Fernhill

Fernhill Central Precinct
Ecology Assessment

December 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 Central Precinct within the Fernhill Estate at Mulgoa, NSW (the 'proposal'). The DA would be submitted to Penrith City Council ('Council') for approval under Part 4 of the NSW *Environmental Planning 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 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Proposal description

1.2.1 Overview

The proposal is one of three proposed development precincts within the Fernhill Estate which are subject to a development application (DA). The proposal includes the following activities within the Central Precinct subject site shown on Figure 1:

- Use of land, existing structures and temporary structures for the use of Events, Functions (Function Centre land use under the *Penrith Local Environment Plan 2010* (LEP).
- Use of land, existing structures and temporary structures for the use an Equestrian Centre comprising agistment, riding training and riding events (An equestrian Centre forms part of Recreation Centre (outdoor) under the LEP).
- Use of land and temporary structures for sporting activities (permanent use of land for this activity forms part of Recreation Centre (outdoor) under the LEP).
- Temporary use of land and existing structures for the purpose of outdoor entertainment.
- Use of land, existing structures and temporary structures for the purpose of a camping ground ancillary to the above uses.
- Use of land, existing structures and temporary structures for the purpose of a market ancillary to the above uses.
- Construction of a third entrance road to the property from Mulgoa Road to allow for safe and efficient movement of traffic during events. This third entrance would be located approximately 75-80 metres south of the existing Hayshed Entrance.

Temporary events within the subject site would include the following activities:

- Site Construction and Event Preparation
  - Demarcation and localised clearing of the site for the event.
  - Establishment temporary infrastructure for the event (stages, seating, stabling, *etc* as required).
  - Installation of environmental controls.
  - Establishment of support infrastructure (car parking, water and aid stations, base / assembly area, *etc* as required).
- Event Operation

  - Use of the site by event participants.
  - Maintenance of temporary infrastructure, environmental controls and support facilities.
- Demobilisation and Rehabilitation
  - Dismantling temporary infrastructure and support facilities.
  - Reinstating removed topsoil and subsoil.
  - Removal of environmental controls.
  - Rehabilitation of exposed surfaces.

1.2.2 Proposed events and activities

The Statement of Environmental Effects (SEE) has been prepared to accompany the DA for the use of the Central Precinct within the Fernhill Estate to hold a variety of activities and events (AE Design, 2013). These events and activities would be held in distinct precincts with the type and scale of activity appropriate to the environment and infrastructure within each precinct. A detailed description of these precincts and planned events and activities is provided within the SEE (AE Design, 2013) and summarised below:

- House and Garden Precinct - The main house and garden area including the Ballroom, Great Hall and gardens would be used to hold short duration events with less than 300 people such as private or corporate functions.
- Farm Buildings and Western Paddocks Area – Open space north and west of the House and Garden Precinct which would be used for parking, and set down and waste management areas associated with the activities proposed in the House and Garden precinct.
- Racetrack Area - An extensive area that could accommodate between 300 and 30,000 patrons with a variety of uses in different areas as follows:
  - Racetrack: for race training, demonstration events, private racing, show jumping, dressage events, training, a marque area and associated amenities for equestrian / recreation activities.
  - Stables Complex: for continued use as a Stables Complex and outdoor recreation facility with temporary structures.
  - Amphitheatre Area: an outdoor entertainment facility and major outdoor recreational facility within a large tract of land forming a natural amphitheatre. Includes several locations for temporary stages for events attended by up to 30,000 patrons and associated car parking areas.
- Hayshed Area - a variety of uses in different areas as follows:
  - The Hayshed - a heritage listed building proposed to be utilised as a function centre. The two buildings that are adjacent to the hayshed are removable demountable buildings that will be used for amenities and preparing food.
  - The Hayshed Lawn area and driveway - utilised as an outdoor area ancillary to the hayshed.
  - Pecan Grove - utilised for camping ancillary to events held within the Central Precinct. The area can accommodate up to 520 people within approximately 260 tents. The area is appropriate for holding markets with up to 100 stalls to be attended by up to 2,500 people.
  - Lake Jessica - to be utilised by private groups for angling purposes.
- Large Athletic Endurance Events - The Central Precinct would be utilised for up to two large endurance athletic activities each year, which may incorporate mountain bike

events or a combination of physical activities. It is proposed that these events utilise similar paths to those which were utilised within the Tough Mudder Event in April 2013.

These precincts and indicative locations for temporary infrastructure and events are shown on Figure 1.

1.2.3 Third entrance construction

A third entrance road to the Fernhill Estate from Mulgoa Road would be constructed to allow for safe and efficient movement of traffic during events. This third entrance would be utilised for regular and larger events proposed within the Central Precinct. This entrance would be located 75-80m south of the Hayshed (northern) entrance access drive. The intention of this alternative access is to improve accessibility to the events and to provide direct and efficient access to on-site parking facilities. The third entrance has been designed to accommodate the majority of site generated events and has been designed to accommodate the majority of site generated traffic. A dedicated right turn bay would also allow full turning movements. This access would be under traffic control during larger events.

1.3 Terms and definitions

The following terms are used in this report:

The proposal: The proposed activities in the Fernhill Central 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 land, existing structures and temporary structures within the Central Precinct subject site shown on Figure 1.

Study area: the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly. In this study it includes the subject site and immediately adjoining areas of native vegetation.

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

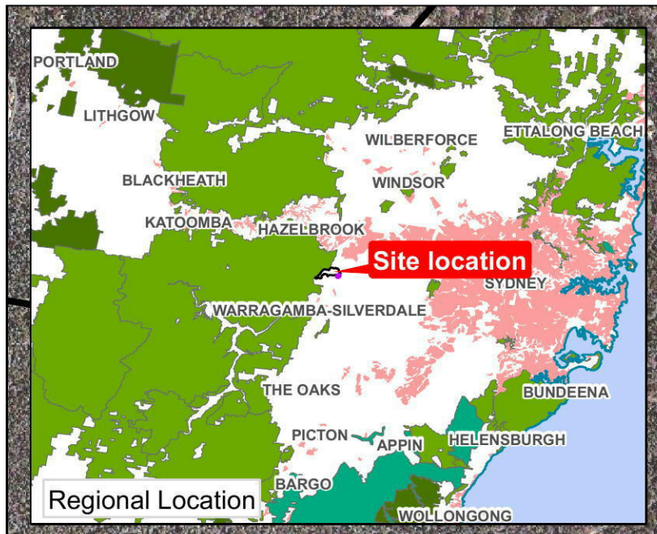
Threatened biota: Threatened species, populations and communities that are listed under the TSC Act, FM Act and/or the EPBC Act.

1.4 Scope of Assessment

The scope of this ecology assessment report is to:

- Describe the existing environment of the study area, including vegetation communities and fauna habitats.
- 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.

- Complete assessments of significance according to the DEWHA (2009) guidelines for MNES 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 MNES or the requirement or otherwise for further assessment or approvals at the State or federal level.



LAKE JESSICA

Hayshed and event facilities

Hayshed entrance

Proposed third entrance

4

Camping/ market

Car parking

Staff parking

2

Fernhill House

1

Car parking

Stage and concert facilities/ car parking

3

Racetrack and equestrian facilities

Potential overflow parking

MULGOA ROAD

Main entrance

LITTLE EFFIELD CREEK

MULGOA

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1:6,500 (at A3)

0 30 60 120 180 240 300

Metres

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

N

Legend

Fernhill site boundary

Central Precinct subject site

Drainage lines and waterbodies

1 - House and garden
2 - Farm buildings & western paddocks
3 - Racetrack precinct (& amphitheatre)
4 - Hayshed precinct

INO Angas Securities Ltd
Fernhill Central Precinct
Ecology Assessment

Job Number 22-1670902
Revision D
Date 18 Dec 2013

Subject site location

Figure 1

G:\22\16709\GIS\Maps\2216709_Z003_FernHill_Central_Site_Location_20131217.mxd

Data Source: Geoscience Australia; 250k Data - Jan 2011;ESRI World Imagery: Aerial Imagery, Accessed: 2013; GHD: Vegetation, 20-12-2012. Ecological: Grevillea Locations digitised from hard copy. Created by: cwilson

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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, Population 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. Assessments of significance for MNES considered to have the potential to occur in the study area are included in Appendix C. These assessments conclude that a significant impact is not likely on MNES of relevance to the proposal.

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 or to be affected by the proposal are included in Appendix C. These assessments conclude 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, and ecological communities, and key threatening processes in NSW. Potential impacts on threatened biota must be subject to an impact significance assessment by addressing the seven factors listed under section 5A of the EPA Act (the so called seven-part test). Seven-part tests have been prepared for threatened biota listed under the TSC Act and are presented in Appendix C.

If a significant effect on threatened biota is likely, a Species Impact Statement (SIS) must be completed and submitted with the DA. Impacts on threatened biota listed under the TSC Act are discussed in Section 7. 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.

Impacts on threatened biota listed under the FM Act are discussed in Section 4.4.2 and Section 5 The proposal is considered unlikely to impact on any threatened biota listed under the FM Act (see Appendix A). The proposal does not require specific approvals under the FM 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 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 general intent of the LEP is to conserve and manage the natural environment of the Penrith LGA. The objectives of the LEP and of Clause 5.10 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 and ecological assessments 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.
- GHD (2013) *Fernhill Eastern Precinct Subdivision Ecological Assessment*.
- GHD (2012) *Preliminary Ecology Assessment and 7-part test to support the Development Application (DA) for the proposed Athletic Endurance course (Tough Mudder) at Fernhill NSW*.
- 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 A.

3.2 Field survey

The field survey of the subject site included vegetation mapping and habitat assessment. This ecological assessment did not include targeted, subject site specific ecological surveys because:

- The subject site is predominantly cleared land and exotic grassland
- The proposal does not involve any vegetation clearing or construction of new, permanent infrastructure
- GHD have completed a number of site surveys over the broader Fernhill Estate that have contributed to the understanding of the existing environment for this assessment.

Field surveys that have contributed to this assessment are summarised in Table 1 below.

Table 1 Survey effort

Stage	Date	Survey Technique
'Tough Mudder' DA preliminary survey	11 December 2012	Broad-scale vegetation survey, vegetation mapping, opportunistic fauna and threatened flora observations.
'Tough Mudder' pre-event ecology site visit	21 March 2013	Ecological constraints assessment, opportunistic fauna and threatened flora observations.
Fernhill conservation lands ecological assessment survey	6 and 7 June 2013	Fine-scale vegetation survey and vegetation mapping, 20 m x 50 m BioBanking plot / transects, random meander searches for threatened plants, habitat assessments, opportunistic fauna observations.
Eastern Precinct DA supplementary Cumberland Plain Land Snail survey (GHD, 2013)	20 June 2013	8 hours of active searches for Cumberland Plain Land Snail within the Eastern Precinct study area and other areas of snail habitat in the Fernhill Estate, habitat assessments and opportunistic fauna observations.
Third entrance survey	16 October 2013	One 20 m x 50 m BioBanking plot / transect random meander searches for threatened plants, habitat assessments, opportunistic fauna observations and active searches for Cumberland Plain Land Snail within the footprint for the proposed third entrance to the property from Mulgoa Road.

3.2.1 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.

3.2.2 Habitat assessment

Habitat assessments for threatened plants were undertaken throughout the study area, including observation of geomorphology, soil type, degree of weed infestation, grazing intensity, vegetation type, structure and condition.

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 'poor', 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 (i.e. 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.

3.2.3 Flora sampling

One plot/transect survey was conducted the footprint for the proposed third entrance 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.

All vascular plants (i.e. not mosses, lichens or fungi) observed were recorded on a proforma field data sheet. Each species list was accompanied by a detailed biophysical description, including vegetation structure, soils, geology and geomorphology, habitat and disturbance history. 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.

3.2.4 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 conducted the footprint for the proposed third entrance and adjoining vegetation.

3.2.5 Active searches

Active searches of woody debris and other ground litter were conducted throughout the the footprint for the proposed third entrance, 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.

3.3 Survey Limitations

This ecological assessment did not include targeted, subject site specific ecological surveys beyond the footprint for the proposed third entrance. 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. This approach is considered appropriate to the habitats present and landscape context and to the proposal, which does not involve any vegetation clearing or construction of new, permanent infrastructure aside from the footprint for the proposed third entrance. The footprint for the proposed third entrance includes native vegetation and habitat resources and so this area has been directly surveyed (see Table 1 and description of survey effort above).

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 2.

Table 2 Staff qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Ben Harrington	Senior Ecologist / site surveys and reporting	BSc, MSc (Physical Geography) BioBanking Assessor Accreditation	8+ years
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 Central Precinct at Fernhill is the proposed location for the use of existing infrastructure and temporary events at the subject site (see Figure 1). 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 Mulgoa Road and rural-residential land on the outskirts of Mulgoa village.
- North and west by near-intact native vegetation within the Fernhill Estate that has historically been grazed and will be set aside for biodiversity conservation. This land adjoins an extensive area of native vegetation in the Blue Mountains National Park.
- South by the proposed Fernhill Eastern Precinct subdivision (GHD, 2013) and private rural-residential land on the outskirts of Mulgoa village.

Access to the subject site is via Mulgoa Road at two separate entry points, the main (southern) entrance road and Hayshed (northern) entrance road.

The subject site shown on Figure 1 includes four separate sub-precincts:

1 - House and garden, which includes the main house of the Fernhill estate, additional accommodation, garages, landscaped gardens and stables

2 - Farm buildings and western paddocks, which includes fenced paddocks containing exotic grassland, garages, stables, stores and construction laydown areas

3 - Racetrack precinct (and amphitheatre), which includes fenced paddocks containing exotic grassland, patches of remnant native woodland, drainage lines and waterbodies, an equestrian centre, stores and a racetrack

4 - Hayshed precinct, which includes fenced paddocks containing exotic grassland, patches of remnant native woodland, an exotic tree plantation and a functions centre (the hayshed). Land adjacent to Lake Jessica is also an extension of the Hayshed Precinct for picnics and future investigation.

Figure 1 shows the indicative locations of events that would be held in these precincts and associated temporary infrastructure.

All four sub-precincts are serviced by a network of sealed roads and unformed access tracks.

The subject site is approximately 2 km to the east of the Nepean River and lies on the northern edge of the village 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

Drainage lines and water bodies in the study area are shown on Figure 2. The subject site is bound to the south by Littlefield Creek, and to the north by an un-named tributary of Mulgoa Creek, which in turn drains to the Nepean River. The subject site is dissected by unnamed first and second order drainage lines which have been dammed at multiple points to create water storage for livestock. All drainage lines and water bodies contained water at the time of the site visits, and supported varying degrees of in stream and riparian vegetation. The extent of such vegetation is limited to the area directly around the water bodies, which are clearly artificial, and so were not discriminated from the surrounding vegetation communities.

Figure 2 includes a desktop assessment of riparian corridors. The proposal would exclude activities from these areas as described in Section 6.1.

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 and vegetation communities

4.2.1 Overview

Over 100 species of flora from around 50 families have been recorded within the study area and similar vegetation in adjoining areas (GHD, 2013). No threatened flora species have been

recorded. Characteristic plant species are discussed below in relation to the vegetation communities occurring within the study area.

Vegetation mapped within the study area is shown on Figure 2 and described below. Three distinct vegetation communities have been identified in the subject site based on vegetation types and broad condition classes and are summarised in Table 3 and described below. The Fernhill Estate contains a number of other vegetation communities which are shown for context on Figure 2 but are not described in detail in this report.

Table 3 Vegetation communities in the subject site

Vegetation Community	Condition (DECC, 2008)	Area in Subject Site (ha)	Conservation Significance	Area within locality[a] (hectares)
Grey Box - Forest Red Gum grassy woodland on flats	Moderate/good	7.57	CEEC listed under the TSC Act and EPBC Act (Cumberland Plain Woodland)	14833[b]
Forest Red Gum - Rough-barked Apple grassy woodland	Moderate/good	0.39	EEC listed under the TSC Act (River-Flat Eucalypt Forest)	6215[c]
Cleared land / exotic grassland	Cleared	105.91		
Total Native Vegetation		**7.96**		**137,140**
Total All Vegetation		**113.87**		

Notes

* Threatened Ecological Community

a = based on NPWS (2002) vegetation mapping.

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

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

Native vegetation within and adjoining 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 EPBC Act.

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. This vegetation includes isolated paddock trees that are remnants of adjoining native woodland and forest, as well as planted avenues of indigenous native trees. Both remnant and planted trees have considerable conservation significance as habitat trees as well as visual amenity and heritage value.

Grey Box - Forest Red Gum grassy woodland is associated with mid slopes, on shale derived soils. The condition of this vegetation community varies across the subject site as a result of previous land uses and grazing intensity, as well as potential impacts associated with edge effects. Areas that have been historically cleared and, as a result of easier access for cattle, heavily grazed, now contain regrowth vegetation in lower condition.

Grey Box - Forest Red Gum grassy woodland grades into Forest Red Gum - Rough-barked Apple grassy woodland on lower slopes and flats 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 lower 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 are a number of dams and flooded depressions throughout the subject site (mapped as 'water bodies' on Figure 2). These water bodies have been formed by the construction of barriers across small drainage lines. They are clearly not natural geomorphic features and so do not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains'. These water bodies contain 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*). Two of the larger water bodies in the central portion of the subject site are surrounded by a dense strip of Swamp Oak (*Casuarina glauca*). In this context these trees have almost certainly been planted as a visual screen or for bank stability and do not comprise a local occurrence of the EEC 'Swamp Oak Floodplain Forest'.

The study area has been grazed and canopy vegetation has been extensively 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. There are patches of sub-mature regrowth dominated by *Acacia* species with no native overstorey. Notwithstanding the immaturity of most patches of woodland vegetation, mature hollow-bearing trees are relatively abundant across the subject site. Hollow-bearing trees occur as occasional remnants in patches of woodland or forest, isolated paddock trees in exotic grassland and frequently as planted or retained avenues along the two existing entrance roads to the subject site.

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

4.2.2 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 as remnant patches on midslopes of the subject 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 sparse open mid-storey contains occasional Black Thorn (*Bursaria spinosa*), Black Wattle (*Acacia decurrens*) and scattered patches of Lantana (*Lantana camara*). Mid-storey vegetation appears

to have been suppressed by grazing in most areas. The groundcover is dominated by exotic pasture species. Native groundcover consists of occasional patches of native grasses such Kangaroo Grass (*Themeda australis*), Weeping Meadow Grass (*Microlaena stipoides*), and Bordered Panic (*Entolasia marginata*) and herb or forbs such as Kidney Weed (*Dichondra repens*), Commelina (*Commelina cyanea*), *Lomandra gracilis*, *Glycine clandestina,* and Indian Pennywort (*Centella asiatica*) in less intensively grazed areas such as around tree trunks.

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

Grey Box - Forest Red Gum grassy woodland within the footprint for the proposed entrance road was sampled with a BBAM plot/transect. The results of this survey are included in Appendix B. These data indicate that the Grey Box - Forest Red Gum grassy woodland is in moderate/good – poor condition according to the BBAM with: below benchmark values for overstorey cover and species richness; very low to nil mid storey, shrub and forb cover; no hollow bearing trees; and no fallen logs (see Appendix C). Further, these data are only from the first 30 metres of the transect which is the maximum width of the disturbance footpint. The remaining 20 metres was located in exotic grassland with negligible native plant cover.

4.2.3 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*).

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

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*).

4.2.4 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 usitatus* and Red Leg Grass (*Bothriochloa macra*).

This community includes patches of planted and opportunistic trees and shrubs including:

- A plantation of the exotic ornamental tree *Zelkova serrata* in the hayshed sub-precinct

- Strips of Swamp Oak (*Casuarina glauca*) around water bodies in the racetrack sub-precinct
- Non-indigenous natives such as Silky Oak (*Grevillea robusta*), Brush Box (*Lophostemon confertus*) and White Cedar *(Melia azedarach*), exotic ornamental trees and garden plants in the house and gardens sub-precinct
- Remnant Grey Box (*Eucalyptus moluccana*), Rough-barked Apple (*Angophora floribunda*) Forest Red Gum (*Eucalyptus tereticornis*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) paddock trees throughout
- Planted Rough-barked Apple along the main (southern) entrance road and Narrow-leaved Ironbark along the Hayshed (northern) entrance road.

The mapped area of this community includes buildings, fences and hardstand areas such as driveways. There are also extensive areas of compacted earth with very little groundcover associated with the race track, stables and equestrian activities.

Threatened species (GHD 2013)

- Cumberland Plain Land Snail
- Glossy Black-cockatoo
- Varied Sitella
- Cumberland Plain Land Snail

Vegetation type

- Coastal freshwater wetland
- Grey Myrtle dry rainforest
- Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland
- Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest
- Red Bloodwood - Grey Gum woodland
- Red Bloodwood - scribbly gum heathy woodland
- Turpentine - Smooth-barked Apple moist shrubby forest
- Forest Red Gum - Grey Box shrubby woodland
- Forest Red Gum - Rough-barked Apple grassy woodland
- Grey Box - Forest Red Gum grassy woodland

1
2
3
4

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1:8,500 (at A3)

0 30 60 120 180 240 300

Metres

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

N

Legend

- Fernhill site boundary
- Central Precinct subject site

Designated Riparian Corridors*

1 - House and garden
2 - Farm buildings & western paddocks
3 - Racetrack precinct (& amphitheatre)
4 - Hayshed precinct

- Stream order 1 riparian corridor (20m)
- Stream order 2 riparian corridor (40m)
- Drainage lines and waterbodies

*stream classifications and riparian corridors have been mapped based on desktop assessment only.

INO Angas Securities Ltd
Fernhill Central Precinct
Ecology Assessment

Job Number	22-1670902
Revision	C
Date	18 Dec 2013

Vegetation, threatened species and riparian corridors

Figure 2

G:\22\16709\GIS\Maps\2216709_Z001_FernHill_Central_Vegetation_Riparian_revised.mxd

Data Source: Geoscience Australia; 250k Data - Jan 2011;ESRI World Imagery: Aerial Imagery, Accessed: 2013; GHD: Vegetation, 20-12-2012. Ecological: Grevillea Locations digitised from hard copy. Created by: cwilson

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4.2.5 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 at least six species declared as noxious weeds in the Penrith LGA, as shown in Table 4 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. 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 4 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 europea 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
Rubus fruticosus aggregate species	Blackberry	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence

Scientific Name	Common Name	Control category	Legal Requirements
			and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed

4.3 Fauna and habitats

4.3.1 Fauna species

Over 70 species of fauna have been recorded within the study area and similar vegetation in adjoining areas (GHD, 2013). No threatened fauna species have been recorded in the subject site; however the following threatened species have been recorded in adjoining land:

- 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 Glossy Black-cockatoo (*Calyptorhynchus lathami*) which is listed as a vulnerable species under the TSC Act.

Records of threatened fauna species are shown on Figure 2.

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

Birds

The majority of bird species observed are common woodland bird species often seen in semi-urban bush remnants around Sydney. Bird species diversity and abundance were higher within relatively intact vegetation in the far south and west of the subject site. Exotic grassland and cleared land in the racetrack sub-precinct and 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*).

A group of seven Varied Sitellas were observed foraging in Grey Box – Forest Red Gum grassy woodland in the Eastern Precinct approximately 500m south east of the subject site.

Mammals

Microbat species of forest and woodland would occur in the study area including 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 could also forage in the study area.

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 although not positively identified, are likely to indicate the presence of wallabies (*Wallabia* spp.) in addition to Eastern Grey Kangaroos.

Common Brushtail Possums (*Trichosurus vulpecula*) have been observed 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*), Rusa deer (*Cervus timorensis*) and Horses (*Equus ferus caballus*.) are grazed 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. 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

The Cumberland Plain Land Snail (*Meridolum corneovirens*) has been recorded in the Fernhill Eastern Precinct and at other locations in the Fernhill Estate (see Figure 2). 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). This species may occur in denser patches of woodland and forest in the broader study area but is unlikely to occur in the majority of the subject site due to: the scarcity of woody debris or other shelter sites; prevalence of exotic pasture; and grazing and trampling of understorey vegetation by livestock.

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 is 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 grazing land. These areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture.

Exotic grassland and cleared land 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 and north in the Fernhill Estate and other rural residential blocks with limited clearing. It is unlikely that any local populations of native fauna would be reliant on the exotic grassland on the subject site for their survival.

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 provide moderate quality fauna habitats. Habitat resources include: mature canopy trees and associated nectar, fruits and leaves as well as foraging substrate; a range of fruiting and flowering small trees and shrubs; and connectivity with wetland and aquatic habitat.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 equestrian activities on site, Mulgoa village and Mulgoa road. Based on these attributes, this vegetation would be expected to support a moderate diversity of native fauna. A number of threatened fauna species may use the subject site on an occasional or opportunistic basis. These species are not likely to reside in the subject site on a permanent basis or to rely on habitat resources within the subject site.

The subject site and broader study area contains moderate quantities of pre-European age trees, including hollow bearing habitat trees and stags. Notably there are a number of mature, hollow-bearing Rough-barked Apple (*Angophora floribunda*) along the main entrance road. Hollow-bearing trees in the subject site may provide nest sites for parrots, such as the Rainbow Lorikeet (*Trichoglossus haematodus*). Given the size and location of these tree hollows they would be 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).

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. Forest Red Gum is a Koala food tree listed under Schedule 2 of SEPP 44 and is a regional primary food trees identified in the Koala Recovery Plan.

Two Glossy Black-cockatoos (*Calyptorhynchus lathami*) were observed flying over the study area (see Figure 2). Glossy Black-cockatoos feed almost exclusively on the fruits of a few species of *Casuarina and Allocasuarina* and feed, roost and breed in vegetation with high concentrations of these foraging resources (OEH, 2013c). There is no suitable foraging habitat for this species in the study area. The population of the Glossy Black-cockatoo in the locality would forage and probably also breed in sandstone forest types in the western portion of the Fernhill Estate and the Blue Mountains National Park.

The shrub and ground layer vegetation and habitat features of the woodland and forest in the subject site have been removed and 'cleaned up' for grazing and contains poor quantities of woody debris and leaf litter. There is relatively little shelter and foraging substrate for native reptiles, frogs and invertebrates including the Cumberland Plain Land Snail.

Drainage line and wetland habitats

Drainage lines and waterbodies are shown on Figure 2. Littlefield Creek is a small, second order drainage line running to the south of the subject site. There is another unnamed second order drainage line to the north of the subject site. Both drainage lines feature near-intact geomorphology and good instream 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. Both creeks contain pools of surface water up to 30 cm deep. Given the slight slope and heavy clay soil, these creeks are 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 (*Litoria lesueuri*).

The racetrack sub-precinct contains a number of first and second order drainage lines. These creeks are poorly defined and surrounded by exotic grassland. They feature highly modified geomorphology including dammed sections, very little instream and riparian vegetation, moderate to severe weed infestation and extensive degradation by livestock such as grazing, bank erosion, increased turbidity and probably also nutrient enrichment from waste. These drainage lines combine to form a third order drainage line in the eastern portion of the racetrack sub-precinct. This reach is in better condition and features a vegetated riparian corridor with similar attributes to Littlefield Creek as described above.

Littlefield Creek and these other small drainage lines are not suitable habitat for any of the threatened frogs with the potential to occur in the locality, which are all associated with clear, rocky streams located on sandstone substrates higher in the catchment.

There are a number of dams and flooded depressions in the subject site with varying growth of native wetland plant and aquatic plants. There are no extensive reed beds. A moderate diversity and abundance of native waterfowl, waders and other wetland birds were observed in these water bodies. Given their context, lack of extensive reed beds and presence of livestock they are unlikely to provide foraging habitat for threatened wetland birds such as the Australasian

Bittern (*Botaurus poiciloptilus*) or Australian Painted Snipe (*Rostra Tula australis*). Common, generalist frogs and reptiles have been recorded in these waterbodies including the Common Eastern Froglet, Brown-striped Frog and Eastern Water Skink. They 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 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 equestrian activities and 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. 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 subject site is positioned at the end of this network of habitat with connectivity severed to the east by extensively cleared rural residential land and Mulgoa Road. Fauna movement and other ecological processes would occur around the subject site via the vegetated riparian corridor to the north and the Littlefield Creek corridor to the south. Patch-size dependant species of fauna 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 the CMA sub-region surrounding 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.

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 subject site 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 by GHD and EcoLogical (2010). EcoLogical (2010) recorded the Juniper-leaved Grevillea in the Fernhill Western Precinct around 3km to the west of the subject site. 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 in the subject site for this assessment.

The Spiked Rice-flower is known to be difficult to detect when not flowering and may persist in grazed native vegetation (OEH, 2013c). 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

Three threatened fauna species have been recorded near the subject site during recent GHD field surveys:

- Varied Sittella (*Daphoenositta chrysoptera*) which is listed as a vulnerable species under the TSC Act.
- Glossy Black-cockatoo (*Calyptorhynchus lathami*) 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.

The Varied Sittella and Cumberland Plain Land Snail were recorded within Grey Box - Forest Red Gum grassy woodland and Forest Red Gum - Rough-barked Apple grassy woodland as shown in Figure 2. The Glossy Black-cockatoo was recorded flying over the study area.

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). The Varied Sittella would be unlikley to breed and forage in the subject site because it contains only fragmented patches of woodland with little understorey vegetation.

A total of 33 live Cumberland Plain Land Snail individuals or shells have been recorded in the Fernhill Eastern Precinct study area and elsewhere on the Fernhill Estate (GHD, 2013). 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 (B Harrington *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, 2013b) and around 2100 hectares of suitable habitat in shale woodlands or forest based on regional vegetation mapping (Tozer 2010). There is relatively poor habitat for the Cumberland Plain Land Snail in the subject site because the woodland contains little native understorey vegetation or shelter sites.

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*)."

The subject site contains poor quality habitat for these mobile threatened fauna species given the extent of cleared land, fragmented native vegetation patches and ongoing grazing and equestrian activities. 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 broader study area on a transitory or opportunistic basis. Since the proposal would be restricted to the use of exsiting infrastructure and/or temporary events held within disturbed, cleared land, none of these mobile threatened fauna are likely to occur in the subject site or be affected by the proposal.

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 A).

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 World Heritage Area, is 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. Only a small proportion of thesubject site has been sampled with plots and so all mapped stands of this

community are assumed to meet the condition thresholds for inclusion as the EPBC Act-listed CEEC.

No other threatened ecological communities listed under the EPBC Act are present in the subject site.

Threatened flora

No threatened flora species listed under the EPBC Act were recorded within the subject site. Based on the site surveys and habitat assessments conducted one threatened flora species may occur in the subject site 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 no threatened fauna MNES are likely to occur in the study area and/or be affected by the proposal.

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 has been recorded in the subject site: the Cattle Egret (*Ardea ibis*) which was observed foraging in moist grassland. Each of the predicted species listed above may occur in the study area on occasion.

The EPBC Act lists migratory species that are 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.

5. Potential Impacts

5.1 Direct impacts

5.1.1 Vegetation clearing and habitat removal

The proposal would require the removal of around 300 square metres (0.03 hectares) of native vegetation for construction of the proposed third entrance. The footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. The native vegetation to be removed is 'Grey Box - Forest Red Gum grassy woodland on flats' (HN528; OEH, 2013a) which is part of a local occurrence of Cumberland Plain Woodland. The Cumberland Plain Woodland that would be removed is approx. 0.002 % of the total estimated area of that community in the locality (around 1,480 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 approx. 65 hectares within the Fernhill Estate and 74 hectares within the nearby Mulgoa biobank (GHD, 2012) that would be set aside for conservation. There is approx. 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 Appendices C and D provide a detailed assessment of significance of impacts on Cumberland Plain Woodland.

As described in Section 4.2.2 and Appendix C the footprint of the entrance road contains woodland in poor condition. The clearing of around 300 square metres of native vegetation in poor condition would involve the removal of a moderately diverse range of non-threatened native plants, including two mature trees (200-300mm diameter at breast height – DBH) and a further four sub-mature trees (<200mm DBH). Mature trees have value within plant populations as sources of pollen and seed. There are no hollow bearing trees or other notable habitat resources in the disturbance footprint.

The vegetation that would be removed potentially provides some habitat resources for native fauna species, including a known local population of the Cumberland Plain Land Snail. The targeted survey of the footprint of the proposed third entrance road did not reveal any snails nor any notable shelter sites such as logs or woody debris. The disturbance footprint contains some foraging substrate for the the Cumberland Plain Land Snail however would comprise a negligible proportion of such resources in the locality, including substantial areas that contain suitable shelter sites such as woody debris.

There are extensive areas of this vegetation community and its component species and habitats in the locality. The total area of native vegetation to be removed (3.55 hectares) is around 0.0002 % 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 and habitat resources would not threaten the persistence of local populations of native species. Flora and fauna populations would persist within adjoining areas of alternative habitat beyond the study area.

The disturbance footprint is within a narrow, fragmented patch 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. Approximately 300 hectares of native vegetation would be

conserved in biobanks within the Fernhill Estate and purposefully managed to improve their condition.

The remainder of the proposal involves the use of existing infrastructure for temporary events that would be located entirely in cleared land and exotic grassland. The proposal would include:

- Use of existing infrastructure.
- Detailed planning and siting of temporary infrastructure to restrict direct impacts to cleared land and exotic grassland.
- Environmental safeguards and mitigation measures, including fencing of adjoining areas of native vegetation or habitat to avoid indirect impacts.

The Tough Mudder event which was held at the Fernhill Estate in early 2013 was assessed and then delivered with a similar approach (GHD, 2012) and did not result in any tangible impacts on the natural environment outside of cleared land and exotic grassland (*pers. obs.*). The proposal would not involve any native vegetation clearing or the permanent removal or modification of any habitat.

The disturbance footprint for events held in the subject site would comprise only 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 impacts on vegetation in these areas through placement of temporary infrastructure or traffic would remove a small number of individuals of non-threatened native plants and noxious and environmental weeds.

The area that would be directly affected by the proposal provides very limited habitat resources for native fauna species, including threatened species of fauna. Construction of temporary infrastructure and public visitation during events would temporarily remove foraging resources and/or restrict access to habitat in exotic grassland. This exotic grassland habitat would be occupied by common and generalist species of native fauna such as the Eastern Grey Kangaroo and bird species of open country. These species are common, widespread and adaptable and are unlikely to rely on habitat within the subject site. They would not be significantly affected by occasional, short term impacts on these habitats.

The proposed events may result in minor, indirect impacts on known local populations of two threatened fauna species, the Varied Sittella and Cumberland Plain Land Snail. The proposed events may remove some habitat resources for these two species in exotic grassland adjoining native woodland and there may be occasional indirect impacts on their woodland habitat (see Section 5.2 below).

The broader Fernhill Estate contains suitable foraging habitat and potential breeding habitat for a number of threatened fauna species of forest, woodland and wetland habitats. 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 would have a negligible impact on local populations of threatened biota.

5.1.2 Aquatic habitats

There is some moderate quality wetland, riparian and aquatic habitat in the subject. All of these areas are included in mapped riparian corridors as shown on Figure 2. Temporary events would be entirely excluded from these riparian corridors. There are also 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 south. 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 some 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 the proposed activities. Construction of the proposed third entrance or of temporary infrastructure for events 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 the subject 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. Fenceing of native vegetation is 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 habitat for the Cumberland Land Snail that would be removed for construction of the proposed third entrance is approximately 0.002 % of the total estimated area of equivalent vegetationin the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The proposed events would potentially risk harm to a small number of snails (if any) that may be resident in exotic grassland or fragmented woodland out of around 112 hectares of better quality woodland habitat in the Fernhill Estate and over 1,480 hectares in the locality (Tozer, 2010).

The proposal would result in a minor increase in the overall volume of traffic in the locality and occasional short term but greater magnitude increases in traffic volumes associated with major events. This would have a minor effect on the risk of vehicle collisions with native fauna given:

- That events would be held in daylight hours and in cleared land and exotic grassland
- That event-traffic would be subject to speed restrictions
- The existing volume of traffic on Mulgoa Road
- That the subject site adjoins the edges of vegetated corridors and is not likely to be a fauna movement corridor (see Section 4.3.2).

5.2 Indirect impacts

5.2.1 Habitat fragmentation

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 edge 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.

Construction of the third entrance road would clear approx. 300 metres squared of native vegetation and create a gap in habitat a maxium of 12.5 metres wide. Fauna movement and other ecological processes would continue across this minor gap in habitat. In the context of the partially cleared and developed land in the locality this would comprise a very minor increase in the degree of habitat fragmentation.

The proposed events involve construction of temporary structures that may obstruct movement of fauna attempting to travel through the study area, such as fences, toilets or seating. These barriers would be parallel to existing, equivalent barriers, including livestock fences around and within the entire subject site and Mulgoa road to the east. These structures 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 corridors to the north and south.

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. 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 drainage lines through the racecourse sub-precinct and livestock access. The proposal would result in minor, temporary increases in the proportion of hardstand surfaces in the study area. 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.

The proposal 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 visitor shoes, clothing or vehicles.

The proposal involves the removal of a small area of native vegetation in an area that already contains fragmented vegetation remnants and would therefore not constitute a novel impact. The severity of impacts arising from edge effects and weed invasion would be limited by the

presence of existing disturbance and would be considerably less than in an undisturbed 'green field' site. All vegetation within the subject site and broader study area already adjoins cleared land dominated by exotic plants.

An EMP with a vegetation management sub-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 because visitors are unlikely to have arrived after visiting other areas of native vegetation.

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. The equestrian facilities in the subject site are already operational and routinely involve vehicle and horse traffic and lighting. Habitats adjacent to the subject site therefore already experience noise, light and vibration disturbance. The proposal may increase traffic flow though this is likely to have a minor impact given the current residents and employees at Fernhill, the population of the village of Mulgoa and the volume of through traffic on Mulgoa Road. As described in Section 5.1.3 the risk of additional fauna injury or mortality is low.

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 comprises a continuation and intensification of activities within the subject site. 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. There would be some cumulative impacts associated with construction of the third entrance road, installation of temporary infrastructure, increased visitation to the site and associated increased traffic, noise, light and potentially impacts on soil and water.

Mitigation measures are proposed to ameliorate each of these potential cumulative impacts and are included as Section 6. Notably fenceing and management of native vegetation during events is proposed to mitigate against additional degradation of intact native vegetation and habitat in the study area.

Cumulative impacts arising from the proposal are likely to be very minor and would not 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 5 below. Mitigation measures to limit the impacts of these KTPs are discussed in Section 6.

Table 5 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 involves the clearing of around 300 square metres of native vegetation which would comprise a negligible increasein the operation of this KTP.
Clearing of hollow-bearing trees	TSC Act	Clearing of hollow-bearing trees has occurred historically within and around the study area. The proposal does not involve the clearing of any native vegetation or removal of any hollow-bearing trees and would not increase the operation of this KTP.
Removal of dead wood and dead trees	TSC Act	There are occasional fragments of dead wood and standing dead habitat trees in the subject site that would provide habitat resources for native fauna. The proposal does not involve the clearing of any native vegetation or removal of any woody debris and would not increase 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 moderate infestation. Native vegetation would be fenced and excluded from temporary construction areas or public access. 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 earthworks, damming of drainage lines, clearing for agriculture and surrounding suburban development. Aquatic habitat within the subject site would be fenced and excluded from temporary construction areas or public access. 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

KTP	Status	Comment
		on native vegetation. Native vegetation would be fenced and excluded from temporary construction areas or public access. Vegetation within the study area is fragmented and grazed and so the proposal is highly unlikely to result in novel impacts. 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. Native vegetation would be fenced and excluded from temporary construction areas or public access. Vegetation within the study area is fragmented and grazed and so the proposal is highly unlikely to result in novel impacts. 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 or public access have the potential to introduce amphibian chytrid to the study area, which could lead to death of local frogs. Aquatic habitat within the subject site would be fenced and excluded from temporary construction areas or public access. Vegetation within the study area is fragmented and grazed and so the proposal is highly unlikely to result in novel impacts. The proposal is unlikely to increase the operation of this KTP.

6. Mitigation Measures

The proposal involves the use of existing infrastructure for activities and construction of temporary infrastructure for events in disturbed cleared land. The proposal is unlikely to result in direct impacts on native biota and their habitats because native vegetation and habitat within the subject site would be fenced and excluded from temporary construction areas or public access. There is the potential for impacts on habitat outside the disturbance area during construction and during the longer-term use of the subject site for events. Specific mitigation measures are recommended to minimise such impacts on the natural environment.

The following sections detail the avoidance of impacts and mitigation measures recommended for the proposal. No biodiversity offset contributions would be required for the proposal because it does not involve the removal or modification of native vegetation or habitat or any other notable impacts on native biota.

6.1 Avoidance of impacts

The proposal is a continuation and slight intensification of activities in the Fernhill Estate. The majority of the subject site falls within land which is extensively modified by existing activities. The subject site is located at the edge of a vegetated corridor and would not increase the degree of habitat fragmentation or indirect effects on remnant vegetation in the study area. 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.

The alignment of the third entrance road has been purposefully selected to avoid impacts on Cumberland Plain Woodland as much as possible. The alignment is in a relatively narrow portion of the vegetated strip adjoining Mulgoa Road and does not contain any hollow-bearing trees or trees over 300mm DBH.

The proposal would further avoid impacts on native biota through:

- Supplementary ecological survey and constraints assessment prior to individual events.
- Identification of native vegetation and other no-go areas.
- Fenceing of no-go areas and exclusion of temporary construction and public access.

Native vegetation in the subject site is already substantially demarcated from cleared land and exotic grassland by existing stock fencing (pers. obs.).

The Tough Mudder event which was held at the Fernhill Estate in early 2013 was assessed and then delivered with a similar approach (GHD, 2012) and did not result in any tangible impacts on the natural environment outside of cleared land and exotic grassland (pers. obs.). The proposal would not involve any native vegetation clearing or the permanent removal or modification of any habitat.

6.2 Mitigation of impacts

6.2.1 Planning phase

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

- Identifying and mapping of ecological constraint across the entire Central Precinct and restricting activities to areas of lower constraint (noting that the Central Precinct subject site that is the subject of this assessment contains predominatly low constraint lands).
- Documentation and communication of environmental values and constraints in the study area.

6.2.2 Environmental Management Plan

An Environmental Management Plan (EMP) would be required for construction of temporary infrastructure for the proposal. The EMP 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 EMP should be prepared and implemented by the contractor. The proposed measures would include environmental safeguards developed with reference to:

- The Development Approval that would be issued by Penrith City Council.
- The Statement of Environmental Effects (SEE) and this ecology assessment prepared for the proposal.
- Guideline for the Preparation of Environmental Management Plans (DIPNR, 2004).
- AS/NZS ISO 14001:2004 - Environmental Management Systems.
- Relevant NSW and Commonwealth legislation.

The EMP is the key management tool and lead environmental management document in relation to environmental performance during the construction, operation and rehabilitation of the subject site.

The objectives of the EMP would be to:

- Meet the conditions of the Development Approval related to environmental management;
- Comply with the requirements of relevant NSW and Commonwealth legislation; and
- Implement environmental controls and mitigation measures to adequately manage environmental risks.

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

- An erosion and sediment control sub-plan, which would require:
  - Installation of erosion and sediment control measures
  - 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
  - Bare earth would be revegated as soon as practicable after events to minimise the time that bare earth is exposed to erosion.
- A vegetation management sub-plan (VMP), which should include (but not be limited to) the following:
  - Delineation and protection of exclusion zones around native vegetation
  - Communication with construction and events 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 fauna management sub-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-event ecological constraints surveys should be undertaken by a qualified ecologist, and the required methodology and targeted species should be developed as part of the EMP. Surveys should include:

- Clear marking/erection of exclusion fencing around protected vegetation areas and delineation of 'no-go' areas
- Targeted pre-construction surveys in accordance with the Cumberland Plain Land Snail protocol. Pre-construction surveys would include targeted searches of thefootprints for any temporary infrastructure required for eventsand 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.
- Supplementary targeted surveys for the Spiked Rice-flower, during the known flowering period to determine whether the species is present in the study area and define any 'no-go' areas around resident populations (if present)
- Inspections of trees for other resident fauna and/or nests or other signs of fauna occupancy
- Inspection and identification/marking of hollow-bearing trees or roost 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 EMP
- 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.

The suite of threatened biota potentially relevant to this assessment is presented in Appendix A, along with the nature of any previous records in the locality and an assessment of the likelihood of occurrence in the subject site or being affected by the proposal. Based on the targeted surveys and habitat assessments undertaken, a number of the threatened biota presented in Appendix A 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 6 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. The results of the assessments of significance for guilds of affected threatened biota are described below.

Table 6 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
Spiked Rice-flower	*Pimelea spicata*	E	E
Cumberland Plain Land Snail	*Meridolum corneovirens*	E	

7.2 Threatened ecological communities recorded on site

Assessments of significance of impacts on on the local occurrences of Cumberland Plain Woodland and River Flat Eucalypt Forest have been prepared pursuant to s.5A of the EPA Act (see Appendix B). The outcome of these assessments is that the proposal would not have a significant effect on these TECs, given:

- Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (around 1,480 hectares, based on Tozer (2010) vegetation mapping).
- The proposed events would not permanently remove or modify any native vegetation or otherwise threaten the viability or persistence of these TECs in the locality or the region.
- Mitigation measures in accordance with an EMP are proposed to ameliorate potential indirect impacts, notably including fenceing and exclusion of activities from native vegetation during events.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 these TECs.

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 effect on the Spiked Rice-flower, given:

- Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of habitat for the Spiked Rice-flower in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping).
- The proposed events would not permanently remove or modify any native vegetation or otherwise threaten the viability or persistence of the species in the locality or the region.
- Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of individual plants (if present) within vegetation in the subject site (which is unlikely).
- There is around 1,480 hectares 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.
- Mitigation measures in accordance with an EMP are proposed to ameliorate potential indirect impacts, notably including fenceing and exclusion of activities from native vegetation during events.
- 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 species.

7.4 Threatened fauna that may potentially occur

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 effect on the Snail, given:

- Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of habitat for the Spiked Rice-flower in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping).
- Potential impacts of the proposal on the life cycle of the species would be restricted to the injury or mortality of individual snails (if present) within native vegetation in the subject site (which is unlikely).
- There is around 1,480 hectares of potential habitat for the Cumberland Plain Land Snail 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 proposal 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.

7.5 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 MNES

An assessment of significance of impacts on on the local occurrence of Cumberland Plain Woodland has been prepared pursuant to the DEWHA (2009) guidelines (see Appendix C). The outcome of this assessment is that the proposal would not have a significant effect on Cumberland Plain Woodland.

'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 broader 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 was identified:

- River-Flat Eucalypt Forest EEC, which is present in the subject site.
- Cumberland Plain Woodland CEEC, 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 broader Fernhill Estate and locality.

Assessments of significance for these threatened biota have been prepared pursuant to s.5A of the EPA Act and conclude that the proposal is not likely to have a significant effect on the local populations of any threatened biota given:

- Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping).
- The proposed events would not permanently remove or modify any native vegetation or otherwise threaten the viability or persistence of threatened biota in the locality or the region.
- Potential impacts of the proposal on the life cycle of threatened biota would be restricted to the removal of 300 square metres of Cumberland Plain Woodland and a small number of individual threatened species (if present) within native vegetation in the subject site (which is unlikely).
- There are extensive areas of habitat for threatened biota in the locality. The minor magnitude of impacts associated with the proposal would not threaten the viability or persistence of the species in the locality or the region.
- Mitigation measures in accordance with an EMP are proposed to ameliorate potential indirect impacts, notably including fenceing and exclusion of activities from native vegetation during events.
- 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 any threatened biota.

A Species Impact Statement is not required for the proposal.

The subject contains a number of MNES and/or their habitats. Based on the impact assessments and assessments of significance included in this report the proposal is not likely to have a significant impact on any MNES.

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.*

GHD otherwise disclaims responsibility to any person other than Fernhill arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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.

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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 - Threatened Biota Assessment

Threatened ecological communities 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
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
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

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site
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 torulos*a over a low, open shrub layer and an understorey of grasses, herbs and ferns.	Known within 10km (OEH 2013a)	Not present
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
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 E*ucalyptus 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 by *Bursaria spinosa*, and grasses such as *Themeda australis* and *Microlaena stipoides var stipoides*.	Known within 10km (OEH 2013a)	Present
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney	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	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
Basin and South East Corner Bioregions	Basin and South East Corner Bioregions			regime, though is usually dominated by herbaceous plants and has few woody species.		
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 parramattensis are also common. The shrub layer includes *Breynia oblongifolia*, *Hairy Clerodendrum Clerodendrum tomentosum and* Indian Weed *Siegesbeckia orientalis ssp orientalis*.	Known within 10km (OEH 2013a)	Not present
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
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 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.	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
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
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	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
				River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick.		
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
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 2013).	Known within 10km (OEH 2013a)	Not present
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

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site
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
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
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 layer combines with vines to form dense thickets in sheltered locations.	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
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 (DSEWPA C 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 (DSEWPA C 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)	Unlikley	Suitable habitat present within the Fernhill estate but not the subject site.
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)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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 leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm)	20 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
				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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high	18 records within 10km (OEH 2013a); Recorded within study area (Birdata 2013)	Present	Suitable habitat present within the Fernhill estate but not 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
				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 tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar	2 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
				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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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	8 records within 10km (OEH 2013a); Predicted within 10km(DSE WPAC 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
				and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.			
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 with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	1 record within 10km (OEH 2013a)	Unlikely	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
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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
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)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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	1 record within 10km (OEH 2013a)	Unlikely	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
				breeding. Territories range from 30 to 200 hectares.			
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 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	10 records within 10km (OEH 2013a)	Unlikely	Suitable foraging habitat in the subject site and study area
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	2 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not 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
				paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.			
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 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.	3 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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)	Unlikely	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
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 shrubby understorey or higher up under nests of other species.	2 records within 10km (OEH 2013a)	Unlikely	Suitable habitat present within the Fernhill estate but not the subject site
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.	12 records within 10km (OEH 2013a)	Unlikely	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
				Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but 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)	Unlikely	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 canopy or along creek beds (Churchill 2008). In southern Sydney appears to be	5 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Unlikely	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
				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)	Unlikely	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 Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	22 records within 10km (OEH 2013a)	Unlikely	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
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)	Unlikely	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 (Churchill 2008)	9 records within 10km (OEH 2013a)	Unlikely	Suitable foraging habitat and potential roost sites in the subject site and study area
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	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.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
				preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Mostly feeds on sap, nectar and honeydew.			
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 fruits of shrubs and trees.	2 records within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Nil	no suitable rocky escarpment habitat
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)	Unlikely	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
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 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)	Unlikley	Preferred forest on sandy soils with thick groundcover are not present
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)	Unlikely	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
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 maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	4 records within 10km (OEH 2013a)	Unlikely	Suitable foraging habitat and potential roost sites in the subject site and study area
Reptiles							
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.

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
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. 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.	1 record within 10km (OEH 2013a); Predicted within 10km (DSEWPAC 2013a)	Unlikley	Preferred ridgetop habitats on sandy soils not present
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)	Unlikely	Suitable foraging habitat and potential breeding habitat 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
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
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

Scientific name	Common Name	TSC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in subject site	Notes
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 Watagan Mountains north of the Hawkesbury and the lower Blue Mountains (White 2008b).	Predicted within 10km (DSEWPAC 2013)	Unlikley	Preferred rocky stream habitats in rainforest not present
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.	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
				Larvae are found under rocks where they co-exist with Austrocordulia refracta.			
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)	Possible	33 live individuals or shells recorded in the Fernhill Estate. Potential lower quality habitat in the subject site.

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 B – Survey Results

Appendix Table 1 Flora species recorded in Plot 1 within the Third Entrance Road Footprint

Family	Exotic	Scientific Name	Common Name	TSC Status	EPBC Status	Cover Abundance
Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum			3
Myrtaceae		*Eucalyptus crebra*	Narrow-leaved Ironbark			3
Fabaceae (Mimosoideae)		*Acacia parramattensis*	Parramatta Wattle			3
Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush			2
Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne			2
Poaceae	*	*Eragrostis curvula*	African Lovegrass			3
Asteraceae	*	*Sonchus oleraceus*	Common Sowthistle			1
Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush			1
Asteraceae	*	*Senecio madagascariensis*	Fireweed			1
Fabaceae (Faboideae)		*Glycine microphylla*	Small-leaf Glycine			1
Asteraceae	*	*Conyza bonariensis*	Flaxleaf Fleabane			1
Asparagaceae	*	*Asparagus officianalis*				1
Asteraceae	*	*Bidens subalternans*	Greater Beggar's Ticks			1
Poaceae	*	*Chloris sp.*				2
Poaceae		*Imperata cylindrica*	Blady Grass			2
Rosaceae	*	*Rubus fruticosus sp. agg.*	Blackberry complex			2
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade			1
Verbenaceae	*	*Lantana camara*	Lantana			2
Fabaceae (Faboideae)		*Glycine tabacina*	Variable Glycine			1
Clusiaceae	*	*Hypericum perforatum*	St. Johns Wort			3
Poaceae		*Oplismenus aemulus*				1
Poaceae		*Microlaena stipoides*	Weeping Grass			4
Poaceae	*	*Pennisetum clandestinum*	Kikuyu Grass			2
Phormiaceae		*Dianella longifolia var. longifolia*	A Blue Flax Lily			2
Poaceae		*Themeda australis*	Kangaroo Grass			2

Poaceae	*	*Lolium sp.*	A Ryegrass			2
Adiantaceae		*Cheilanthes sieberi*	Rock Fern			1
Convolvulaceae		*Dichondra repens*	Kidney Weed			1
Verbenaceae	*	*Verbena bonariensis*	Purpletop			2
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues			2
Polygonaceae	*	*Rumex sp.*	Dock			2
Asteraceae	*	*Taraxacum officinale*	Dandelion			1
Poaceae		*Cynodon dactylon*	Common Couch			1
Oxalidaceae		*Oxalis perennans*				1
Poaceae	*	*Briza subaristata*				2
Juncaceae		*Juncus prismatocarpus*				2
Juncaceae		*Juncus capensis*				1
Poaceae		*Dichelachne micrantha*	Shorthair Plumegrass			1
Fabaceae (Faboideae)		*Glycine clandestina*	Twining glycine			1
Chenopodiaceae		*Einadia trigonos*	Fishweed			
Poaceae	*	*Chloris gayana*	Rhodes Grass			2
Poaceae	*	*Bromus catharticus*	Praire Grass			3

* = 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 recorded in Plot 1 within the Third Entrance Road Footprint

Veg. n Zone	Veg. Type ID	Plot ID	Native plant species rich ness	Nativ e over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exoti c plant cove r	Numb er of trees with hollow s	Over storey regenerati on	Total length of fallen logs	Easting	Northin g	Zon e
1	HN52 8	Bench mark	29	20.5-25.5	25.5-30.5	26.8-30.8	0-5	14.8-18.8	0	> = 0	1	> = 0			
1	HN52 8	1	22	12	0.2	63	0	0	98	0	1	0	282751.0 0	625501 8	56

Appendix C – TSC Act Assessments of Significance

Assessments of Significance have been prepared in accordance with the threatened species assessment guidelines (DEC & DPI 2005) for threatened species and communities recorded or likely to occur in the subject site. Assessments are provided for the following:

- Threatened flora species
  - Spiked Rice flower (*Pimelea spicata*)
- Threatened ecological communities
  - Cumberland Plain Woodland
  - River Flat Eucalypt Forest
- Threatened fauna species
  - Cumberland Plain Land Snail (*Meridolum corneovirens*)

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
The proposal would require the removal of approx. 300 square metres (0.03 hectares) of native vegetation for construction of the proposed third entrance. The footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. The Cumberland Plain Woodland that would be removed is approximately 0.002 % of the total estimated area of that community in the locality (around 1,480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the CEEC in the locality or the region. The proposed events would not involve any vegetation clearing or otherwise reduce the extent of Cumberland Plain Woodland. An EMP 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. 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 require the removal of approx. 300 square metres (0.03 hectares) of Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). This small area would contain a very minor proportion of the individuals within the populations of the species that collectively comprise Cumberland Plain Woodland in the locality. Removing this individuakls would not tangibly alter the composition of the local occurrence of the community. The proposed events would not involve any vegetation clearing or other activities in intact Cumberland Plain Woodland. Construction of temporary infrastructure in exotic grassland may remove some native plants or displace some native animals that are component species of Cumberland Plain Woodland. The individual plants within the subject site would not be 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 CEEC. Given the scale and context of the proposal it is unlikely to modify the composition of any Cumberland plain

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
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 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
The proposal would require the removal of approx. 300 square metres (0.03 hectares) of Cumberland Plain Woodland for construction of the proposed third entrance. The proposed events would not directly affect any habitat for Cumberland Plain Woodland. An EMP 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 footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. Construction of the third entrance road would clear approx. 300 metres squared of native vegetation and create a gap in habitat a maxium of 12.5 metres wide. Fauna movement and other ecological processes would continue across this minor gap in habitat. In the context of the partially cleared and developed land in the locality this would comprise a very minor increase in the degree of habitat fragmentation. The proposed events would not involve any vegetation clearing and 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 edge 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 temporary 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 stock fences, existing buildings 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 vegetated riparian corridors to the north, south and west. 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 300 square metres (0.03 hectares) of habitat to be removed for construction of the proposed third entrance is approximately 0.002 % of the total estimated area of equivalent habitat in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The disturbance footprint is within a narrow, fragmented patch 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

Assessment of Significance for Cumberland Plain Woodland (critically endangered ecological community)
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. No additional habitat would be removed, fragmented or isolated for the proposed events as described above.
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 proposal would not involve any clearing or otherwise affect this EEC and so is consistent with these priority actions.
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 Key Threatening Process (KTP) 'Clearing of native vegetation' has occurred historically within and around the study area. The proposal involves the clearing of approx. 300 square metres of native vegetation which would comprise a negligible increase in the operation of this KTP. The proposal would not directly contribute to the operation of any other KTPs of relevance to Cumberland Plain Woodland. 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 any 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
The proposal would not involve any vegetation clearing or otherwise reduce the extent of River Flat Eucalypt Forest. An EMP 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. 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 not involve any vegetation clearing or other activities in intact River Flat Eucalypt Forest. Construction of temporary infrastructure in exotic grassland may remove some native plants or displace some native animals that are component species of River Flat Eucalypt Forest. The individual plants within the subject site would not be an ecologically significant proportion of any of the individual species that make up the River Flat Eucalypt Forest ecological community. The proposal is not likely to remove, modify or fragment a significant proportion of the habitat for this EEC 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 EEC. Given the scale and context of the proposal it is unlikely to modify the composition of any River Flat Eucalypt Forest beyond the subject site and immediately adjoining areas. As such, the proposal is not likely to modify the composition of the EEC in the locality such that any component 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
The proposal would not directly affect any habitat for River Flat Eucalypt Forest. An EMP 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 proposal would not involve any vegetation clearing and will not directly isolate or fragment any areas of habitat.

Assessment of Significance for River Flat Eucalypt Forest (EEC)
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 edge 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 temporary 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 stock fences, existing buildings 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 vegetated riparian corridors to the north, south and west. 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,
No habitat would be removed, fragmented or isolated as described above.
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 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 proposal would not involve any clearing or otherwise affect this EEC and so is consistent with these priority actions.
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 not directly contribute to the operation of of any KTPs of relevance to River Flat Eucalypt Forest. 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 any 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 surveys conducted at Fernhill. Hence, for the purposes of this assessment, it is assumed that the study area supports a local population (at least in part) of this species. Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of habitat for the Spiked Rice-flower in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The proposed eventswould not permanently remove or modify any additional native vegetation or otherwise threaten the viability or persistence of the species in the locality or the region.Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of individual plants (if present) within exotic grassland in the subject site (which is unlikely). There is around 1480 hectares 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, lower quality habitat would not threaten the viability or persistence of the species in the locality or the region. An EMP 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:

Assessment of Significance for Spiked Rice-flower (*Pimelea spicata*) (endangered species)
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
Construction of the proposed third entrance road would require the removal of around 300 square metres (0.03 hectares) of habitat for the Spiked Rice-flower in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (around 1480 hectares, based on Tozer (2010) vegetation mapping). The proposed eventswould not directly affect any known habitat for the Spiked Rice-flower. The proposal would result in impacts on some native plants within areas of exotic grassland, which may potentially comprise low quality habitat for the species. All of these impacts would be temporary and associated with infrequent events and would not permanently remove or modify any of this low quality habitat. An EMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including habitat for the Spiked Rice-flower .
(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 footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. Construction of the third entrance road would clear approx. 300 metres squared of native vegetation and create a gap in habitat a maxium of 12.5 metres wide. Pollination and other ecological processes would continue across this minor gap in habitat. In the context of the partially cleared and developed land in the locality this would comprise a very minor increase in the degree of habitat fragmentation. The proposed events would not involve any vegetation clearing and will not directly isolate or fragment any areas of habitat for the Spiked Rice-flower. The proposal involves construction of temporary structures that would not impede ecological processes for plants. These ecological processes would at continue to function around the subject site via vegetated riparian corridors to the north, south and west. In this context, the proposal would not fragment or isolate any habitat.
(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 300 square metres (0.03 hectares) of habitat to be removed for construction of the proposed third entrance is approximately 0.002 % of the total estimated area of equivalent habitat in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The disturbance footprint is within a narrow, fragmented patch 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. No additional habitat would be removed, fragmented or isolated for the proposed events as described above.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Assessment of Significance for Spiked Rice-flower (*Pimelea spicata*) (endangered species)
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 (including 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 and would result in the removal of any known habitat for the species. The proposal is consistent with the recovery plan for the Spiked rice-flower .
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 KTP 'Clearing of native vegetation' has occurred historically within and around the study area. The proposal involves the clearing of around 300 square metres of native vegetation which would comprise a negligible increase in the operation of this KTP. The proposal would not directly contribute to the operation of any other KTPs of relevance to the Spiked Rice-flower. 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 any 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 population of the 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 33 live individuals or shells were recorded in Fernhill 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. —Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of habitat for the Spiked Rice-flower in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The proposed events would not permanently remove or modify any native vegetation or otherwise threaten the viability or persistence of the species in the locality or the region. Potential impacts of the proposal on the life cycle of the species would be restricted to the removal of individual snails (if present) within exotic grassland in the subject site (which is unlikely). There is around 1480 hectares of potential habitat for the Cumberland Plain Land Snail 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, lower quality habitat would not threaten the viability or persistence of the species in the locality or the region. An EMP 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. 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.
d) in relation to the habitat of a threatened species, population or ecological community:

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
Construction of the proposed third entrance road would require the removal of approx. 300 square metres (0.03 hectares) of habitat for the Cumberland Plain Land Snail in Cumberland Plain Woodland which is approximately 0.002 % of the total estimated area of that community in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The proposed eventswould not directly affect any known habitat for the Cumberland Plain Land Snail. The proposal would result in impacts on some native plants within areas of exotic grassland, which may potentially comprise low quality habitat for the species. All of these impacts would be temporary and associated with infrequent events and would not permanently remove or modify any of this low quality habitat. An EMP is recommended for the proposal, which would contain measures to avoid direct and indirect impacts on native vegetation adjoining the subject site, including habitat for the Cumberland Plain Land Snail.
(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 footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. Construction of the third entrance road would clear approx. 300 metres squared of native vegetation and create a gap in habitat a maxium of 12.5 metres wide. Snail movement other ecological processes would continue across this minor gap in habitat. In the context of the partially cleared and developed land in the locality this would comprise a very minor increase in the degree of habitat fragmentation. The proposed events would not involve any vegetation clearing and will not directly isolate or fragment any areas of habitat for the Cumberland Plain Land Snail. Shale woodland to the north and south of the subject site is likely to be an important habitat corridor for the Cumberland Plain Land Snail. The subject site is located at the edge of this patch of habitat and does not, in itself, comprise an important connecting linkage. Fauna movement and other ecological processes would occur around, rather than through, the subject site. The proposed events involve construction of temporary 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 stock fences, existing buildings 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 vegetated riparian corridors to the north, south and west. In this context, the proposal would not fragment or isolate any habitat.
(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 300 square metres (0.03 hectares) of habitat to be removed for construction of the proposed third entrance is approximately 0.002 % of the total estimated area of equivalent habitat in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The disturbance footprint is within a

Assessment of Significance for Cumberland Plain Land Snail (Meridolum corneovirens) (endangered species)
narrow, fragmented patch 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. No additional habitat would be removed, fragmented or isolated for the proposed events as described above.
d) in relation to the habitat of a threatened species, population or ecological community:
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.
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. T 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 Key Threatening Process (KTP) 'Clearing of native vegetation' has occurred historically within and around the study area. The proposal involves the clearing of approx. 300 square metres of native vegetation which would comprise a negligible increase in the operation of this KTP. The proposal would not directly contribute to the operation of any other KTPs of relevance to the Cumberland Plain Land Snail. 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 any KTPs.
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.

Appendix D - EPBC Act Assessment of Significance

Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a MNES. An assessment of significance has been prepared for key MNES in accordance with the *EPBC Act Significant Impact Guidelines 1.1* (DEWHA 2009) to provide an indication of the potential level of impact of the proposal. The following includes the assessment of signficance for the critically endangered ecological community, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

EPBC Act Assessment of Significance
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
According to the DEWHA (2009) 'significant impact criteria' for critically endangered ecological communities, an action is likely to have a significant impact on an vulnerable species if there is a real chance or possibility that it will: Reduce the extent of an ecological community
The proposal would require the removal of approx. 300 square metres (0.03 hectares) of native vegetation for construction of the proposed third entrance. The footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. The Cumberland Plain Woodland that would be removed is approximately 0.002 % of the total estimated area of that community in the locality (approx 1,480 hectares, based on Tozer (2010) vegetation mapping). This minor reduction in extent would not threaten the viability or persistence of the CEEC in the locality or the region. The proposed events would not involve any vegetation clearing or otherwise reduce the extent of Cumberland Plain Woodland. An EMP 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. The likely magnitude of edge effects or other indirect effects would not be sufficient to further reduce the extent of the ecological community
Fragment of increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
The footprint for the proposed entrance road passes through a 30 metre wide strip of native vegetation adjoining Mulgoa Road before continueing west into an area of exotic grassland. Construction of the third entrance road would clear approx. 300 metres squared of native vegetation and create a gap in habitat a maxium of 12.5 metres wide. Fauna movement and other ecological processes would continue across this minor gap in habitat. In the context of the partially cleared and developed land in the locality this would comprise a very minor increase in the degree of habitat fragmentation. The proposed events would not involve any vegetation clearing and will not directly isolate or fragment any areas of this community. 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 edge 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 temporary 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 stock fences, existing buildings 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 vegetated riparian corridors to the north, south and west. In this context, the proposal would not have an adverse effect on fauna movement or habitat connectivity and is unlikely to threaten the persistence of this community in the locality or result in the isolation or fragmentation of any areas of habitat for this community.
Adversely affect habitat critical to the survival of an ecological community

EPBC Act Assessment of Significance
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
There is no critical habitat listed for this threatened ecological community. The proposal would not involve any vegetation clearing and will not directly isolate or fragment any areas of habitat considered critical to the survival of the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients of soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns
The proposal may impact on water quality through increased sedimentation or pollution during construction works within and near waterways. Any such impacts are anticipated to be minor, given the current degraded condition of creeks, drainage lines and waterbodies within the proposal footprint, and the ongoing disturbances to each via livestock access. An EMP is recommended for the proposal, which would contain measures to reduce direct and indirect impacts (i.e. erosion and sedimentation) on native vegetation adjoining the subject site, including this CEEC. Any alterations as a result of the proposal are unlikely to result in destruction of abiotic conditions necessary for the ecological communities' survival in the locality.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
The proposal will not result in changes to the existing fire regime within the proposal footprint, nor will there be any fauna harvesting undertaken. The proposal would not involve any vegetation clearing or other activities in intact Cumberland Plain Woodland. Within the proposal footprint and adjoining areas, this ecological community has been degraded through historic disturbance, with many areas cleared for agriculture, infrastructure and residential development. Within the proposal footprint, this community has some areas that are infested by exotic species, and some areas that have an understorey comprised of a mixture of exotic species and native species. Similarly, exotic species occur throughout the proposal footprint. The historical disturbances to this community are likely to have influenced the floristic assemblage within the proposal footprint. Many of the species identified within this community are common and widespread, and are typically those species less palatable to livestock. Construction of temporary infrastructure in exotic grassland may remove some native plants or displace some native animals that are component species of Cumberland Plain Woodland. The individual plants within the subject site would not be 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. 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 CEEC. 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.

EPBC Act Assessment of Significance
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: Assisting invasive species, that are harmful to the listed ecological community, to become established, or
The proposal would require the removal of approx. 300 square metres (0.03 hectares) of Cumberland Plain Woodland for construction of the proposed third entrance. The proposed events would not involve any vegetation clearing or otherwise reduce the extent of Cumberland Plain Woodland. The proposal would add to the impacts of edge effects on native vegetation adjacent to the proposal footprint. Adjacent areas of vegetation are already subject to extensive levels of disturbance and weed infestation, with much of the native vegetation having been previously cleared for agriculture, infrastructure and residential development. As a result, the magnitude of any increase in weed infestation is likely to be relatively minor.
Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
The proposal does not directly involve production or transport of any fertilisers, herbicides or other chemicals or pollutants. Construction vehicles and equipment would cause a minor localized increase in the risk of hydrocarbon contamination. Mitigation measures are outlined in Section 6 for the appropriate storage of any chemicals used in the construction process. The proposal is unlikely to result in the mobilisation of chemicals or pollutants into the ecological community that may harm or inhibit the growth of species in the ecological community.
Interfere with the recovery of an ecological community
The 300 square metres (0.03 hectares) of habitat to be removed for construction of the proposed third entrance is approximately 0.002 % of the total estimated area of equivalent habitat in the locality (approx. 1,480 hectares, based on Tozer (2010) vegetation mapping). The disturbance footprint is within a narrow, fragmented patch 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. This clearing would have a very minor impact on the recovery of the community. The proposed events would not involve any clearing and so is unlikely to interfere with the recovery of the community.The DECCW (2011) *Cumberland Plain Recovery Plan* lists four major recovery objectives, none of which are of particular relevance to this proposal.
Conclusion:
The proposal is unlikely to result in a significant impact on CPW, pursuant to s.5A of the EP&A Act given: • The proposal would not involve any vegetation clearing or otherwise reduce the extent of Cumberland Plain Woodland. • The relatively large areas that exists within the locality. • The disturbed and modified nature of the native vegetation within and adjacent to the proposal

EPBC Act Assessment of Significance
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
footprint.

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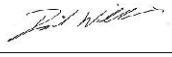
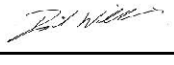
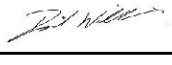
1	B Harrington	J Pepper	*J Pepper*	Dan Williams		22/10/2013
2	B Harrington	Dan Williams		Dan Williams		18/12/2013

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