, cryptic species that may not have been detected in field surveys

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Streblus pendulinus	Siah's Backbone, Sia's Backbone, Isaac Wood		E	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010).On Norfolk Island, the species is found in a variety of forest types, though it is rare (DNP 2010).	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Tetratheca glandulosa	Glandular Pink-bell	V	V	Restricted to The Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat (shale-cappings over sandstone). Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils generally shallow, yellow, clayey/sandy loam, commonly with lateritic fragments. Vegetation varies from heath to open forest and is broadly equivalent to Sydney Sandstone Ridgetop Woodland community.	Predicted to occur within 10km (DSEWPAC 2013a)	Unlikely	Suitable soil types and geomorphology not present.
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Kangaloon Sun-orchid		CE	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Predicted to occur within 10km (DSEWPAC 2013a)	Nil	Suitable soil types and geomorphology not present and outside of known range.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Zieria murphyi	Velvet Zieria	V	V	Found in the Blue Mountains at Mt Tomah and on the southern tablelands where it has been recorded in Morton National Park in the Bundanoon area. Grows in gullies in dry sclerophyll forest with sandy soil. Associated species include Eucalyptus stricta, Dillwynia sericea and Lomandra longifolia	1 record within 10km (OEH 2013a)	Unlikely	Suitable soil types and geomorphology not present.

All information in this table is taken from NSW OEH and Commonwealth DSEWPaC Threatened Species profiles (OEH, 2013a; DSEWPaC 2013a) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

Threatened flora known or predicted from the locality, habitat association and likelihood of occurring at the subject site.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	E	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	4 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable habitat present within the subject site and study area
Botaurus poiciloptilus	Australasian Bittern	E	E	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp.and Eleocharis spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	1 record within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable habitat present within the study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Burhinus grallarius	Bush Stone-curlew	E		Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (OEH 2013).	2 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area
Callocephalon fimbriatum	Gang-gang Cockatoo	V		This species is nomadic, spending summer in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests and winter at lower altitudes in drier more open eucalypt forest and woodlands, particularly in coastal areas. This species nests in hollow-bearing trees close to water with breeding taking place between October and January. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests.	17 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in	20 records within 10km (OEH 2013a)	Unlikely	There is no suitable foraging habitat and no potential nest trees in the study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).			
Chthonicola sagittata	Speckled Warbler	V		Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	10 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement.	18 records within 10km (OEH 2013a); Recorded within study area (Birdata 2013)	Present	Seven indiviudals observed foraging in woodland in the study area.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.			
Ephippiorhynchus asiaticus	Black-necked Stork	E		In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	1 record within 10km (OEH 2013a)	Unlikley	Infrequently occurs in the Sydney region.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Erythrotriorchis radiatus	Red Goshawk	CE	V	Typically occurs in coastal and subcoastal areas, with 90% of recent records in NSW confined to the Northern Rivers and Northern Tablelands regions, north of the Clarence River. Formerly occurred south to Port Stephens. Prefer woodlands and forests with a mosaic of vegetation types that are open enough for fast manoeuvring flight, avoiding very open or very dense habitats. In NSW inhabits mixed subtropical rainforest, Melaleuca swamp forest and open eucalypt forest along coastal rivers. Nests built within 1km of a permanent freshwater body in a large, tall tree(>20m) within a remnant stand. Home ranges large (120-200km2).	Predicted within 10km (DSEWPAC 2013)	Unlikley	Infrequently occurs in the Sydney region.
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and	2 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially Eucalyptus viminalis, E. blakelyi and E. dealbata. Most breeding records are from the western slopes.			
Ixobrychus flavicollis	Black Bittern	V		Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	1 record within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Lathamus discolor	Swift Parrot	E	E	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	8 records within 10km (OEH 2013a); Predicted within 10km(DSEWPAC 2013a)	Possible	Suitable habitat present within the subject site and study area
Limosa limosa	Black-tailed Godwit	V	M; C,J,K	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons	1 record within 10km (OEH 2013a)	Possible	Suitable habitat present within the study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.			
Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km2.	5 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.	1 record within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area
Neophema pulchella	Turquoise Parrot	V		Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	1 record within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Ninox connivens	Barking Owl	V		Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	1 record within 10km (OEH 2013a)	Possible	Suitable foraging habitat in the subject site and study area
Ninox strenua	Powerful Owl	V		Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400	10 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				- 1,450 ha. Forages within open and closed woodlands as well as open areas.			
Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	2 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area
Petroica phoenicea	Flame Robin	V		Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and	3 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.			
Rostratula australis	Australian Painted Snipe	E	V,M	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Predicted within 10km (DSEWPAC 2013)	Possible	Suitable habitat present within the study area
Stagonopleura guttata	Diamond Firetail	V		Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in	2 records within 10km (OEH 2013a)	Possible	Suitable habitat present within the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				shrubby understorey or higher up under nests of other species.			
Stictonetta naevosa	Freckled Duck	V		Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/ccreeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	2 records within 10km (OEH 2013a)	Unlikley	Water bodies in the study area are too small and shallow.
Tyto novaehollandiae	Masked Owl	V		Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but	12 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				arboreal species may also be taken.			
Tyto tenebricosa	Sooty Owl	V		Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40cm wide, 100cm deep) tree hollows in unlogged/unburnt gullies within 100m of streams or in caves.	1 record within 10km (OEH 2013a)	Possible	Suitable foraging habitat in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Mammals							
Cercartetus nanus	Eastern Pygmy-possum	V		Occurs along the east coast of NSW, and inland to the Pillaga, Dubbo, Parkes and Wagga Wagga. Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest (Tulloch and Dickman 1995). Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Ward and Turner 2008). Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases (Ward and Turner 2008, Tulloch and Dickman 2006).	1 record within 10km (OEH 2013a)	Unlikley	There is no suitable foraging habitat in the study area
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the	5 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable foraging habitat in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.			
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	14 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013)	Possible	Suitable foraging habitat in the subject site and study area
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and	22 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).			
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	8 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat and potential roost sites in the subject site and study area
Myotis macropus	Southern Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December	9 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat and potential roost sites in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				(Churchill 2008)			
Petaurus australis	Yellow-bellied Glider	V		Occurs along the east coast to the western slopes of the Great Dividing Range. Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together. In southern NSW its preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Mostly feeds on sap, nectar and honeydew.	10 records within 10km (OEH 2013a)	Unlikley	Preferred tall, moist forest foraging habitat not present and probably too few hollow-bearing trees to maintain a local population.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and	2 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Nil	no suitable rocky escarpment habitat

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				fruits of shrubs and trees.			
Phascolarctos cinereus	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	19 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable foraging habitat in the subject site and study area
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	V	V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Predicted within 10km (DSEWPAC 2013a)	Unlikely	No suitable coastal forest with sandy soils
Pseudomys novaehollandiae	New Holland Mouse, Pookila		V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy	Predicted within 10km (DSEWPAC 2013a)	Unlikley	Preferred forest on sandy soils with thick groundcover are not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.			
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	24 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable foraging habitat in the subject site and study area
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in	4 records within 10km (OEH 2013a)	Possible	Suitable foraging habitat and potential roost sites in the subject site and study area

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).			
Reptile							
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	1 record within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Nil	Preferred rocky escarpment habitat not present.
Frogs							
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest.	1 record within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Unlikley	Preferred ridgetop habitats on sandy soils not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.			
Litoria aurea	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	1 record within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Possible	Suitable foraging habitat and potential breeding habitat in the study area
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	V	V	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Predicted within 10km (DSEWPAC 2013)	Unlikley	Preferred rocky stream habitats on slopes and plateaus not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	E	V	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range: within the Sydney Basin, White (2008a) located only 3 populations south of Sydney (Macquarie Pass and Mt Werong) and Daly et al. (2002, in White 2008a) found only 2 extant populations between Macquarie Pass and Victoria. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts (Mahony et al 1997).	Predicted within 10km (DSEWPAC 2013)	Unlikley	Preferred rocky stream habitats in rainforest not present
Mixophyes iteratus	Giant Barred Frog, Southern Barred Frog	E	E	Occurs on the coast and ranges from south-eastern QLD to the Hawkesbury River in NSW, particularly in Coffs Harbour - Dorrigo area. Forage and live amongst deep, damp leaf litter in rainforest, moist eucalypt forest and nearby dry eucalypt forest. Breed in shallow, flowing rocky streams. Within Sydney Basin, confined to small populations in tall, wet forest in the	Predicted within 10km (DSEWPAC 2013)	Unlikley	Preferred rocky stream habitats in rainforest not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				Watagan Mountains north of the Hawkesbury and the lower Blue Mountains (White 2008b).			
Pseudophryne australis	Red-crowned Toadlet	V		Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	38 records within 10km (OEH 2013a)	Unlikley	Preferred ridgetop habitats on sandy soils not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Fish							
Macquaria australasica	Macquarie Perch	V	E	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas.Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Predicted within 10km (DSEWPAC 2013); Found in the Hawkesbury/ Nepean CMA	Unlikley	Preferred clear, deep, rocky streams are not present
Prototroctes maraena	Australian Grayling		V,M	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	Predicted within 10km (DSEWPAC 2013)	Unlikley	Preferred clear, rocky streams are not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Invertebrates							
Archaeophya adamsi	Adam's emerald dragonfly	E (FM Act)		The species is only known from a few sites in the greater Sydney region. Larvae have been found in small creeks with gravel or sandy bottoms, in narrow, shaded riffle zones with moss and rich riparian vegetation. Adult dragonflies generally fly away from the water to mature before returning to breed. Males congregate at breeding sites and often guard a territory. Females probably lay their eggs into the water.	Found in the Hawkesbury/ Nepean CMA (DPI 2013)	Unlikley	Preferred shady, gravel streams are not present
Austrocordulia leonardi	Sydney Hawk Dragonfly	E (FM Act)		The Sydney hawk dragonfly has a very restricted distribution. The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is known from the Hawkesbury-Nepean, Georges River, Port Hacking and Karuah drainages. The Sydney hawk dragonfly has specific habitat requirements, and has only ever been collected from deep and shady riverine pools with cooler water. Larvae are found under rocks where they co-exist with Austrocordulia refracta.	Found in the Hawkesbury/ Nepean CMA (DPI 2013)	Unlikley	Preferred deep, clear streams are not present

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
Meridolum corneovirens	Cumberland Plain Land Snail	E		Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	72 records within 10km (OEH 2013a)	Present	Live individuals or shells recorded in three locations in the subject site and a further two locations in the study area

Notes:
Marine and littoral threatened species (particularly shorebirds) which are restricted to coastal or estuarine environments were excluded from the threatened biota table.
Wildlife Atlas records: only records from 1980 or later were considered. The date of the last record is included for any species which have not been recorded within the last 20 years.
A search of the DPI online records viewer (DPI 2013a) and OEH Bionet websites revealed no records of threatened fish species within the Sydney Metropolitan catchment.

All information in this table is taken from NSW OEH and Commonwealth DSEWPaC Threatened Species profiles (OEH, 2013a; DSEWPaC 2013a) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

Appendix D - TSC Act Assessments of Significance

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to this CEEC.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to this CEEC.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
A maximum of 2.03 hectares of Cumberland Plain Woodland would be removed, which is approximately 0.14 % of the total estimated area of that vegetation community in the locality (around 1480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the TEC in the locality or the region. The local population of Cumberland Plain Woodland includes around 65 hectares within the Fernhill Estate and 74 hectares within the Mulgoa biobank (GHD, 2012) that would be set aside for conservation. There is around 200 hectares of Cumberland Plain Woodland and related TECs within Mulgoa Nature reserve that is already under secure tenure (NPWS, 2008). The proposal would include retention of mature trees in residential lots wherever possible within design contraints. These trees would continue to provide at least some contribution to the extent of the EEc in the locality. A VMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including this EEC. The likely magnitude of edge effects or other indirect effects would not be sufficient to further reduce the extent of the ecological community.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
The 2.03 hectares of Cumberland Plain Woodland to be directly affected is approximately 0.14 % of the estimated area in the locality (Tozer (2010). The minor proportion of the local population of the TEC that is contained within the subject site is unlikely to contain an ecologically significant proportion of any of the individual species that make up the Cumberland Plain Woodland ecological community. The proposal is not likely to remove, modify or fragment a significant proportion of the habitat for this CEEC in the locality (refer part d). The extensive areas of floristically similar vegetation in the study area and locality are likely to be sufficient to maintain viable local populations of the species that comprise the TEC. Given the scale and context of the proposal it is unlikely to modify the composition of any Cumberland plain Woodland beyond the subject site and immediately adjoining areas. As such, the proposal is not likely to modify the composition of the CEEC in the locality such that any component

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
species would become locally extinct.
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
A maximum of 2.03 hectares of vegetation which constitutes Cumberland Plain Woodland habitat would be removed. This habitat would be permanently cleared of the community. The proposed impact mitigation and environmental management measures are likely to mitigate against any substantial effects on the local population of the CEEC during construction, outside of the immediate disturbance footprint. Once the residential subdivision is established the proposal could further modify habitat for the CEEC through edge effects, weed infestation or fauna mortalities. Given the community is in moderate condition, features weed infestation and adjoins cleared grazing or residential land any such cumulative impacts are likely to be minimal. A Vegetation Management Plan is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including this CEEC.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in the Blue Mountains National Park and the Nepean River riparian strip to the west of the subject site is likely to be an important habitat corridor. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. Fauna movement, pollination and seed fall of plants and other ecological processes would occur around, rather than through, the subject site. The proposal involves construction of structures that may obstruct movement of fauna attempting to travel through the study area, such as fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which fauna movement is disrupted. Fauna movement and ecological processes would at continue to function around the subject site via the vegetated riparian corridor to the north. In this context, the proposal would not have an adverse effect on fauna movement or habitat connectivity.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The proposal would result in the removal of 2.03 hectares of vegetation which constitutes this CEEC, which is approximately 0.14 % of the total estimated area of that vegetation community in the locality (around 1480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the TEC in the locality or the region. The local population of Cumberland Plain Woodland includes around 65 hectares within the Fernhill Estate and 74 hectares within the Mulgoa biobank (GHD, 2012) that would be set aside for conservation. There is

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
around 200 hectares of Cumberland Plain Woodland and related TECs within Mulgoa Nature reserve that is already under secure tenure (NPWS, 2008). As such, the moderate value habitat (located on the edge of the patch, with evidence of ongoing impacts resulting from grazing, weed infestation and edge effects) within the subject site is not likely to be important to the long term survival of the community in the locality.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
There is no critical habitat listed for this CEEC.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
There is no recovery plan for this CEEC. OEH identifies a number of priority actions intended to abate threats to this CEEC and ensure its long term conservation (OEH, 2011b), including the protection of habitat by minimising further clearing of the community. The removal of 2.03 hectares of this community from the subject site is inconsistent with identified priority actions but is unlikely to substantially affect the recovery of the community in the locality given the small area and modified nature of the vegetation to be removed and the extent of conserved woodland in the locality as discussed above.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The proposal would contribute to the operation of the following Key Threatening Processes (KTPs) of relevance to CPW: Clearing of native vegetation through the removal of 3.55 hectares of native vegetation, including 2.03 hectares of Cumberland Plain Woodland Removal of hollow-bearing trees, through the removal of two such trees in the subject site Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. Retention of large trees, including hollow-bearing trees in open space within residential lots as far as possible within design constraints. The proposal also has the potential to indirectly cause or increase the operation of the following KTPS that are of potential relevance to this ecological community: Invasion of plant communities by perennial exotic grasses – the proposal would create disturbed edges through native vegetation and potentially transfer exotic grass propagules Infection of native plants by Phytophthora cinnamomi - the proposal would disturb soil within and adjoining native vegetation and potentially transfer fungi spores Infection of frogs by amphibian chytrid causing the disease chytridiomycosis - the proposal would disturb soil within and adjoining native vegetation and periodically flooded depressions and potentially transfer fungi spores. The proposal would include environmental management measures including specific consideration of

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
potential impacts on soil, water and native vegetation (refer Section 6). These measures would mitigate against the operation of these KTPs.
Conclusion of Assessment of Significance
Based on consideration of the above criteria, the proposal is unlikely to have a significant effect on the local occurrence of Cumberland Plain Woodland.

Assessment of Significance for River Flat Eucalypt Forest (EEC)
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to EECs.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to EECs.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
A maximum of 1.52 hectares of River Flat Eucalypt Forest would be removed, which is approximately 0.24 % of the total estimated area of that vegetation community in the locality (around 621 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in the extent of River Flat Eucalypt Forest as a result of the proposal would not threaten the viability or persistence of the TEC in the locality or the region. The proposal would include retention of mature trees in residential lots wherever possible within design contraints. These trees would continue to provide at least some contribution to the extent of the EEc in the locality. A VMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including this EEC. The likely magnitude of edge effects or other indirect effects would not be sufficient to further reduce the extent of the ecological community.
(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
The proposal would modify the composition of the local occurrence of the EEC by modifying the composition of retained and regenerating vegetation in close proximity to the subject site due to edge effects. Extra light, wind and resultant temperature changes may favour the growth of weeds and or hardier native species along newly created edges. Overall the clearing and edge effects would comprise a minor modification and a minor reduction in the overall number of plant species and individuals that contribute to the composition of the EEC in the locality. The 1.52 ha of vegetation to be removed or modified is highly unlikely to contain an ecologically significant proportion of the local population of any of the species that make up the community such that the species composition of the EEC as a whole would change. Each of the component species within the EEC would be likely to persist in the 621 hectares of similar vegetation in the locality. Therefore the proposal is not likely to modify the composition of the EEC such that the local occurrence is likely to be placed at risk of extinction.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
A maximum of 1.52 hectares of River Flat Eucalypt Forest would be removed.

Assessment of Significance for River Flat Eucalypt Forest (EEC)
The proposed impact mitigation and environmental management measures are likely to minimise the risk of any substantial adverse effects on the local population of the EEC during construction, outside of the immediate disturbance footprint. Once the residential subdivision is established the proposal could further modify habitat for the EEC through edge effects or fauna mortalities. Given the community is in moderate condition, features weed infestation and adjoins cleared grazing or residential land any such cumulative impacts are likely to be minimal. A VMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including this EEC.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in the Blue Mountains National Park and the Nepean River riparian strip to the west of the subject site is likely to be an important habitat corridor. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. Fauna movement, pollination and seed fall of plants and other ecological processes would occur around, rather than through, the subject site. The proposal involves construction of structures that may obstruct movement of fauna attempting to travel through the study area, such as fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not substantially increase the degree to which fauna movement is disrupted. Fauna movement and ecological processes would continue to function around the subject site via the vegetated riparian corridor to the north. The proposal would reduce the width of this vegetated corridor by 20 to 50 metres but it would still be at least 150 metres wide where it passes adjacent to the subject site, which is likely to be sufficient to provide for fauna movement and other ecological processes.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
Around 1.52 hectares of River Flat Eucalypt Forest would be removed, which is 0.24 % of the total estimated area of that vegetation community in the locality (around 621 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the EEC in the locality or the region. The local occurrence of River Flat Eucalypt Forest includes around 47 hectares within the Fernhill Estate and 20 hectares within the Mulgoa biobank (GHD, 2012) that would be set aside for conservation. River Flat Eucalypt Forest is also present within Mulgoa Nature reserve and therefore under secure tenure (NPWS, 2008). As such, the moderate value habitat (located on the edge of the patch, with evidence of ongoing impacts resulting from grazing, weed infestation and edge effects) within the subject site is not considered to be important to the long term survival of the community in the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat listed for this EEC.
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat

Assessment of Significance for River Flat Eucalypt Forest (EEC)
abatement plan.
There is no recovery plan for River Flat Eucalypt Forest. OEH identifies a number of priority actions intended to abate threats to this EEC and ensure its long term conservation (OEH, 2011b), including the protection of habitat by minimising further clearing of the community. The removal of 1.52 hectares of this community from the subject site is inconsistent with identified priority actions but is unlikely to substantially affect the recovery of the community in the locality given the small area and modified nature of the vegetation to be removed and the extent of conserved woodland in the locality as discussed above.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
The proposal would contribute to the operation of the following Key Threatening Processes (KTPs) of relevance to River Flat Eucalypt Forest: Clearing of native vegetation, through the removal of 3.55 hectares of native vegetation, including 1.52 hectares of River Flat Eucalypt Forest Removal of hollow-bearing trees, through the removal of two such trees in the subject site Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. Retention of large trees, including hollow-bearing trees in open space within residential lots as far as possible within design constraints. The proposal also has the potential to indirectly cause or increase the operation of the following KTPs that are of potential relevance to this ecological community: Invasion of plant communities by perennial exotic grasses – the proposal would create disturbed edges through native vegetation and potentially transfer exotic grass propagules Infection of native plants by Phytophthora cinnamomi - the proposal would disturb soil within and adjoining native vegetation and potentially transfer fungi spores Infection of frogs by amphibian chytrid causing the disease chytridiomycosis - the proposal would disturb soil within and adjoining native vegetation and periodically flooded depressions and potentially transfer fungi spores. The proposal would include environmental management measures including specific consideration of potential impacts on soil, water and native vegetation (refer Section 6). These measures would mitigate against the operation of these KTPs.
Conclusion of Assessment of Significance
Based on consideration of the above criteria, the proposal is unlikely to have a significant effect on the local occurrence of River Flat Eucalypt Forest.

Assessment of Significance for Spiked Rice-flower (*Pimelea spicata*) (endangered species)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
There are two previous records of the Spiked Rice-flower in the locality (OEH, 2013b). However, given the cryptic nature of the species and the extent of suitable shale woodland habitat in the locality it is likely that the local population of the species is more widespread. This may include seeds or plants that were not detected in the survey of the subject site. Hence, for the purposes of this assessment, it is assumed that the site supports a local population (at least in part) of this species. The stands of Cumberland Plain Woodland within the site represent potential habitat for Spiked Rice Flower. Accordingly, construction of the proposal will require the removal of around 2.03 hectares of potential habitat. Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of habitat and potentially plants (if present) within the 2.03 hectares of Cumberland Plain Woodland. The proposal would affect around 0.14 % of the total estimated area of potential habitat for the Spiked Rice-flower in shale woodlands in the locality (based on Tozer (2010) vegetation mapping). The minor magnitude of impacts on any individual plants that may occur in the subject site or on potential habitat would not threaten the viability or persistence of the species in the locality or the region. A VMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including potential habitat for the Spiked Rice-flower. Given these mitigation measures and the extent of existing weed infestation and disturbance in the study area, the proposal would result in a minor increase in weed infestation and other edge effects. Overall, given the limited extent of impacts and the mitigation measures proposed, the proposal is not likely to have an adverse effect on the life cycle of the species such that a local population is likely to be placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to threatened species.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to threatened species.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to threatened species.
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
A maximum of 2.03 hectares of potential habitat for the Spiked Rice-flower would be removed. This habitat would be permanently cleared.

Assessment of Significance for Spiked Rice-flower (*Pimelea spicata*) (endangered species)
The proposed impact mitigation and environmental management measures are likely to mitigate against any substantial effects on the local population of the Spiked Rice-flower during construction, outside of the immediate disturbance footprint. Once the residential subdivision is established the proposal could further modify habitat for the species through edge effects or weed infestation. Given the habitat for the Spiked Rice-flower is in moderate condition, features weed infestation and adjoins cleared grazing or residential land any such cumulative impacts are likely to be minimal.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The habitat for Spiked Rice Flower to be removed lies at the end of a vegetated corridor. In addition, the clearing of habitat proposed would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Movement of pollinators and other ecological processes would continue to function around the subject site via the vegetated riparian corridor to the north.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The proposal would result in the removal of 2.03 hectares of potential Spiked Rice-flower habitat, which is approximately 0.14 % of the total estimated area of similar habitat (i.e. shale woodlands) in the locality (which is around 1480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the species in the locality or the region. The species has not been recorded at the study area and there are no records in the immediate vicinity that suggest this habitat is of particular significance. The subject site is located on the edge of the local patch of habitat, with evidence of ongoing impacts resulting from grazing, weed infestation and edge effects and is not likely to be important to the long term survival of the Spiked rice-flower in the locality.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
There is no critical habitat listed or nominated for the Spiked Rice-flower.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
There recovery plan for the Spiked Rice-flower identifies a number of priority actions intended to ensure the long term conservation of the species in the wild (DEC, 2006). The removal of 2.03 hectares of native vegetation from the subject site is at least partially inconsistent with the stated objective to: “conserve P. spicata using land-use and conservation planning mechanisms” (DEC, 2005). The proposal includes this ecology assessment and assessment of significance and so has included due consideration of NSW, conservation planning mechanisms however the proposal would still result in the removal of habitat for the species. This inconsistency with the recovery plan is unlikely to substantially affect the viability of the Spiked rice-flower in the locality given the small area and modified nature of the vegetation to be removed and the extent of conserved woodland in the locality as discussed above.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The proposal would contribute to the operation of the ‘clearing of native vegetation’ KTP through the

Assessment of Significance for Spiked Rice-flower (*Pimelea spicata*) (endangered species)
removal of 2.03 hectares of potential habitat for the species. The proposal also has the potential to indirectly cause or increase the operation of the following KTPs that are of potential relevance to this species: Invasion of plant communities by perennial exotic grasses – the proposal would create disturbed edges through native vegetation and potentially transfer exotic grass propagules Infection of native plants by Phytophthora cinnamomi - the proposal would disturb soil within and adjoining native vegetation and potentially transfer fungi spores. The proposal would include environmental management measures including specific consideration of potential impacts on soil, water and native vegetation (refer Section 6). These measures would mitigate against the operation of these KTPs.
Conclusion of Assessment of Significance
Based on consideration of the above criteria, the proposal is unlikely to have a significant effect on the local occurrence of Spiked Rice-flower.

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area contains a local population of the Cumberland Plain Land Snail based on direct observations of live snails and shells during the GHD site surveys (see figure 3). OEH (2013b) provides the following information about the biology and life history of the Cumberland Land Snail. It is hermaphroditic and lays clutches of eggs in moist and dark areas such as under logs. The species probably reproduces year round, where conditions are suitable. It is a fungal feeder and is generally active at night. Nothing is currently known about rates of fecundity, length of life span, dispersal patterns and over what distances individuals can move. Based on the above, potential risks to the life cycle of a local population of the species include: removal, modification or fragmentation of important areas of habitat; injury or mortality to an ecological significant proportion of the local population; or removal of suitable shelter sites. A total of five live individuals or shells were recorded in the subject site in loose leaf litter or under woody debris or rubbish. Additional Cumberland Plain Land Snails are likely to be present, buried in loose soil or leaf litter. The 2.75 hectares of woodland and forest within the subject site is contiguous with a large area of habitat to the north and west. A further 28 live individuals or shells were recorded in the study area and nearby areas in the supplementary Cumberland Plain Land Snail survey (see figure 4). These areas contained good quantities of habitat resources such as woody debris and leaf litter. There are 72 previous records of the species in the locality (OEH, 2013b) and around 2100 hectares of suitable habitat in shale woodlands or forest based on Tozer (2010) mapping. On this basis, the proposal is unlikely to remove an ecologically significant proportion of either individuals or habitat resources due to the limited area directly affected (2.75 ha). Additionally, the habitat available within the other parts of the study area and the wider locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local population. As part of the proposed mitigation measures for thjis species, pre-clearing surveys, including salvage of any snails or woody debris, would be conducted within the construction footprints. This would partially mitigate impacts on local populations. Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of the Cumberland Plain Land Snail.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to this threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed…
Not applicable to this threatened species.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The development will remove approximately 2.75 ha of native woodland and forest that would comprise

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)
potentially suitable shelter and foraging habitat for the species. The remainder of the development footprint is derived grassland or disturbed cleared land, without suitable shelter sites or foraging substrate and does not comprise habitat for the species. The proposed construction would disturb some important shelter resources associated with woody debris in the subject site. The proposed pre-clearing surveys and retention of woody debris and placement in adjacent areas of intact habitat is likely to mitigate against the removal of these habitat resources. Retained woody debris and mulch generated by clearing are also likely to have habitat value for the species after construction has ceased. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for the species outside of construction footprints.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat for the Cumberland Plain Land Snail. Vegetation in to the west of the subject site and in the riparian strip to the north is likely to be an important habitat corridor for this species. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would obstruct movement of snails, such as fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of the Cumberland Plain Land Snail would be maintained around the subject site via the vegetated riparian corridor to the north. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
A total of five live individuals and/or shells was recorded in the subject site, which suggests that this area of habitat has value to the local population of the species. A further 28 live individuals or shells were recorded in the study area and nearby areas in the supplementary Cumberland Plain Land Snail survey. These areas contained good quantities of habitat resources of relevance to the snail, such as woody debris and leaf litter. There are 72 previous records of the species in the locality (OEH, 2013b) and around 2100 hectares of suitable habitat in shale woodlands or forest based on Tozer (2010) mapping. The habitat within the subject site would have minor importance to the long term survival of the species in the locality due to the limited area directly affected (2.75 ha or 0.14% of similar habitat in the locality based on Tozer (2010) mapping). The remainder of the study area and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local population.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this species (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)
There is no recovery plan for the Cumberland Land Snail. OEH (2013b) identifies a total of 8 strategies and associated priority actions to help recover this threatened species. These strategies involve community consultation, research and habitat management. Other than through the removal of habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
The development would contribute to the operation of the following Key Threatening Processes (KTPs) of relevance to the Cumberland Plain Land Snail: Clearing of native vegetation through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of suitable habitat Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site.
Conclusion of Assessment of Significance
Based on the consideration of the above factors, the proposal is not likely to have a significant effect on the local population of the Cumberland Plain Land Snail.

Assessments of significance for threatened woodland bird species:
Varied Sitella (Daphoenositta guttata), Diamond Firetail (Stagonopleura guttata), Flame Robin (Petroica phoenicea), Hooded Robin (south-eastern form) (Melanodryas cucullata cucullata), Scarlet Robin (Petroica boodang), Speckled Warbler (Chthonicola sagittata), Turquoise Parrot (Neophema pulchella) (vulnerable species); and Bush Stone-curlew (Burhinus grallarius) (endangered species)
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area may support local populations of these threatened woodland bird species based on the presence of suitable foraging and nesting habitat. Potential habitat for these woodland bird species comprises 3.54 hectares of potential foraging or nesting habitat within the subject site (comprising intact and regrowth woodland and forest). Potential risks to the life cycle of these local populations include: removal, modification or fragmentation of important areas of habitat; or injury or mortality to an ecological significant proportion of the local population. Potential impacts of the proposal on the life cycle of these woodland bird species would be restricted to the removal of edge habitat and potential injury or mortality of birds within the habitat to be removed during construction. The proposal would affect around 0.14 % of the total estimated area of potential habitat for these woodland birds in grassy woodland and forest in the locality (based on Tozer (2010) vegetation mapping) and that this minor magnitude of impacts on any individual birds that may be resident in the subject site or on nest sites or other potential habitat resources would not threaten the viability or persistence of the local population of these species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any nests or roosts in construction footprints and salvage and treatment of any resident fauna. This would partially mitigate impacts on local populations. Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of these woodland birds.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed.
Not applicable to threatened species.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The proposal will remove approximately 3.54 ha of native woodland and forest that would comprise potentially suitable shelter, nesting and foraging habitat for these species. The remainder of the development footprint is derived grassland or disturbed cleared land, without suitable shelter or foraging substrate and does not comprise habitat for these woodland bird species.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a

Assessments of significance for threatened woodland bird species:
result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north is likely to be an important habitat corridor. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of woodland birds and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of these woodland birds would be maintained around the subject site via the vegetated riparian corridor to the north. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
Varied Sittellas were recorded foraging in the subject site which suggests that this area of habitat has value to the local population of this species. Native woodland and forest within the site is connected to extensive areas of vegetation to the west and contains a mix of attributes that suggest that it would comprise moderate quality shelter, nesting and foraging habitat for the Varied Sittella and each of the woodland bird species listed above. There is around 2100 hectares of equivalent habitat in shale woodlands or forest in the locality (Tozer 2010). The habitat within the subject site would have minor importance to the long term survival of these species in the locality due to the limited area directly affected (3.55 ha or 0.14% of similar habitat in the locality based on Tozer (2010) mapping). The value of the habitat in the subject site may be less than this area suggests because it is all edge habitat, adjoining the village of Mulgoa. The value of this habitat is likely to be reduced because of this context and associated noise and light disturbance and risk of vehicle collisions or predation by domestic animals. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for local populations.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
There are no recovery plans for any of these woodland bird species. OEH (2013b) identifies a total of 8 strategies and associated priority actions to help recover this threatened species. These strategies involve community consultation, research and habitat management. Other than through the removal of habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
The development would contribute to the operation of the following Key Threatening Processes (KTPs)

Assessments of significance for threatened woodland bird species:
of relevance to these woodland birds: Clearing of native vegetation, through the removal of 3.54 hectares of habitat Removal of hollow-bearing trees, through the removal of two such trees in the subject site Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. Retention of large trees, including hollow-bearing trees in open space within residential lots as far as possible within design constraints.
Conclusion of Assessment of Significance
Based on the consideration of the above factors the proposal is not likely to have a significant effect on local populations of threatened woodland birds, including the Varied Sitella, Diamond Firetail, Flame Robin, Hooded Robin, Scarlet Robin, Speckled Warbler, Turquoise Parrot or Bush Stone-curlew.

Assessments of significance for threatened migratory or nomadic bird species:
Regent Honeyeater (Anthochaera phrygia) (critically endangered species); Swift Parrot (Lathamus discolor) (endangered species); Gang-gang Cockatoo (Callocephalon fimbriatum), Little Lorikeet (Glossopsitta pusilla) (vulnerable species).
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area may support a local population of these threatened migratory or nomadic birds species on an occasional basis based on the presence of suitable foraging habitat. Potential risks to the life cycle of this local population include: removal, modification or fragmentation of important areas of habitat; increasing the risk or energy costs of migration; or injury or mortality to an ecological significant proportion of the local population. As stated in part d), the subject site does not contain any breeding habitat for these species. These species may forage within the study area on occasion, but as stated in part d) these species are highly unlikely to depend on the resources that would be affected by the proposal. The proposal would not cause any barrier to movement between areas of foraging habitat. The proposal would affect just 0.02 % of the total estimated area of potential habitat for these birds in native woodland and forest in the locality (based on Tozer (2010) vegetation mapping). This minor magnitude of impacts on any individual birds that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of these species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. Clearing of vegetation and construction for the proposal is highly unlikely to result in injury or mortality of any individuals of these highly mobile species. Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of these bird species.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to this threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed…
Not applicable to this threatened species.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The proposal will remove approximately 3.54 ha of native woodland and forest that would comprise potentially suitable foraging habitat for these species. The remainder of the proposal footprint is derived grassland or disturbed cleared land, without suitable shelter or foraging substrate and does not comprise habitat for these migratory or nomadic bird species. The subject site does not contain any breeding habitat for these species because they breed in other regions on a seasonal basis (OEH, 2013b) and/or there are no suitable large hollow-bearing nest trees. The two hollow-bearing trees in the subject site contain only small hollows and are located in fragmented woodland or cleared land and are unlikely to be used as a nest tree by the Gang-gang Cockatoo or the Little Lorikeet.

Assessments of significance for threatened migratory or nomadic bird species:
Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for these species outside of construction footprints.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north is likely to be an important habitat corridor. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of birds and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of these birds would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of migration of these species. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
The total area of habitat to be removed (3.55 hectares) is around 0.03 % of the estimated area of native vegetation in the locality (around 13,714 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). The small area of vegetated habitat to be removed would have very limited value to these highly mobile species. Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa. The value of this habitat is likely to be reduced because of this context and associated noise and light disturbance and risk of vehicle collisions or predation by domestic animals. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for these species.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
There are no recovery plans for any of these migratory or nomadic bird species. OEH (2013b) identifies a number of strategies and associated priority actions to help recover these threatened species. These strategies involve community consultation, research and habitat management. Other than through the removal of habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Assessments of significance for threatened migratory or nomadic bird species:
The proposal would contribute to the operation of one KTP of relevance to these migratory or nomadic bird species: ‘clearing of native vegetation’ through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of intact woodland and forest The proposal would include measures to at least partially mitigate against the operation of this KTP including retention of large trees, and associated foraging resources in open space within residential lots as far as possible within design constraints.
Conclusion of Assessment of Significance
Based on the consideration of the above factors the proposal is not likely to have a significant negative effect on local populations of the Regent Honeyeater, Swift Parrot, Gang-gang Cockatoo and Little Lorikeet.

Assessments of significance for threatened large predatory bird species:
Barking Owl (Ninox connivens); Masked Owl (Tyto novaehollandiae); Powerful Owl (Ninox strenua); Sooty Owl (Tyto tenebricosa) and Square-tailed Kite (Lophoictinia isura) (vulnerable species).
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area may support a local population of these threatened large predatory bird species on an occasional basis, based on the presence of suitable foraging habitat. Potential risks to the life cycle of these local populations include: removal, modification or fragmentation of important areas of habitat; or injury or mortality to an ecological significant proportion of the local population. There are no suitable hollow bearing trees that could provide roost sites for forest owls within the subject site. The Square-tailed Kite is unlikely to nest in the fragmented, edge vegetation in the subject site. There may be suitable roost or nest trees in vegetation to the north or west of the subject site associated with gullies containing tall, moist forest. Construction and operation of the proposal is highly unlikely to affect availability or usage of roost sites in the broader study area because: environmental management measures are likely to restrict direct impacts to the subject site; and indirect impacts such as noise, light spill and the risk of vehicle collisions would be equivalent to those impacts currently associated with the study area. These species may forage within the study area on occasion, but as stated in part d) these species are highly unlikely to depend on the resources that would be affected by the proposal. The subject site would make up only a small proportion of the home range of individuals within the local population of these species (if present). The proposal would not cause any barrier to movement between areas of foraging habitat. The proposal would affect just 0.02 % of the total estimated area of potential habitat for these birds in native woodland and forest in the locality (based on Tozer (2010) vegetation mapping). This minor magnitude of direct impacts on any individual birds that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of these species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. Clearing of vegetation and construction for the proposal is highly unlikely to result in injury or mortality of any individuals of these highly mobile species. Given the large area of protected habitat present in the locality, and the large home ranges of each of these species, the proposal is unlikely to impact the lifecycle of these species such that a viable local population is placed at risk of extinction.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to this threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed…
Not applicable to this threatened species.
d) In relation to the habitat of a threatened species, population or ecological community:

Assessments of significance for threatened large predatory bird species:
(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The proposal will remove approximately 2.75 ha of native woodland and forest that would comprise potentially suitable foraging habitat for these species. The remainder of the proposal footprint is derived grassland or disturbed cleared land, without suitable shelter or foraging substrate and does not comprise habitat for these large predatory bird species. The subject site does not contain any breeding habitat for these species. The two hollow-bearing trees in the subject site contain only small hollows and are located in fragmented woodland or cleared land and are unlikely to be used as a nest tree by the large forest owls. The Square-tailed Kite is unlikely to nest in the fragmented, edge vegetation in the subject site. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for these species outside of construction footprints.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north is likely to be an important habitat corridor. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of birds and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of these birds would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of migration of these species. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
These forest owl species have very large home ranges, of which the subject site would only be a very small proportion. Habitat for these species is present throughout Blue Mountains National Park to the west and other native vegetation in the locality. It is possible that these species would forage occasionally in the subject site but would not depend solely on these foraging resources. The proposal would remove a very small proportion of available foraging resources for local populations of these forest owls. The total area of habitat to be removed (2.75 hectares) is around 0.02 % of the estimated area of native vegetation in the locality (around 13,680 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). The small area of foraging habitat to be removed would have very limited value to these highly mobile species. Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa. The value of this habitat is likely to be reduced because of this context and associated noise and light disturbance and risk of vehicle collisions. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have

Assessments of significance for threatened large predatory bird species:
greater value for these species.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
A Recovery Plan has been prepared for the large forest owls (Masked, Sooty and Powerful Owls). The overall objective of the NSW Large Forest Owl recovery plan is to ensure that viable populations of the three species continue in the wild in NSW in each region where they presently occur (DEC, 2006). Recovery objectives in this plan are primarily related to research, surveys and mapping of core habitat and are not directly relevant to the proposal. Relevant specific objectives include to: “ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes” (DEC, 2006). Impacts to these species have been assessed in this report. The proposal is therefore consistent with this recovery objective. There is a draft recovery plan for the Barking Owl (NPWS, 2003). As above most objectives in this plan are not directly relevant to the proposal. Relevant specific objectives include to: ‘Undertake threat abatement and mitigation’, including to ‘Assist with the protection of Barking Owl habitat from disturbance due to developments and activities’. The proposal is not consistent with this objective in that it involves the removal of Barking Owl habitat. There is no recovery plan for the Square-tailed Kite. OEH (2013b) identifies a number of strategies and associated priority actions to help recover these threatened species. These strategies involve community consultation, research and habitat management. Other than through the removal of habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated. The proposal will remove a small area of potential foraging habitat for these species compared with the local and regional extent of potential habitat and will not remove roosting or breeding habitat. On this basis, the proposal is unlikely to interfere with the recovery of either species.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
The proposal would contribute to the operation of one KTP of relevance to these migratory or nomadic bird species: ‘clearing of native vegetation’ through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of intact woodland and forest. The proposal would include measures to at least partially mitigate against the operation of this KTP including retention of large trees, and associated foraging resources in open space within residential lots as far as possible within design constraints.
Conclusion of Assessment of Significance
Based on the consideration of the above factors the proposal is not likely to have a significant negative effect on local populations of the Barking Owl, Masked Owl, Powerful Owl, Sooty Owl or Square-tailed Kite.

Assessments of significance for threatened wetland bird species:
Australasian Bittern (Botaurus poiciloptilus) and Australian Painted Snipe (Rostratula australis) (endangered species); Black Bittern (Ixobrychus flavicollis) and Black-tailed Godwit (Limosa limosa) (vulnerable species).
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area may support a local population of these threatened wetland birds species on an occasional basis based on the presence of suitable foraging habitat in the large dam to the west of the subject site and flooded depressions within River Flat Eucalypt Forest. Potential risks to the life cycle of this local population include: removal, modification or fragmentation of important areas of habitat; increasing the risk or energy costs of migration; or injury or mortality to an ecological significant proportion of the local population. The subject site does not contain any core wetland foraging or breeding habitat for these species. Given the small scale of the proposal and proposed mitigation measures it would be unlikely to result in any substantial indirect impacts on any breeding, foraging or roosting habitat for these species in wetlands in the study area. Impacts would be restricted to the removal of a maximum of 8.37 hectares of less suitable grassland, woodland or forest habitat that may be used by these species as occasional foraging or shelter habitat or while travelling between preferred wetland habitats. These species are highly unlikely to depend on the resources that would be affected by the proposal. The proposal would not cause any barrier to movement between areas of foraging habitat. The proposal would affect just 0.02 % of the total estimated area of potential habitat for these birds in native woodland and forest in the locality (based on Tozer (2010) vegetation mapping). There are also substantial areas of additional habitat associated with dams, drainage lines or flooded depressions within areas of exotic grassland. Notably, the Fernhill estate contains a number of large vegetated water bodies that are adjacent to large patches of native vegetation (see Figure 4). This minor magnitude of impacts on any individual birds that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of these species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. Clearing of vegetation and construction for the proposal is highly unlikely to result in injury or mortality of any individuals of these highly mobile species. Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of these bird species.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed…
Not applicable to threatened species.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Assessments of significance for threatened wetland bird species:
The subject site does not contain any core wetland foraging or breeding habitat for these species. The proposal would remove approximately 8.37 hectares of less suitable grassland, woodland or forest habitat that may be used by these species as occasional foraging or shelter habitat or while travelling between preferred wetland habitats. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for these species outside of construction footprints.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north adjoins wetland habitat and may an important movement corridor for these wetland bird species. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of birds and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of these birds would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of migration of these species. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
A maximum of 8.37 hectares of occasional foraging or movement habitat for these wetland species would be removed. The habitat to be removed has very low value given its attributes, condition and context. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for these species. Notably, the Fernhill estate contains a number of large vegetated water bodies that are adjacent to larger patches of native vegetation and further from the village of Mulgoa (see Figure 4).
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
There are no recovery plans for any of these wetland bird species. OEH (2013b) identifies a number of strategies and associated priority actions to help recover these threatened species. These strategies involve community consultation, research and management of important wetland habitat. The proposal would not directly affect any wetland habitat. Other than through the removal of lower quality habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in

Assessments of significance for threatened wetland bird species:
the operation of, or increase the impact of, a key threatening process
The proposal would contribute to the operation of one KTP of relevance to these migratory or nomadic bird species: ‘clearing of native vegetation’ through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of intact woodland and forest. The proposal would include measures to at least partially mitigate against the operation of this KTP including retention of large trees and associated foraging and roosting resources in open space within residential lots as far as possible within design constraints.
Conclusion of Assessment of Significance
Based on the consideration of the above factors the proposal is not likely to have a significant negative effect on local populations of the Australasian Bittern, Australian Painted Snipe; Black Bittern or Black-tailed Godwit.

Assessments of significance for the Green and Golden Bell-frog (*Litoria aurea*)
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The study area may support a local population of the Green and Golden Bell-frog on an occasional basis based on the presence of suitable habitat in the large dam to the west of the subject site and flooded depressions within River Flat Eucalypt Forest. No evidence of this species has been recorded during the current survey or previous targeted surveys. There is one record (post 1980) of this species within the locality (OEH 2013a). The known dispersal ability of the species indicates that they can travel up to 1.5 km in a night and have been recorded several kilometres from the nearest breeding site (OEH 2013b). As such, it is possible that individuals could disperse and occur within the study area on an occasional basis, within the large wetland to the west of the subject site or within adjoining dense grassy vegetation. Potential risks to the life cycle of this local population include: removal, modification or fragmentation of important areas of habitat; increasing the risk or energy costs of migration; or injury or mortality to an ecological significant proportion of the local population. The subject site does not contain any core wetland foraging or breeding habitat for the species. Given the small scale of the proposal and proposed mitigation measures it would be unlikely to result in any substantial indirect impacts on any breeding or foraging habitat in wetlands in the study area. Impacts would be restricted to the removal of a maximum of 8.37 hectares of less suitable grassland, woodland or forest habitat that may be used as occasional foraging or shelter habitat or while travelling between preferred wetland habitats. The species are highly unlikely to depend on the resources that would be affected by the proposal. The proposal would not cause any barrier to movement between areas of foraging habitat. There are substantial areas of alternative habitat associated with dams, drainage lines or flooded depressions within areas of both exotic grassland and native vegetation in the locality. Notably, the Fernhill estate contains a number of large vegetated water bodies that are adjacent to large patches of native vegetation (see Figure 4). This minor magnitude of impacts on any individual frogs that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of these species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. Clearing of vegetation and construction for the proposal is unlikely to result in injury or mortality of any individuals of this species. Therefore the proposed action is unlikely to have adverse effect on the life cycle of local population of the Green and Golden Bell-frog.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable to threatened species.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed…
Not applicable to threatened species.
d) In relation to the habitat of a threatened species, population or ecological community: (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The subject site does not contain any core wetland foraging or breeding habitat for the Green and golden

Assessments of significance for the Green and Golden Bell-frog (*Litoria aurea*)
bell-frog. The proposal would remove approximately 8.37 hectares of less suitable grassland, woodland or forest habitat that may be used as occasional foraging or shelter habitat or while travelling between preferred wetland habitats. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat outside of construction footprints.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north adjoins wetland habitat and may an important movement corridor for the Green and Golden Bell-frog. The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of frogs and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of migration of the green and Golden Bell-frog. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
As described above, the habitat that would be removed would be unlikely to support permanent populations of this species, and is highly unlikely to be important for the long-term persistence of this species in the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
The draft recovery plan describes five specific objectives to recover this species. These strategies involve community consultation, research, disease management and management of important wetland habitat. The proposal would not directly affect any wetland habitat. Other than through the removal of lower quality habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated. The proposal would be unlikely to interfere with the recovery of this species within the locality given the lack of suitable breeding habitat within the subject site.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process
The proposal has the potential to contribute to the following KTPs of relevance to this threatened

Assessments of significance for the Green and Golden Bell-frog (*Litoria aurea*)
species: Infection of native frogs by amphibian chytrid causing the disease chytridiomycosis. Clearing of native vegetation through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of suitable habitat Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: A CEMP, including measures to isolate the construction site from nearby native vegetation or wetland habitat standard environmental management procedures to prevent downstream impacts on aquatic habitats. A fauna management protocol including measures to avoid the risk of transmission of amphibian chytrid. The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. The proposal design would be unlikely to significantly affect downstream flow regimes and so would not contribute to the KTP: alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
Conclusion of Assessment of Significance
Based on the consideration of the above factors the proposal is not likely to have a significant negative effect on the local population of the Green and Golden bell-frog.

Assessments of significance for threatened cave-roosting microbats
Large-eared Pied Bat (Chalinolobis dwyeri) and Eastern Bentwing Bat (Miniopteris schreibersi oceanensis) (vulnerable species)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
These cave-roosting microbat species have been recorded in the locality (OEH, 2013b). The subject site contains potential foraging habitat for these species and so it assumed that a viable local population of these species may forage in the subject site on an occasional basis.The factors that could potentially disrupt the life cycle of these cave-roosting microbats are: loss of roost sites in suitable caves or fissures; loss of significant areas of foraging habitat; injury or mortality of an ecologically significant proportion of the local population. There are no caves, overhangs or fissures in the subject site that could comprise potential roost sites for the species. The proposal is highly unlikely to adversely affect any such roost sites that would be present elsewhere in the locality. These species may forage within the study area on occasion, but is highly unlikely to depend on the resources in the 3.55 hectares of potential foraging habitat in woodland and forest that would be removed by the proposal. Clearing of vegetation and construction for the proposal would only occur during daylight hours and is highly unlikely to result in injury or mortality of any individuals of these highly mobile and nocturnal species. The proposal is therefore unlikely to adversely affect the lifecycle of these species such that a viable local population is placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to threatened species
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to threatened species
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to threatened species
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The proposal would remove a maximum of 3.55 hectares of potential foraging habitat for these species, comprising intact and regrowth woodland and forest. These microbats would also use aerial foraging habitat above cleared land and exotic grassland in the subject site however the final proposal footprint

Assessments of significance for threatened cave-roosting microbats
would have equivalent value and so the proposal would not remove any such habitat. There is no known or potential roosting habitat for the species that would be removed or modified by the proposal.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat for these bat species. The proposal involves construction of structures that may obstruct movement of fauna including fences and buildings. However, these cave-roosting microbats would easily traverse these obstructions as both species area known to routinely travel several kilometres in a night to forage (Churchill 2008). Further, all of the above listed barriers would be parallel to existing, equivalent barriers and would not significantly increase the energy costs of flying over the subject site or otherwise increase the degree to which fauna movement is already disrupted.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The total area of potential habitat to be removed (3.55 hectares) is around 0.03 % of the estimated area of native vegetation in the locality (around 13,714 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). The small area of vegetated habitat to be removed would have very limited value to the local population of the species. Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa and subject to noise and light impacts and the risk of vehicle collision.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
There is no critical habitat identified or nominated for these species.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
There is no recovery plan for either of these species. OEH (2013b) has identified a number of priority actions for these species which generally relate to protection of roosting habitat. No priority actions are particularly relevant to the proposal. The proposal is therefore not inconsistent with the priority actions for this species.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The proposal would directly contribute to the operation of the KTP 'Clearing of native vegetation' through the removal of 2.75 hectares of intact native vegetation. The total area of native vegetation to be removed is less than 0.02% of the estimated area of native vegetation in the locality based on Tozer (2010) vegetation mapping, much of which is conserved in national parks and thus comprises a very minor increase in the operation of the KTP. The proposal would not affect the operation of any other KTPs of relevance to this threatened species.
Conclusion of Assessment of Significance
On consideration of the above criteria, the proposal is unlikely to have a significant effect on the local population of the Large-eared Pied Bat or Eastern Bentwing Bat.

Assessments of significance for threatened tree-roosting microbats
Eastern Freetail-bat (Mormopterus norfolkensis), Greater Broad-nosed Bat (Scoteanax rueppellii) and Southern Myotis (Myotis macropus) (vulnerable species)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
These tree-roosting microbat species have been recorded in the locality (OEH, 2013b). The subject site contains potential foraging and roosting habitat for these species and so it assumed that a viable local population of these species may occur in the subject site on an occasional basis. The factors that could potentially disrupt the life cycle of these tree-roosting microbats are: loss of roost trees; loss of areas of foraging habitat; or injury or mortality of an ecologically important portion of the local population. The proposal would remove two hollow-bearing trees that may be used by local populations of these tree-roosting microbats as longer term hibernation roosts or maternity roosts and a further two habitat trees with fissures or loose bark that may be used as diurnal roosts. Microbats may also use foliage in the subject site as diurnal roosts during warmer weather. There was no evidence such as multiple, recent local records of these species (OEH, 2013b), or guano accumulations to suggest that these trees are frequently used. The locality contains around 13, 680 hectares of similar woodland and forest based on Tozer (2010) mapping, much of which is located in conservation land and is likely to contain similar or greater numbers of hollow-bearing trees. The proposal is unlikely to remove an ecologically significant proportion of either individuals or habitat resources due to the limited quantum of direct impacts (3.55 ha containing a maximum of four roost trees). The area impacted is likely to have less value than this quantum suggests, as the subject site immediately adjoins disturbed cleared land and is subject to noise, light and other disturbance. The remainder of the study area and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local populations of these species. The proposal is highly unlikely to prevent these species from using roost trees in the broader study area through indirect effects. These species may forage within the study area on occasion, but as stated in part d) the species is highly unlikely to depend on the resources that would be removed by the proposal. The proposal is unlikely to remove an ecologically significant proportion of either individuals or habitat resources due to the limited area directly affected (3.55 ha). The remainder of the study area and locality is likely to contain sufficient amounts of both individuals and habitat resources to maintain the local population. The proposed construction would include fauna management protocols including careful felling of habitat trees and salvage and treatment of any resident fauna. This would partially mitigate impacts on local populations of these tree-roosting microbats if any individuals are in the subject site during construction. The proposal is therefore unlikely to adversely affect the lifecycle of these species such that a viable local population is placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Assessments of significance for threatened tree-roosting microbats
Not applicable to this threatened fauna species
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to this threatened fauna species
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to this threatened fauna species
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The proposal would remove a maximum of 3.55 hectares of potential foraging habitat for these species in the subject site comprising intact and regrowth woodland. These microbats would also use aerial foraging habitat above cleared land and exotic grassland in the subject site and so the proposal would not remove any such habitat. The proposal would remove two hollow-bearing trees that may be used local population of these tree-roosting microbats as longer term hibernation roosts or maternity roosts and a further two habitat trees with fissures or loose bark that may be used as diurnal roosts. Microbats may also use foliage in the subject site as diurnal roosts during warmer weather.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. The proposal involves construction of structures that may obstruct movement of fauna including fences and buildings. These tree-roosting microbats would easily traverse these obstructions as these species area known to routinely travel several kilometres in a night to forage (Churchill 2008). Further, all of the above listed barriers would be parallel to existing, equivalent barriers and would not significantly increase the energy costs of flying over the subject site or otherwise increase the degree to which fauna movement is already disrupted.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The total area of habitat to be removed (3.55 hectares) is around 0.03 % of the estimated area of native vegetation in the locality (around 13,714 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). The small area of vegetated habitat to be removed would have very limited value to the local population of the species. There was no evidence such as multiple, recent local records of these species (OEH, 2013b), or guano accumulations to suggest that the four habitat trees to be removed are frequently used. The locality contains around 13, 680 hectares of similar woodland and forest based on Tozer (2010) mapping, much of which is located in conservation land and is likely to contain similar or greater numbers of hollow-bearing trees. The subject site is unlikely to contain ecologically significant proportion of either individuals

Assessments of significance for threatened tree-roosting microbats
or habitat resources due to the limited quantum of direct impacts (3.55 ha containing a maximum of four roost trees). Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa and subject to noise and light impacts and the risk of vehicle collision.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
There is no critical habitat identified or nominated for these species.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
There are no recovery plans for these species. OEH (2011b) has identified a number of priority actions for these species which generally relate to protection of roosting habitat. No priority actions are particularly relevant to the proposal. The proposal is therefore not inconsistent with the priority actions for this species.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The proposal would contribute to the operation of the following Key Threatening Processes (KTPs) of relevance to these tree-roosting microbats: Clearing of native vegetation through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of intact woodland and forest. Removal of hollow-bearing trees, through the removal of two such trees in the subject site. Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. Retention of large trees, including hollow-bearing trees in open space within residential lots as far as possible within design constraints.
Conclusion of Assessment of Significance
On consideration of the above criteria, the proposal is unlikely to have a significant negative effect on the local population of the Eastern Freetail-bat, Greater Broad-nosed Bat or Southern Myotis .

Grey-headed Flying-fox (*Pteropus poliocephalus*) (vulnerable)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
Potential impacts on the life cycle of the Grey-headed Flying-fox include: removal of critical foraging habitat; removal or disturbance of roost camps; or injury or mortality of an ecologically significant proportion of the population. The species may forage within the study area on occasion, but as stated in part d) the species is highly unlikely to depend on the resources that would be removed by the proposal. The proposal would not cause any barrier to movement between roost sites and potential foraging habitat. Grey-headed Flying-foxes roost and breed in large colonies (camps). All the flying-fox camps in eastern Australia are linked into one population and numbers in any one camp are influenced by food availability and the requirements of mating and raising young. Fluctuations in the size of a camp can vary week by week, month by month or in some cases from one night to the next, and reflect the nomadic nature of Grey-headed Flying-foxes (KBCS 2011). No Grey-headed Flying-fox camps are present in the study area. The locations of such camps are relatively well known: the closest continuously occupied camp to the site is at Penrith, some 15 km to the north-east; which is well beyond the range of any indirect effects potentially arising from the proposal. Clearing of vegetation and construction for the proposal would only occur during daylight hours and is highly unlikely to result in injury or mortality of any individuals of this highly mobile and nocturnal species. The proposal is therefore unlikely to adversely affect the lifecycle of the species such that a viable local population is placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to this threatened fauna species
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to this threatened fauna species
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to this threatened fauna species
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The primary food source for Grey-headed Flying-foxes is blossom from Eucalyptus species and other Myrtaceous species but in some areas it also utilises a wide range of rainforest fruits (Eby 1998). The Grey-headed Flying-fox is a highly mobile species which regularly travels up to 50 kilometres in a night to forage, and has been shown to make migratory movements of almost 1000 kilometres within a year

Grey-headed Flying-fox (*Pteropus poliocephalus*) (vulnerable)
(Churchill 2008, Webb and Tidemann 1996). Around 2.75 hectares of potential foraging habitat for the species in intact native woodland and forest with Myrtaceous tree species and a small number of isolated trees in exotic grassland would be removed as a result of this proposal. The total area of habitat to be removed is around 0.03% of the estimated area of native vegetation in the locality based on Tozer (2010) vegetation mapping, much of which is conserved in national parks. As stated in part a) no known or potential roosting habitat for the species would be removed or modified by the proposal.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. The proposal involves construction of structures that may obstruct movement of fauna including fences and buildings. The Grey-headed Flying Fox would easily traverse these obstructions as it is known to routinely travel up to 50 km in a night to forage (Churchill 2008). Further, all of the above listed barriers would be parallel to existing, equivalent barriers and would not significantly increase the energy costs of flying over the subject site or otherwise increase the degree to which fauna movement is already disrupted.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The subject site contains mature Eucalypts that would provide blossoms and nectar for the species. Grey-headed Flying-foxes may feed occasionally in the subject site, but would not depend solely on these foraging resources. The proposal would remove a very small proportion of available foraging resources for local populations of the Grey-headed Flying Fox: 0.03% % of the extent of vegetation map units likely to contain Myrtaceous trees in the locality based on Tozer (2010) vegetation mapping.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
The draft national recovery plan for the Grey-headed Flying-fox (DECCW 2009) states that foraging habitat that meets at least one of the following criteria qualifies as critical habitat: productive during winter and spring, when food bottlenecks have been identified. known to support populations of > 30 000 individuals within an area of 50 kilometre radius (the maximum foraging distance of an adult). productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May). productive during the final stages of fruit proposal and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions). known to support a continuously occupied camp. The subject site would not in isolation support a population of more than 30 000 individuals, but would contribute to foraging habitat for some individuals of the broader population in the Sydney region. While there would be some productivity of foraging resources during winter and spring, the resources present in the study area are limited in comparison to available foraging resources in nearby areas, such as the Blue Mountains National Park. The proposal would remove some critical foraging habitat but given the small area of foraging habitat to be removed and the large tracts of other vegetation in the locality the impact on the local population of the species would be minor.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or

Grey-headed Flying-fox (*Pteropus poliocephalus*) (vulnerable)
threat abatement plan,
The draft recovery plan for the Grey-headed Flying-fox (DECCW, 2009) identifies the following recovery objectives of relevance to the removal of foraging habitat for the species: Objective 1. To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range The proposal would remove 2.75 hectares of critical foraging habitat however this is a very minor proportion of native evegation that is also likely to qualify as critical foraging habitat in the locality (0.02% % based on Tozer (2010) vegetation mapping). Objective 2. To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes Out of the native vegetation to be removed, a proportion are winter/spring flowering trees. Foraging resources in the study area are not considered to be key foraging habitat for the Grey-headed Flying-fox, although the species may forage in the study area on occasion during these seasons. Therefore the proposal would result in a reduction of up to 2.75 hectares of critical foraging habitat for the species. The proposed action is therefore not consistent with the draft recovery plan for the species.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The proposal would directly contribute to the operation of the KTP 'Clearing of native vegetation' through the removal of 2.75 hectares of intact native vegetation. The total area of native vegetation to be removed is less than 0.02% of the estimated area of native vegetation in the locality based on Tozer (2010) vegetation mapping, much of which is conserved in national parks and thus comprises a very minor increase in the operation of the KTP. The proposal would not affect the operation of any other KTPs of relevance to this threatened species.
Conclusion of Assessment of Significance
On consideration of the above criteria, the proposal is unlikely to have a significant impact on the local population of the Grey-headed Flying-fox.

Koala (*Phascolarctos cinereus*) (vulnerable)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
There are 19 previous records of the Koala within a 10 kilometre radius of the site since 1985 (OEH, 2013b). Intact forest and woodland within the subject site contains the preferred Koala food tree Forest Red Gum (Eucalyptus tereticornis) identified in the recovery plan (DECCW 2008) and a number of secondary food trees. It is assumed that the study area contains a viable local population of the Koala and that the species may forage in the subject site on an occasional basis. Potential risks to the life cycle of this local population include: removal, modification or fragmentation of important areas of habitat; or injury or mortality to an ecological significant proportion of the local population. The Koala may forage within the study area on occasion, but as stated in part d) the local population is highly unlikely to depend on the resources that would be affected by the proposal. The subject site would make up only a small proportion of the home range of individuals within the local population of the Koala (if present). The proposal would not cause any barrier to movement between areas of foraging habitat. The proposal would affect just 0.02 % of the total estimated area of potential foraging habitat for the Koala in native woodland and forest in the locality (based on Tozer (2010) vegetation mapping). This minor magnitude of direct impacts on any individual Koalas that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of thespecies. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. Clearing of vegetation and construction for the proposal is unlikely to result in injury or mortality of any Koalas. Given the large area of protected habitat present in the locality the proposal is unlikely to impact the lifecycle of these species such that a viable local population is placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to threatened species.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to this threatened fauna species
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to threatened species.
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The development will remove approximately 2.75 ha of native woodland and forest that would comprise

Koala (*Phascolarctos cinereus*) (vulnerable)
potentially suitable foraging habitat. The remainder of the proposal footprint is derived grassland or disturbed cleared land, without suitable shelter or foraging substrate and does not comprise habitat for the Koala. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for the Koala outside of construction footprints.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north may be used as a movement corridor by the local population of the Koala (if present). The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of fauna and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of the Koala would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of movement. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
Habitat for the Koala is present throughout Blue Mountains National Park to the west and other native vegetation in the locality. It is possible that the local population would forage occasionally in the subject site but would not depend solely on these foraging resources. The proposal would remove a very small proportion of available foraging resources: the total area of habitat to be removed (2.75 hectares) is around 0.02 % of the estimated area of similar native vegetation in the locality (around 13,680 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa. The value of this habitat is likely to be reduced because of this context and associated noise and light disturbance and risk of vehicle collisions or predation by domestic animals. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for the Koala.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
The subject site contains the preferred Koala food tree Forest Red Gum identified in the recovery plan (DECCW 2008) and a number of secondary food trees. The foraging habitat to be removed is a very minor proportion of the resources available in the locality and would have proportionally lower value than similar vegetation that is located in larger patches and/or remote from developed areas. The proposal will not fragment or isolate any areas of known habitat for the Koala or create a novel barrier to Koala movements in the locality. Given these considerations, the proposal is unlikely to have an adverse direct

Koala (*Phascolarctos cinereus*) (vulnerable)
or indirect effect on habitat critical for the long-term survival of a population in the wider locality. .
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
As noted in part e) above, the proposal would remove Koala food trees identified in the recovery plan (DECCW 2008) and as such is inconsistent with the objectives of the plan. The proposal will not fragment or isolate any areas of known habitat for the Koala or create a novel barrier to Koala movements in the locality. The proposal involves the construction of roads and associated infrastructure which are recognised in the recovery plan as a threat to Koala populations (DECCW 2008). The subject site would be parallel to existing, equivalent road infrastructure and would not significantly increase the degree to which traffic may affect local and regional Koala populations. Overall the proposal would have a minor, negative effect on the recovery of the Koala.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The development would contribute to the operation of one KTP of relevance to the Koala: 'clearing of native vegetation' through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of intact woodland and forest that comprises foraging habitat for the species. The proposal would include measures to at least partially mitigate against the operation of this KTP including retention of large trees in open space within residential lots as far as possible within design constraints. These isolated trees would no longer comprise foraging resources for the Koala but would contribute to the extent and viability of native vegetation in the locality through provision of pollen and seed.
Conclusion of Assessment of Significance
On consideration of the above criteria, the proposal is unlikely to have a significant negative effect on the local population of the Koala.

Spotted-tailed Quoll (*Dasyurus maculatus*) (vulnerable)
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
There are 14 previous records of the Spotted-tailed Quoll within a 10 kilometre radius of the site since 1985 (OEH, 2013b). Intact forest and woodland within the subject site comprises suitable shelter and foraging habitat and denser riparian forest in the broader study area contains potentially suitable den sites. It is assumed that the study area contains a viable local population of the Spotted-tailed Quoll and that the species may forage in the subject site on an occasional basis. Potential risks to the life cycle of this local population include: removal, modification or fragmentation of important areas of habitat; removal of important denning sites; or injury or mortality to an ecological significant proportion of the local population. The Spotted-tailed Quoll may forage within the study area on occasion, but as stated in part d) the local population is highly unlikely to depend on the resources that would be affected by the proposal. There are no known or potential denning sites in the subject site, which contains only open, edge vegetation with no large hollow, woody debris or caves. Construction and operation of the proposal is highly unlikely to affect availability or usage of den sites in the broader study area because: environmental management measures are likely to restrict direct impacts to the subject site; and indirect impacts such as noise, light spill and the risk of vehicle collisions would be equivalent to those impacts currently associated with the study area. The subject site would make up only a small proportion of the home range of individuals within the local population of the Spotted-tailed Quoll (if present). The proposal would not cause any barrier to movement between areas of foraging habitat. The proposal would affect just 0.02 % of the total estimated area of potential foraging habitat for the Spotted-tailed Quoll in native woodland and forest in the locality (based on Tozer (2010) vegetation mapping). This minor magnitude of direct impacts on any individual Spotted-tailed Quolls that may be resident in the subject site or on potential habitat resources would not threaten the viability or persistence of the local populations of the species. The proposed construction would include a fauna management protocol including pre-clearing survey and identification of any resident fauna in construction footprints. This species is wary and mobile and is likely to vacate the subject site once construction activities commence. Clearing of vegetation and construction for the proposal is unlikely to result in injury or mortality of any Spotted-tailed Quolls. Given the large area of protected habitat present in the locality the proposal is unlikely to impact the lifecycle of these species such that a viable local population is placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
Not applicable to threatened species.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Spotted-tailed Quoll (*Dasyurus maculatus*) (vulnerable)
Not applicable to this threatened fauna species
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to threatened species.
d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
The development will remove approximately 2.75 ha of native woodland and forest that would comprise potentially suitable foraging habitat. The remainder of the proposal footprint is derived grassland or disturbed cleared land, without suitable shelter or foraging substrate and does not comprise habitat for the Spotted-tailed Quoll. There are no known or potential den sites in the subject site. Provided recommended impact mitigation measures are adopted the proposal is highly unlikely to significantly modify any habitat for the Spotted-tailed Quoll outside of construction footprints.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
The subject site is at the terminal end of a vegetated corridor. The proposal would involve widening an existing gap in habitat and so vegetation clearing for the proposal will not directly isolate or fragment any areas of habitat. Vegetation in to the west of the subject site and in the riparian strip to the north may be used as a movement corridor by the local population of the Spotted-tailed Quoll (if present). The subject site is located at the terminal end of this patch of habitat and does not, in itself, comprise an important connecting linkage. The proposal involves construction of structures that would partially obstruct movement of fauna and/or increase the risk or energy costs of travelling such as cleared open spaces, fences and buildings. These barriers would be parallel to existing, equivalent barriers, including residential fences to the south and Mulgoa road to the east, and would not significantly increase the degree to which habitat is disrupted. Continuous habitat for the local population of the Spotted-tailed Quoll would be maintained around the subject site via the vegetated riparian corridor to the north. The proposal would have a negligible effect on the risk or energy costs of movement. In this context, the proposal would not have an adverse effect on habitat connectivity.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
Habitat for the Spotted-tailed Quoll is present throughout Blue Mountains National Park to the west and other native vegetation in the locality. It is possible that the local population would forage occasionally in the subject site but would not depend solely on these foraging resources. The proposal would remove a very small proportion of available foraging resources: the total area of habitat to be removed (2.75 hectares) is around 0.02 % of the estimated area of similar native vegetation in the locality (around 13,680 hectares, based on Tozer (2010) vegetation mapping, much of which is conserved in national parks). Habitat in the subject site would have even less value than this area suggests as it is adjacent to the village of Mulgoa. The value of this habitat is likely to be reduced because of this context and associated

Spotted-tailed Quoll (*Dasyurus maculatus*) (vulnerable)
noise and light disturbance and risk of vehicle collisions or predation by domestic animals. Similar vegetation that is part of larger patches, with lower perimeter to edge ratios and/or more remote from suburban development is likely to have greater value for the Spotted-tailed Quoll.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
There is no recommended or declared critical habitat of relevance to this assessment (OEH, 2013b).
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
There is no recovery plans for the Spotted-tailed Quoll. OEH (2013b) identifies a number of strategies and associated priority actions to help recover this threatened species. These strategies involve community consultation, research and habitat management. Other than through the removal of habitat addressed in factor d) above, the proposal is broadly consistent with these strategies or else unrelated. Overall the proposal would have a minor, negative effect on the recovery of the Spotted-tailed Quoll.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
The development would contribute to the operation of the following KTPs of relevance to the Spotted-tailed Quoll: Clearing of native vegetation through the removal of 3.55 hectares of native vegetation, including 2.75 hectares of habitat for the species Removal of dead wood and dead trees, through the removal of one stag and moderate quantities of fallen woody debris. The proposal would include measures to at least partially mitigate against the operation of these KTPs including: The salvage of woody debris during construction and reinstatement in retained native vegetation adjoining the subject site. Retention of large trees within residential lots as far as possible within design constraints. These isolated trees would no longer comprise foraging resources for the species but would contribute to the extent and viability of native vegetation in the locality through provision of pollen and seed.
Conclusion of Assessment of Significance
On consideration of the above criteria, the proposal is unlikely to have a significant negative effect on the local population of the Spotted-tailed Quoll.

GHD

133 Castlereagh St Sydney NSW 2000

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T: 2 9239 7100 F: 2 9239 7199 E: sydmail@ghd.com.au

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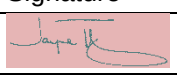
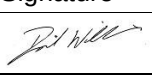
0.	B Harrington/	J Tipping		Dan Williams		28/06/2013
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