Appendix D Biodiversity Impact Assessment

21 August 2014

John Fisher
Principal Consultant
EnviroPlan Pty Ltd
john.fisher@enviroplan.com.au

Dear John,

Re: Biodiversity Impact Assessment for Horsley Park Meter Station upgrade
Our Ref: Job# 18687

Jemena Limited (Jemena) proposes to upgrade to the existing natural gas facility at Horsley Park, New South Wales (the Horsley Park Meter Station). Biosis Pty Ltd was engaged by Jemena via EnviroPlan Pty Ltd to undertake a biodiversity impact assessment for the proposed upgrade works. This letter documents the findings and recommendations with regard to ecological values found within the Horsley Park Meter Station (study area).

A field investigation was undertaken on 5 August 2014 by Jane Murray, Principal Ecologist (Botanist) of Biosis and guided by John Fisher of EnviroPlan Pty Ltd. This assessment has been written by Amy Nelson and reviewed by Jane Murray (Biosis Pty Ltd).

Study Area Context and Proposed Impacts

Horsley Park is located approximately 16 kilometres (km) west of the Sydney Central Business District in the Fairfield Local Government Area (LGA). The Horsley Park Meter Station is located at 194-202 Chandos Road, Horsley Park, on Lot 3 DP 1002746 (Appendix 1, Figure 1). The study area is defined as the area to be directly and indirectly impacted by the proposed works. The study area is located within a semi-rural area surrounded by paddocks, patches of vegetation, exotic grasses and roads. Immediately to the north and adjacent to the study area features two dams (Appendix 2) both of which feature fringing vegetation. To the west lies Eastern Creek which flows parallel to the M7 Motorway and is lined with forest and woodland vegetation. Prospect Reservoir is also located a little over one kilometre to the east (Appendix 2, Figure 1).

The Horsley Park Meter Station was constructed in 2000. The existing facility requires an upgrade which includes increasing the capacity of the facility through the installation of a new gas regulator, metering equipment, gas heating and filter equipment, and associated pipework. The study area falls under the State Environmental Planning Policy (Western Sydney Parklands) 2009. The State Environmental Planning Policy (State and Regional Development) 2011 is applicable and the proposed works will be assessed as State Significant Infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This letter report will form part of the supporting documentation for a Preliminary Environmental Impact Assessment as part of the approvals process.

Specifically, the proposal would include the following:

- Removal of the existing oil separator and associated pipework.

- Installation of two new gas filters.
- Installation of new gas heat exchangers.
- Installation of hot water heaters and associated building.
- Installation of a new gas metering unit.
- Installation of a new gas regulator and noise attenuating enclosure.
- Associated above and belowground connecting pipework.

Disturbances to the ground surface would be undertaken in order to:

- Create trenches for belowground pipework.
- Create trenches for belowground service and telemetry conduits.
- Create concrete pad foundation for gas conveyance control equipment.
- Create footings and foundations for plinths to support aboveground pipework.

Typical plant and equipment required to carry out the proposal includes, but is not limited to, excavators, back hoes, skid loaders, delivery trucks, dump trucks, mobile cranes, concrete trucks and concrete pumps.

Background research

Prior to completing the field investigation, documentation provided by EnviroPlan as well as other key information was reviewed, including:

- Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife for *Threatened Species Conservation Act 1995* (TSC Act) listed threatened biota.
- Department of Environment (DoE) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool.
- NSW Department of Primary Industries (DPI) Threatened and protected species - records viewer for species listed under the *Fisheries Management Act 1994* (FM Act).
- NSW Department of Primary Industries (DPI) *Noxious Weeds Act, 1993* (NW Act) listed weeds for the Fairfield LGA.
- OEH VIS Mapping through the Six Viewer portal.

Field Investigation

Jane Murray of the Biosis Sydney office visited the study area (Appendix 1, Figure 1) at Horsley Park on 5 August 2014 to determine whether there is any TSC Act and/or EPBC Act listed ecological constraints likely to be impacted by the proposed works. The study area was traversed on foot and the flora and fauna composition and condition was noted and threatened biota habitat searched for.

Findings

The study area was found to be in fairly poor condition ecologically, with a high prevalence of exotic grasses and weeds in the immediate vicinity (Appendix 1, Figure 2; Appendix 2, Plate 1). The exotic grasses and weeds community comprised such exotics as; Cape Weed *Arctotheca calendula, Kikuyu Pennisetum clandestinum* and

Large Plaintain *Plantago major.* The exotic grasses and weeds community was found to provide foraging material for birds such as; Red-browed Finches *Neochmia temporalis* and Welcome Swallow *Hirundo neoxena* (Appendix 3, Table 2).

The second vegetation community present on site is Planted Eucalypts Over Exotic (Appendix 1, Figure 2, Plate 2). Due to the age of the trees present it is likely that this vegetation was planted in 2000 when the Meter Station was constructed. The main canopy species observed in this community included a row of; Spotted Gum *Corymbia maculata,* Narrow-leaved Ironbark *Eucalyptus crebra*, Grey Box *Eucalyptus moluccana*, Grey Ironbark *Eucalyptus paniculata* and Forest Red Gum *Eucalyptus tereticornis* (Appendix 2: Table 1). The mid-storey contained a few native species; White Sally *Acacia floribunda* and Prickly-leaved Tea Tree *Melaleuca styphelioides* (Appendix 3, Table 1). The understorey contained a few native grasses such as Common Couch *Cynodon datylon* and Windmill Grass *Microlaena stipoides* but had largely been colonised by exotic grasses, forbs and herbs such as Kikuyu Grass *Pennisetum clandestinum,* Dandelion *Taraxacum offincinale* and Capeweed *Arctotheca calendula* (Appendix 3, Table 1). None of the observed exotic species have been declared as noxious weeds within the Fairfield LGA (NSW DPI, 2014). This community provides foraging resources for avifanua such as Lorikeets *Trichoglossus haematodus* and Gallah's *Eolophus roseicapillus*.

Prior to the site inspection, Biosis confirmed that the vegetation communities surrounding Eastern Creek and Prospect reservoir have previously been mapped as either *River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (Endangered Ecological Community, TSC Act) or *Cumberland Plain Woodland in the Sydney Basin Bioregion* (Critically Endangered Ecological Community under the TSC Act and EPBC Act)(Cumberland V2 2008 VIS map 3785). As the works will be confined to the immediate vicinity of the Horsley Park Meter Station these communities will not be directly or indirectly impacted by the proposed works.

The field investigation indicated that the site drains, via a vegetated trench, northward to a pond in a depression just to the west of one of the dams. Based on preliminary observations it would be likely that the water quality in the pond is influenced by a range of surrounding land use patterns and was considered to be of relatively poor quality, given a high abundance of weeds surrounding the pond, and little habitat for aquatic and amphibious species.

During the desktop and field based survey, all threatened biota protected under the TSC Act, FM Act and/or EPBC Act (excluding migratory species) that have a likelihood of occurring within 5 kilometres were assessed as to their likely presence within or usage of (foraging or dwelling) the study area (Appendix 4). However it should be noted that of these threatened biota, all were deemed to have a low likelihood of occurrence, or were not likely to be directly impacted upon by the proposed works.

Concluding Advice and Recommendations

Given that no threatened biota, nor suitable habitat for such have not been found within the immediate vicinity of the study area the main focus of the associated works would be to limit the impacts of the work to within the perimeter of the existing facility. Therefore the following recommendations have been made with regard to the proposed upgrade:

- Erosion and sediment controls to be implemented around the works area and any associated stockpiles so to avoid run off and associated stormwater related impacts on surrounding lands, including the pond to the north of the study area and Eastern Creek to the west.
- Ensure machinery is free of weed material before entering and exiting the study area for the proposed works.

- Ensure appropriate procedural of physical controls are implemented to limit potential impacts to the planted native trees and shrubs within the existing facility.

Please contact me on 0421 013 061 if you would like to discuss further.

Yours sincerely

Jane Murray
Principal Ecologist

Bibliography

- DECC, 2008, Vegetation Condition Benchmarks for the Sydney Metro Catchment Management Area, Department of Environment and Climate Change.
- DoE, 2013, Protected Matters Search Tool. Accessed August 2014.
- NSW DPI, 2014, Noxious Weed Declarations: Fairfield City Council. Accessed August 2014.
- OEH, 2014, BioNet Atlas of NSW Wildlife for *Threatened Species Conservation Act 1995* (TSC Act) listed threatened biota. Accessed August 2014.
- OEH, 2014, VIS Mapping through the Six Viewer portal. Accessed August 2014.
- *Tozer et. al., 2006, South Coast-Illawarra Vegetation Integration (SCIVI),* vegetation mapping.

Appendix 1: Figures

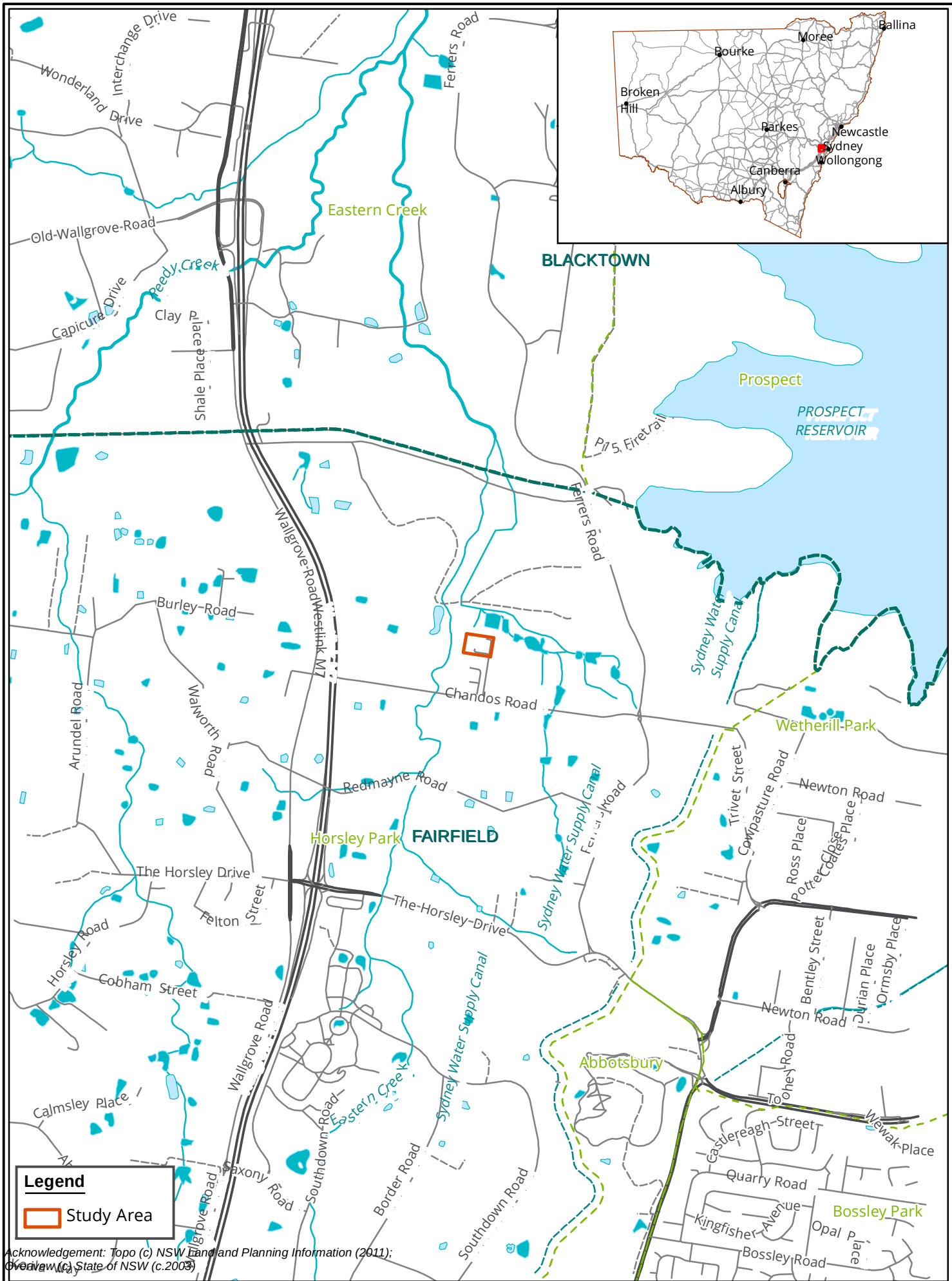

Figure 1: Location of the Project Area – New South Wales

Matter: 18669
Date: 12 August 2014,
Checked by: SJG, Drawn by: JMS, Last edited by: jshepherd
Location:P:\18600s\18669\Mapping\

Scale 1:25,000 @ A4, GDA 1994 MGA Zone 56

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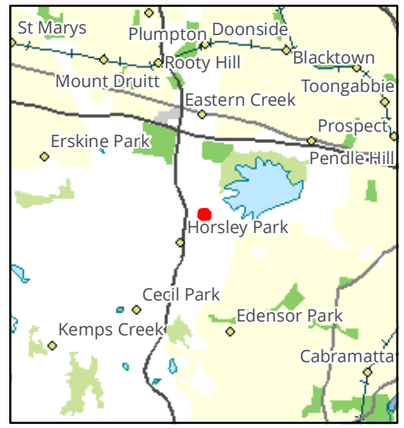

Legend

Study area

Vegetation communities

Exotic grasses and weeds

Planted Eucalyptus over exotic

Figure 2: Vegetation

0 5 10 15 20 25

Metres

Scale: 1:500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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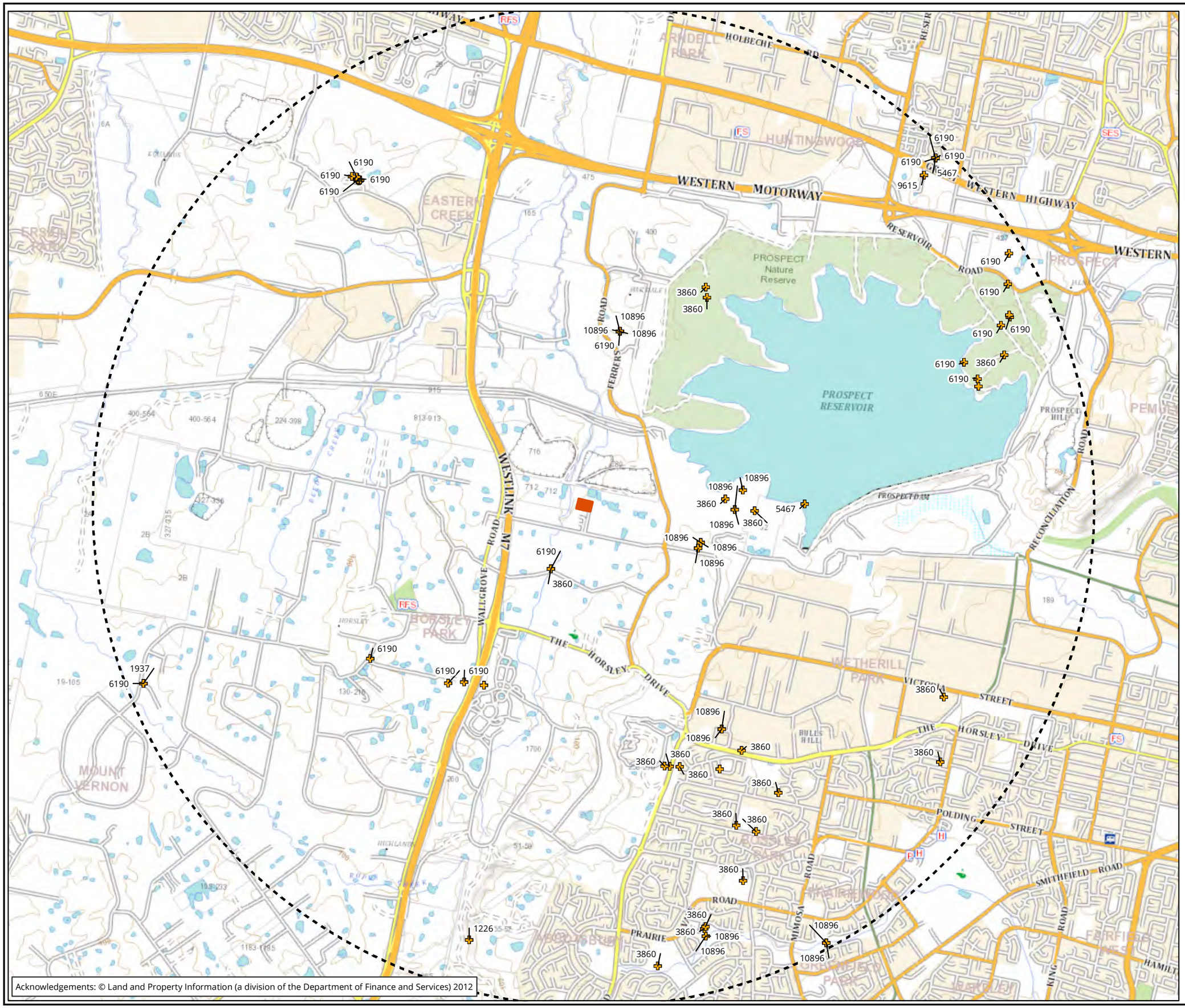
Matter: 18687
Date: 13 August 2014,
Checked by: JMM, Drawn by: JMS, Last edited by: jshepherd
Location:P:\18600s\18687\Mapping
18687_F2_Vegetation



Legend

- Study Area
- Search area

Threatened flora

- 10896; Marsdenia viridiflora subsp. viridiflora
- 1226; Cynanchum elegans
- 1937; Wahlenbergia multicaulis
- 3860; Acacia pubescens
- 5467; Persoonia nutans
- 6190; Pimelea spicata
- 9615; Pterostylis saxicola

Figure 3: Threatened Flora within 5km of the study area

0 350 700 1,050 1,400 1,750

Metres

Scale: 1:35,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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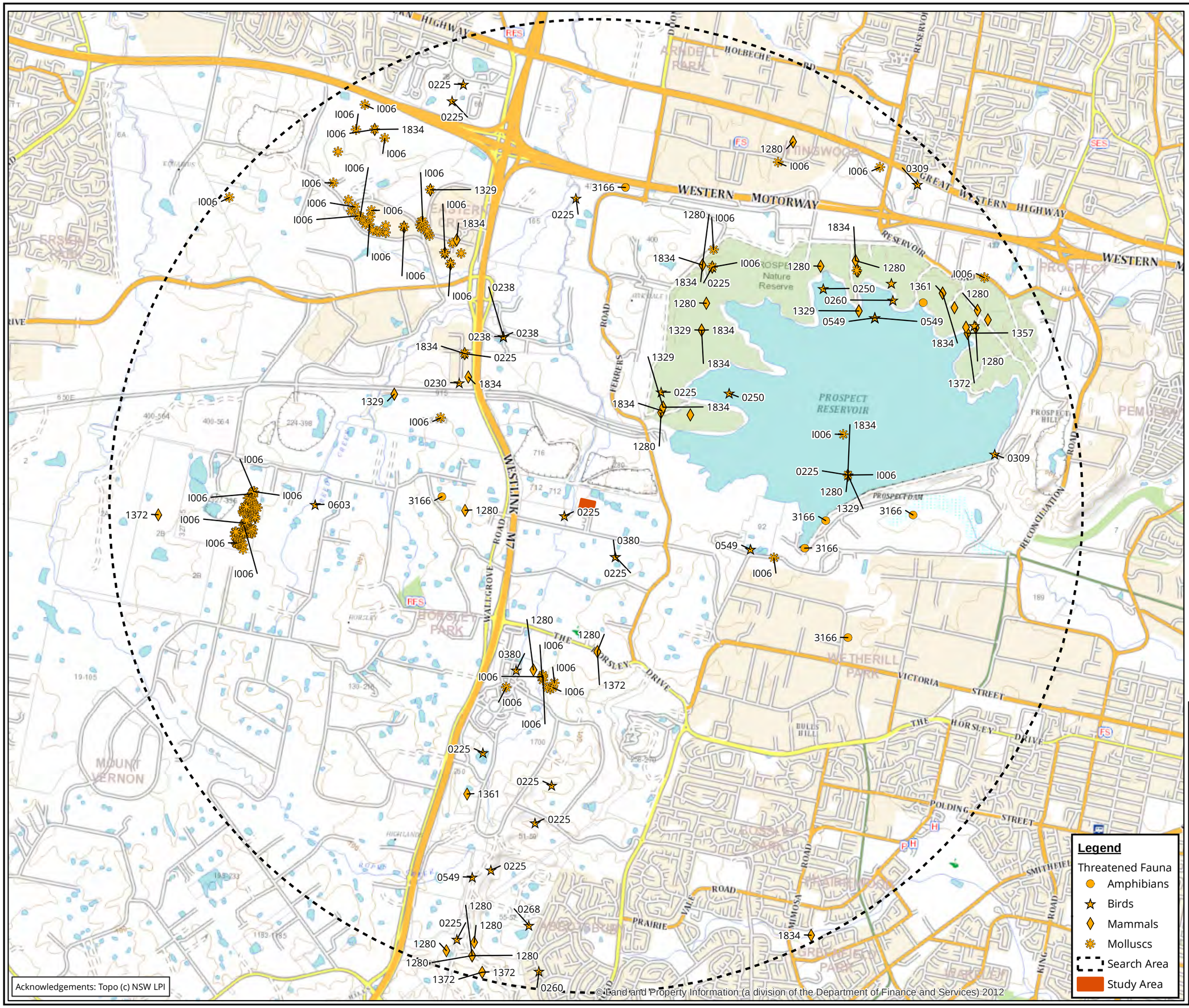
Matter: 18687
Date: 13 August 2014,
Checked by: JKH, Drawn by: JMS, Last edited by: jshepherd
Location:P:\18600s\18687\Mapping
18687_F3_ThrFlora



Species list

Amphibians

3166 - Green and Golden Bell Frog

Birds

0225 - Little Eagle
0230 - Square-tailed Kite
0238 - Black Falcon
0250 - Masked Owl
0260 - Little Lorikeet
0268 - Gang-gang Cockatoo
0309 - Swift Parrot
0380 - Scarlet Robin
0549 - Varied Sittella
0603 - Regent Honeyeater

Mammals

1280 - Grey-headed Flying-fox
1329 - Eastern Freetail-bat
1357 - Southern Myotis
1361 - Greater Broad-nosed Bat
1372 - Eastern False Pipistrelle
1834 - Eastern Bentwing-bat

Molluscs

I006 - Cumberland Plain Land Snail

Figure 4: Threatened Fauna within 5km of the Study Area

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Matter: 15743
Date: 13 August 2014,
Checked by: , Drawn by: SMV, Last edited by: jshepherd
Location:P:\18600s\18687\Mapping\18687_F4_ThrFauna

Appendix 2: Plates

Plate 1: Exotic Grasses and Weeds

Plate 2: Planted Eucalypts

Plate 3: Nearby Dam to the North

Appendix 3: Flora and fauna recorded within the study area

Table 1: Flora species recorded by Biosis, 05.08.2014

Status	Family	Scientific Name	Common Name
	Native species		
	Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally
	Geraniaceae	*Pelargonium australe*	Native Storksbill
	Myrtaceae	*Corymbia maculata*	Spotted Gum
	Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
	Myrtaceae	*Eucalyptus moluccana*	Grey Box
	Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark
	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
	Myrtaceae	*Kunzea ambigua*	Tick Bush
	Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
	Poaceae	*Chloris truncata*	Windmill Grass
	Poaceae	*Cynodon dactylon*	Common Couch
	Poaceae	*Eragrostis brownii*	Brown's Lovegrass
	Poaceae	*Microlaena stipoides*	Weeping Grass
	Introduced species		
	Asteraceae	*Arctotheca calendula*	Capeweed
	Asteraceae	*Soliva sessilis*	Bindi
	Asteraceae	*Sonchus oleraceus*	Common Sowthistle
	Asteraceae	*Taraxacum officinale*	Dandelion
	Fabaceae (Faboideae)	*Trifolium repens*	White Clover
	Fabaceae (Faboideae)	*Trifolium sp*	Berseem Clover
	Malvaceae	*Malva spp.*	Mallow
	Myrsinaceae	*Anagallis arvensis*	Scarlet Pimpernel
	Plantaginaceae	*Plantago major*	Large Plantain
	Poaceae	*Pennisetum clandestinum*	Kikuyu Grass
	Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel

Table 2: Fauna species recorded by Biosis, 05.08.2014

Scientific Name	Common Name	Observation Type
Anthochaera chrysoptera	Little Wattlebird	O
Egretta novaehollandiae	White-faced Heron	O
	Lorikeet	
Eolophus roseicapillus	Galah	O
Eopsaltria australis	Eastern Yellow Robin	O
Grallina cyanoleuca	Magpie-lark	O
Hirundo neoxena	Welcome Swallow	O
Malurus cyaneus	Superb Fairy-wren	O
Manorina melanocephala	Noisy Miner	O
Neochmia temporalis	Red-browed Finch	O
Rhipidura leucophrys	Willie Wagtail	O

Appendix 4: Likelihood of Occurrence - Threatened Biota

Table 3: Threatened fauna likelihood of occurrence

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Birds							
Botaurus poiciloptilus	Australasian Bittern	EN	E1	#	Low	No foraging material or habitat present within study area.	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including *Typha spp*. and *Eleoacharis spp*.. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Callocephalon fimbriatum	Gang-gang Cockatoo		V, E2	2007	Low	No foraging material or habitat present within study area.	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.
Daphoenositta chrysoptera	Varied Sittella		V	2011	Low	No suitable habitat present within study	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands,

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						area.	usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.
Dasyornis brachypterus	Eastern Bristlebird	EN	E1	#	Low	No suitable habitat present within study area.	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.
Falco subniger	Black Falcon		V	2003	Low	No suitable habitat present within study area.	Mainly occur in woodlands and open country where can hunt. Often associated with swamps, rivers and wetlands. Nest in tall trees along watercourses.
Glossopsitta pusilla	Little Lorikeet		V	2007	Low	No suitable habitat present within study area.	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.
Hieraaetus morphnoides	Little Eagle		V	2012	Low	No suitable habitat present within study	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						area.	species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
Lathamus discolor	Swift Parrot	EN	E1	2004/#	Low	No suitable habitat, some foraging material present, however not to be impacted within study area.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.
Lophoictinia isura	Square-tailed Kite		V	2008	Low	No suitable habitat present within study area.	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata*, or *E. smithii*. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Petroica boodang	Scarlet Robin		V	2004	Low	No suitable habitat present within study area.	During the breeding season the Scarlet Robin is found in eucalypt forests and temperate woodlands, often on ridges and slopes. During autumn and winter it moves to more open and cleared areas. It has dispersive or locally migratory seasonal movements. The Scarlet Robin forages amongst logs and woody debris for insects which make up the majority of its diet. The nest is an open cup of plant fibres and cobwebs, sited in the fork of a tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground. It is conspicuous in open and suburban habitats.
Tyto novaehollandiae	Masked Owl		V	2011	Low	No suitable habitat present within study area.	The Masked Owl may be found across a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. It has mostly been recorded in open forests and woodlands adjacent to cleared lands. They nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. The nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet. It has a large home range of between 500 to 1000 ha.
Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	#	Low	No suitable habitat present within study area.	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing maternity roost is in a sandstone cave near Coonabarabran.
Dasyurus maculatus maculatus (SE mainland population)	Spotted-tailed Quoll	EN	V	2004	Low	No suitable habitat present within study area.	Occurs along the east coast of Australia and the Great Dividing Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage. Seventy per cent of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage. The home range of a female is between 180 and 1000 ha, while males have larger home ranges of between 2000 and 5000 ha. Breeding occurs from May to August.
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	2005	Low	No suitable habitat present within study area.	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							found in open forests at lower altitudes. Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails. Has a large foraging range, up to 136 ha. Records show movements of up to 12 km between roosting and foraging sites.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V	2013	Low	No suitable habitat present within study area.	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.
Mormopterus norfolkensis	Eastern Freetail-bat		V	2011	Low	No suitable habitat present within study area.	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.
Myotis macropus	Southern Myotis		V	2013	Low	No suitable habitat present within study area.	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.
Phascolarctos cinereus	Koala	VU	V	#	Low	No suitable habitat present within study area.	Pittwater LGA and Hawks nest: In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include *Eucalyptus robusta, E. tereticornis, E. punctata, E. haemostoma* and *E. signata*. They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha.
Pseudomys novaehollandiae	New Holland Mouse	VU		#	Low	No suitable habitat present within study area.	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn.
Pteropus poliocephalus	Grey-headed Flying-fox	VU	V	2011/#	Low	No suitable habitat present within study area.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.
Scoteanax rueppellii	Greater Broad-nosed Bat		V	2013	Low	No suitable habitat present within study area.	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches.
Reptiles							

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Hoplocephalus bungaroides	Broad-headed Snake	VU	E1	#	Low	No suitable habitat present within study area.	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.
Amphibians							
Heleioporus australiacus	Giant Burrowing Frog	VU	V	#	Low	No suitable habitat present within study area.	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water. Spends the majority of its time in non-breeding habitat 20-250m from breeding sites.
Litoria aurea	Green and Golden Bell Frog	VU	E1	1969/#	Low	No suitable habitat present within study area, potential dispersal habitat to the north and west of the site.	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks , although the species has also been

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop , feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.
Litoria raniformis	Southern Bell Frog	VU	E1	#	Low	No suitable habitat present within study area.	In NSW the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral swamps or billabongs with an abundance of bulrushes and other emergent vegetation along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Outside the breeding season animals disperse away from the water and take shelter beneath ground debris such as fallen timber and bark, rocks, grass clumps and in deep soil cracks.
Fish							
Macquaria australasica	Macquarie perch	EN		#	Low	No suitable habitat present within study area.	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries
Prototroctes	Australian	VU		#	Low	No suitable habitat	The Australian Grayling occurs in streams and rivers on

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
maraena	Grayling					present within study area.	the eastern and southern flanks of the Great Dividing Range from Sydney southwards to the Otway Ranges in Victoria, and Tasmania. Australian grayling do not occur in the inland Murray–Darling Basin system. Grayling is a diadromous species; migrating between freshwater streams and the ocean. This species has been found in clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops, and also in muddy-bottomed, heavily silted habitats.
Invertebrates							
Meridolum corneovirens	Cumberland Plain Land Snail		E1	2013	Low	No suitable habitat present within study area.	Most likely restricted to Cumberland Plain, Castlereagh Woodlands and boundaries between River-flat Forest and Cumberland Plain Woodland. It is normally found beneath logs, debris and amongst accumulated leaf and bark particularly at the base of trees. May also use soil cracks for refuge.

Table 4: Threatened flora likelihood of occurrence

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Acacia pubescens	Downy Wattle	VU	V	2013/#	Low	A range of records nearby, however no species present or suitable habitat within study area.	Acacia pubescens is found in Sydney Metropolitan, and Hawkesbury/Nepean Catchment Management Region, with concentrated populations around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone. The species occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers from August to October. The pods mature in October to December.
Allocasuarina glareicola		EN	E1	#	Low	Associated vegetation community not present within study area.	Found in the Hawkesbury/Nepean and Sydney Metropolitan Catchment Authority Regions. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Also found in Dry Sclerophyll forest/Woodland. Associated species include *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia*

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							elongata, Acacia brownei, Themeda australis and *Xanthorrhoea minor*.
Cynanchum elegans	White-flowered Wax Plant	EN	E1	1993/#	Low	One record to the south of the site approximately 4 kilometers away, associated vegetation community not present.	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean , Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan. *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum, Banksia integrifolia subsp. integrifolia*; *Eucalyptus tereticornis* open forest and woodland; *Eucalyptus maculata* open forest and woodland; and *Melaleuca armillaris* scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific.
Genoplesium baueri	Bauer's Midge Orchid		V	#	Low	Associated vegetation community not present within study area.	This terrestrial orchid species grows in open sclerophyll forest or moss gardens on sandstone. Typically the habitat is a drier heathy forest. The species has been recorded from locations between Nowra and Pit
Haloragis exalata subsp. exalata	Square Raspwort	VU	V	#	Low	Associated vegetation community and moisture not present within study area.	Square Raspwort is known from a few scattered locations in south-eastern NSW including the Nepean River (near Sydney), Lake Illawarra, the Wallaga Lake - Tilba area and the Geehi Valley in Kosciuszko National Park. There are isolated records from northern NSW (Mt Kaputar National

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							Park and Tuggolo State Forest). It also occurs in Victoria. Square Raspwort occurs in damp places near watercourses. It regenerates only from seed. The species appears to be favoured by soil disturbance.
Marsdenia viridiflora subsp. viridiflora	Native Pear		E2	2007	Low	Associated vegetation community not present within study area and not recorded on site.	This species has a wide distribution in subcoastal and southern Queensland but has been recorded rarely in NSW and from a disjunct occurrence near Sydney where it occurs as very scattered plants in areas of remnant vegetation. Grows in woodland and scrub and is typically found in Sydney Turpentine Ironbark Forest. Grows in vine thickets and open shale woodland. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range.
Persoonia nutans	Nodding Geebung	EN	E1	1802/#	Low	Associated vegetation community not present within study area, not recorded on site.	Occurs in Hawkesbury/Nepean and Sydney Metropolitan Catchment. Restricted to the Cumberland Plain between Richmond in the north and Macquarie Fields in the south. Core distribution occurs within the Penrith LGA, and to a lesser extent, Hawkesbury LGA. Small populations also occur in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland. *P. nutans* also occurs on Shale/Gravel Transition Forest and Cooks River Castlereagh Ironbark Forest. In Castlereagh Scribbly Gum Woodlands it is found in open woodland with dominant

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							overstorey species being *Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*. The Agnes Banks Woodlands have a similar array of tree species, with the addition of *Banksia serrata* and *Banksia aemula*. *Persoonia nutans* is found on the Agnes Banks and Berkshire Park soil landscapes. Drainage appears to influence the distribution of *P. nutans* as the species is more common on the deeper sands at Agnes Banks. At other locations on the Cumberland Plain it occurs on low rises as opposed to swales or other low lying areas.
Pimelea curviflora var. curviflora		VU	V	#	Low	Associated vegetation community not present within study area and not recorded on site.	Occurring in Hawkesbury/Nepean and Sydney Metropolitan Catchment Authority Areas. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on lateritic soils and shale-sandstone transition soils on ridge tops in woodland. Associated with Dry Sclerophyll forests and Coastal valley grassy woodlands. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots. Flowers October to May.
Pimelea spicata	Spiked Rice-flower	EN	E1	2013/#	Low	Associated vegetation community not present within study area and not recorded on site.	Once widespread on the Cumberland Plain, *Pimelea spicata* occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							In western Sydney, *P. spicata* occurs on an undulating topography of substrates derived from Wianamatta Shale in areas supporting, or that previously supported, the Cumberland Plain Woodland Vegetation Community. Associated species include: *Eucalyptus moluccana, E. tereticornis, E.crebra, Bursaria spinosa*, and *Themeda australis*. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.
Pomaderris brunnea	Brown Pomaderris	VU	V	#	Low	Associated vegetation community not present within study area and not recorded on site.	*Pomaderris brunnea* is found in a very limited area around the Nepean and Hawkesbury Rivers, including the Bargo area. Occurs in the Central West, Hawkesbury/Nepean, Hunter/Central Rivers Catchments. Occurs on clay & alluvial soils. In the Hawkesbury/Nepean region, the species is known to be associated with Dry sclerophyll forests (Cumberland, Upper Riverina, Sydney Coastal, Sydney Hinterland, Sydney Sand Flats), Coastal Floodplain Wetlands and Coastal Valley Grassy Woodlands. Flowers appear in September and October.
Pterostylis gibbosa	Illawarra Greenhood	EN	E1	#	Low	Associated vegetation community not present within study area and not recorded on site.	Known from a small number of populations in the Hunter region, the Illawarra region and the Shoalhaven region. It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland,

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by *Eucalyptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E.tereticornis* and *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by *E. crebra*, Forest Red Gum and *Callitris endlicherii*. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. The Illawarra Greenhood can survive occasional burning and grazing because of its capacity to reshoot from an underground tuber.
Pterostylis saxicola	Sydney Plains Greenhood	EN	E1	1804/#	Low	Associated vegetation community not present within study area and not recorded on site.	Restricted to western Sydney between Freemans Reach in the north and Picton in the south (Hawkesbury/Nepean and Sydney Metropolitan Catchment). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. All species of *Pterostylis* are deciduous and die back to fleshy, rounded underground tuberoids. The time of emergence and withering has not been

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant whither and die following seed dispersal and the plant persists as a tuberoid until the next year.
Pultenaea parviflora		VU	E1	#	Low	Associated vegetation community not present within study area and not recorded on site.	*Pultenaea parviflora* is endemic to the Cumberland Plain, with a core distribution from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. *P. parviflora* may be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays and in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta*. Flowering may occur between August and November depending on environmental conditions.
Streblus pendulinus	Whalebone Tree	EN		#	Low	Associated vegetation community not present within study area and not recorded on site.	The species 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).
Wahlenbergia multicaulis	Tadgell's Bluebell		E2	1998	Low	Associated vegetation community not present within study area and	Grows in forest, woodland and grassland, chiefly in coastal and tablelands districts south from Sydney and the Blue Mountains, west along the Murray River to Mathoura. This

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						not recorded on site.	listing covers 13 known sites, two of which are in northern Sydney on the Hawkesbury soil landscape with the remainder in inner-western Sydney on the Villawood soil landscape (Rookwood, Chullora, Bass Hill, Bankstown, Georges Hall, Campsie, South Granville and Greenacre). Found in damp, disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. In Hornsby LGA it occurs in or adjacent to sandstone gully forest. In Western Sydney it is found in remnants of Cooks River/ Castlereagh Ironbark Forest.