Flora and fauna assessment.

Lot 2, DP 561484,
Reddalls Road,
Dapto, New South Wales

August 2011

lesryk
ENVIRONMENTAL
CONSULTANTS

Cover photographs:

Photo top left: line of planted trees present within the subject site.
Photo bottom left: Character of the site. Photograph taken looking south eastward from the north western corner.
Photo right: Character of the isolated trees present.

Report prepared at the request of:

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Final	Paul Burcher (Botanist) & Deryk Engel (Zoologist)	Deryk Engel	Deryk Engel	05/08/11
				

Please note that, given the dynamic nature of the relevant pieces of environmental legislation considered in this report, the authors consider that this report only has a 'shelf life' of six months. If a development application, review of environmental factors or statement of environmental effect is not submitted to a determining authority for consideration within this time frame, it is recommended that this report be reviewed and revised where required in light of any relevant legislative listings or changes.

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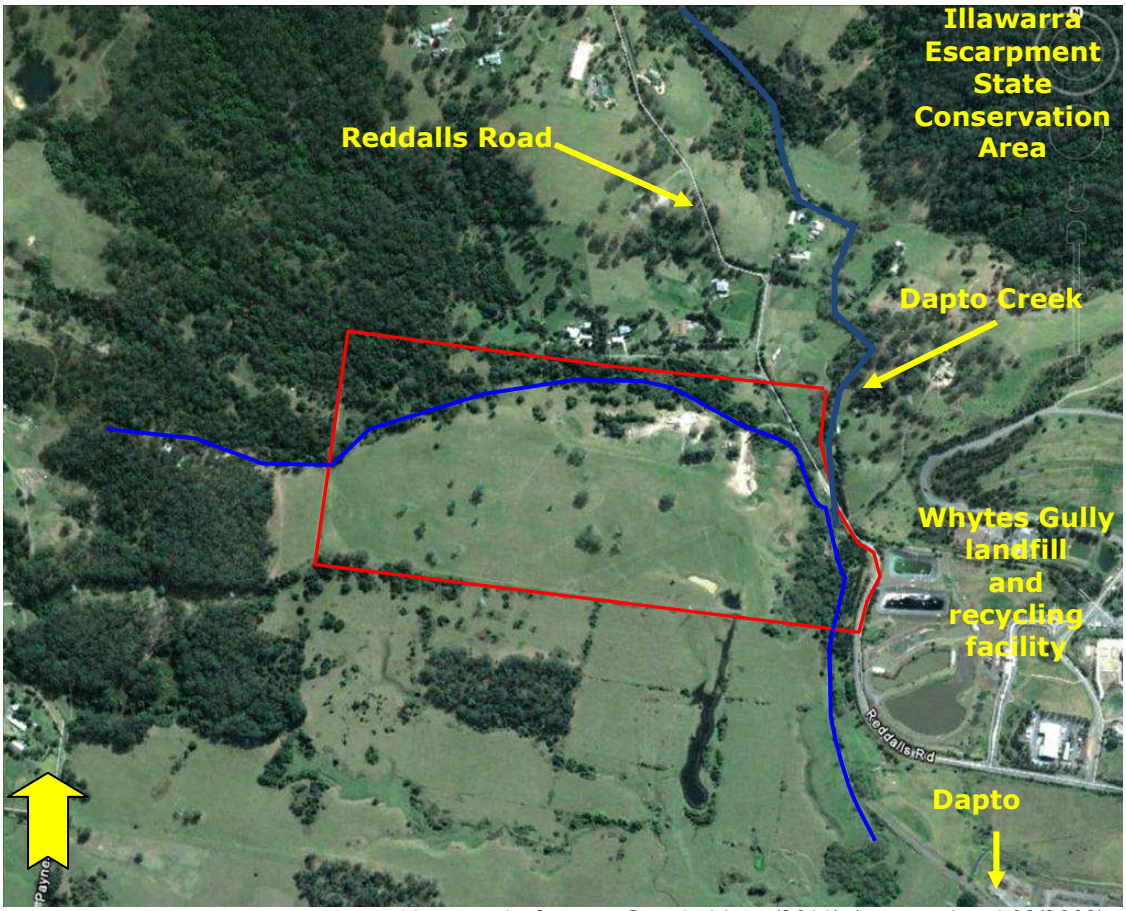
1. Introduction.

This report presents the findings of a vascular flora and vertebrate terrestrial fauna survey of Lot 2, DP 561484, Reddalls Road, Kembla Grange, New South Wales (Figure 1). The ecological investigation has been carried out as the owner of this property is proposing to develop the site to permit the establishment of around 100 light industrial lots. The development of the site would include:

- The construction of an internal network of roads;
- The construction of a new site access across Dapto Creek (this being a bridge structure located in the south eastern corner of the site); and
- The retention of the vegetation that lines the section of Dapto Creek that occurs within the site and a feeder creek.



Not to scale. Source: Google Maps (2011) (picture dated 09/2009).

Figure 1. General boundaries of the subject site (defined by red line).

The vegetation to be retained covers an area of around 6.4 hectares (ha). Recommendations have been made to enhance this vegetation through the removal of exotic plants, the fencing of those stands present and the planting of locally endemic species.

Retention of the vegetation that lines the feeder creek would ensure that a bushland corridor is maintained within the subject site. Retention of this vegetation would provide an east west link for those animals that would be traversing through and across this site.

For the purposes of this investigation:

- Subject site is defined as: the areas directly affected by the works (as per Department of Environment and Climate Change (DECC) 2007), being all lands likely to be disturbed by the industrial development of the site;
- Study area is defined as: the subject site and any additional areas that are likely to be affected by the work, either directly or indirectly (DECC 2007);
- The study region is considered to include the lands that surround the area surveyed for a distance of 10 kilometres (km);
- The proposal is considered to include all activities likely to be undertaken within the area surveyed (as indicated on Figure 1); and
- A local population of a threatened species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area (DECC 2007).

LesryK was engaged to identify those plants, animals and ecological communities present within the subject site and determine whether any of these are threatened at a State or National Level. LesryK was also requested to provide an independent determination as to whether the development in its current form would have a significant effect on any threatened species, populations or ecological communities, or their habitats.

The assessment of possible impacts associated with the undertaking of the proposal is based on a series of field surveys of the study area, a literature review of previous studies undertaken in both the study region and this portion of the Wollongong City Council Local Government Area (LGA), a review of standard databases and the consideration of relevant ecological legislation.

2. Legislative requirements.

A number of State and Commonwealth Acts and policies are relevant to the proposed development and its impact on the area's ecology. The most relevant items are listed in Table 1 below.

3. Environmental setting.

The subject site is approximately 950 metres (m) long and 430m wide and is located within the Wollongong City LGA. The site occurs approximately 2.5 (km) north west of the township of Kembla Grange, this portion of the Wollongong LGA being dominated by semi-rural farming properties. Other land uses present in proximity to the subject site are the Whytes Gully Landfill and Recycling facility, this being located immediately east of the site, industrial developments (1.3km south east of the site) and cleared or partially cleared farming properties.

A portion of the Illawarra Escarpment State Conservation Area is present approximately 900m north east of the subject site. This portion of the park occurs upslope, and east of, Reddalls Road. The Illawarra Escarpment State Conservation Area covers an area of 2,494ha.

The annual average rainfall in the region is around 1278 millimetres (mm) with the greatest falls being experienced between January and March (Bureau of Meteorology 2011). Average temperatures range from a winter low of approximately 9.8°C to a summer high of around 24.4°C (Bureau of Meteorology 2011). Generally, natural elevations within the area surveyed are around 30 metres (m) Above Sea Level.

Table 1: Summary of legislative and policy requirements**.**

Level	Relevant Legislation / Policy	Relevance to study area
Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*)	Under this 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 matter of national environmental significance. Matters of national environmental significance include listed threatened species, ecological communities and migratory species protected under international agreements.
State	NSW *Environmental Planning and Assessment Act 1979* (*EP&A Act*)	Section 5A of this Act requires that a determination be made as to whether a proposed action is likely to have a significant effect on species, populations and ecological communities listed on Schedules 1, 1A and 2 of the *TSC Act*. If there is likely to be a significant impact, a Species Impact Statement is required.
	NSW *Threatened Species Conservation Act 1995/Amendment 2002* (*TSC Act*)	This Act lists those non-aquatic species requiring consideration under Section 5A of the *EP&A Act.* During the field investigations one vulnerable species listed under this Act, the Eastern Bentwing Bat (*Miniopterus orianae oceanensis*), was recorded. In addition, it was considered that several threatened hollow-dependent microchiropteran may also occur.
	NSW *National Parks and Wildlife Act 1974*	This Act defines those species listed as protected in NSW. Protected animals and plants were detected within, and beyond the limits of, the subject site.
	NSW *Noxious Weeds Act 1993*	Part 3, Division 1, Section 13 of this Act requires private landholders and public authorities to control noxious weeds on their own land. Two plants listed as noxious weeds in the Wollongong LGA were found during the survey. Under this Act "the growth and spread of these plants must be controlled according to the measures specified in a management plan published by the local control authority".
	NSW State Environmental Planning Policy No. 44 (SEPP 44) – Koala Habitat Protection	The Wollongong LGA is listed on Schedule 1 of the SEPP 44. Clause 8 of this SEPP requires consideration of whether a proposal will affect core Koala habitat as defined in the SEPP. If so, a plan of management for the Koala must be prepared in accordance with Part 3 of the SEPP. Whilst considered potential Koala habitat, the subject site does not constitute "core" Koala habitat (refer to Section 8.3.).

The subject site is predominantly cleared and used for the grazing of cattle. Portions of the site have been levelled and filled through the placement of imported material. Several sheds are present, as are stockpiles of construction materials. Drainage lines are present along the northern and eastern boundaries of the site. The northern line is a feeder that flows in an easterly direction and discharges into Dapto Creek, whilst Dapto Creek defines the eastern boundary of the property, this flowing in a southerly direction. Both drainage lines were flowing at the time of the field investigations and each supports riparian vegetation (this composed of both native and exotic plants). The site also supports two farm dams.

For reference, a photographic record of the site has been provided (Appendix 1).

Through reference to the listings provided under both the *EPBC* and *TSC Acts*, it is noted that no gazetted areas of critical habitat for any flora or fauna species, populations or communities occur within, or in the vicinity of, the study area. Critical habitats are areas of land that are crucial to the survival of particular endangered species, populations and/or ecological communities.

4. Literature review and field guides.

To identify the diversity of vegetation communities, flora and fauna species known for, or potentially occurring in, the study area, previous ecological studies prepared in the surrounding region, and known databases, were consulted prior to the undertaking of any fieldwork. The identification of known, or potentially occurring, native species within this portion of the Wollongong LGA, particularly those listed under the Schedules to the *EPBC* and/or *TSC Acts*, thereby permits the tailoring of the field survey strategies to the detection of these animals and plants, their vegetation communities and/or necessary habitat requirements. By identifying likely species, particularly any threatened animals or plants, the most appropriate species-specific survey techniques may be selected should their associated vegetation communities/fauna habitats be present. The undertaking of a literature search also ensures that the results from surveys conducted during different climatic, seasonal and date periods are considered and drawn upon as required. This approach therefore increases the probability of considering the presence of, and possible impacts on, all known and likely native species, particularly any plants and animals that are of regional, state and/or national conservation concern. This approach also avoids issues inherent with a one off "snap shot" study.

The studies, reports and databases referred to include:

- The native vegetation of the Illawarra Escarpment and Coastal Plain (DECC 2008);
- Mapping and description of the vegetation of the south-east NSW (Tozer *et al.* 2010);
- The Draft Illawarra Biodiversity Strategy (Lemmon 2010);
- A flora and fauna assessment undertaken as part of the Illawarra Water Quality Project, Reddalls Road, Kembla Grange (LesryK Environmental Consultants 1993);
- A bushland regeneration plan prepared for the Illawarra Escarpment State Recreation Area and Berkeley Nature Reserve (Lesryk Environmental Consultants 1997);
- A flora and fauna assessment undertaken in relation to the proposed expansion of the solid waste and energy recycling facility (SWERF), Reddalls Road, Kembla Grange (LesryK Environmental Consultants 2001);
- A fauna survey undertaken as part of the West Kembla Grange Biodiversity Assessment (this encompassing both the subject site and surrounding areas) (LesryK Environmental Consultants 2002);
- A fauna audit of the lands present within and close to the boundaries of the Illawarra Water Filtration Plant, Reddalls Road, Dapto (Lesryk Environmental Consultants 2009);
- Wollongong City Council's State of the Environment Report 2009-2010 (Wollongong City Council 2010);
- The Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Online Database (DSEWPC 2011);
- The Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (OEH 2011a); and
- The OEH's Threatened Species website (OEH 2011b).

Other reports and documents referred to are provided within the bibliography section of this report.

When accessing the DSEWPC and OEH databases, the search area specified was a 5km radius around the study area.

All these databases and reports were reviewed and drawn upon where relevant. Whilst reviewing these documents, particular attention was paid to identifying records of species listed under the Schedules to the *EPBC* and/or *TSC Acts*, animals, plants and vegetation communities that have been recorded in the region and that may occur within, or in the vicinity of, the study area.

Field guides and standard texts used include:

- Harden (1992, 1993, 2000 and 2002), Brooker and Kleinig (2006) and Costermans (1996) (used for the identification of plants);
- Cogger (2004) (reptiles and frogs);
- Simpson and Day (2008) (birds);
- Van Dyck and Strahan (2008) (non-flying mammals);
- Churchill (2008) (insectivorous bats); and
- Triggs (1996) (identification of scats, tracks and markings).

The naming of those species recorded or known for the region follows the nomenclature presented in these texts or as described on the Schedules to the *EPBC* and *TSC Acts*.

It is noted that the currently accepted scientific names for some of the threatened animals previously recorded in this locality are not consistent with the names used/provided under either the *TSC* or *EPBC Acts*. In these instances, the nomenclature used within this report follow the current approved scientific conventions.

Stands of vegetation were described by their structural characteristics according to Specht (1981), and mapping and community names by DECC (2008). Where applicable, endangered ecological communities were classified and named according to the NSW Scientific Committee's Final and Preliminary Determinations (various dates).

The conservation significance of those plants, animals and vegetation communities recorded is made with reference to:

- A publication on Rare or Threatened Australian Plants (ROTAP's) (Briggs and Leigh 1996);
- Wollongong City Council's State of the Environment Report (Wollongong City Council 2010);
- The *EPBC* and/or *TSC Acts*; and
- Vegetation mapping prepared for the Illawarra region as part of a bioregional assessment of the Illawarra Escarpment and coastal plain (NSW National Parks and Wildlife Service [NPWS] 2002).

4.1. Results of the literature review.

4.1.1. Flora.

4.1.1. (a) Threatened flora species.

A review of the OEH database (OEH 2011a) indicated 12 threatened plants have been previously recorded within a 5km radius of the subject site (Table 2). Based on the review of standard botanical texts, there is the possibility that the area investigated could provide habitat for several of these species. During the field survey, if suitable habitat for one or more of these plants was present, targeted searches for these species were undertaken.

4.1.1. (b) Vegetation mapping.

DECC (2008) updated the mapping and classification of the vegetation of the Illawarra Escarpment and Coastal Plain previously done by the NPWS (NPWS 2002). This mapping indicates that the following vegetation communities occur within the subject site:

- Moist Coastal White Box Forest; and
- Lowland Woollybutt-Melaleuca Forest.

The mapping indicates that the Moist Coastal White Box Forest in the north-west of the site has "moderate disturbance". The Lowland Woollybutt-Melaleuca Forest is indicated as being composed of "scattered trees".

Table 2. Plant species of conservation significance previously recorded in the study region.

Key
CE – Critically Endangered E – Endangered
EP – endangered population V – Vulnerable
Species in **bold** have been recorded within 5km of the subject site.

Species	Legislation		Habitat[1]
	EPBC Act	*TSC Act*	
White-flowered Wax Plant ***Cynanchum elegans***	E	E	Usually on the edge of dry rainforest vegetation but also in littoral rainforest; coastal scrubs; Forest Red Gum woodland; and Spotted Gum open forest/woodland.
Chorizema parviflorum		EP[2]	Heath and sclerophyll woodland and forest on heavy soils.
Pultenaea aristata	V	V	Restricted to the Woronora Plateau where it occurs in dry sclerophyll woodland or wet heath on sandstone.
Biconvex Paperbark *Melaleuca biconvexa*	V	V	Scattered and dispersed populations of this species are found in the Jervis Bay and the Gosford-Wyong areas. It occurs in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.
Haloragis exalata subsp. exalata var. exalata	V	V	Protected and shaded damp situations in riparian habitats.
Pimelea spicata Spiked Rice-flower	E	E	In the Illawarra region, P. spicata is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *Eucalyptus tereticornis, E. eugenioides, Themeda australis* and *Lomandra longifolia.* Associated species in the coastal grasslands include *Themeda australis, Lomandra longifolia, Imperata cylindrica, Acacia sophorae, Banksia integrifolia* and *Westringia fruiticosa.*
Solanum celatum		V	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia growing in rainforest clearings and wet sclerophyll forests.
Caladenia tessellata Thick-lipped Spider-orchid,	V	V	Little is known of the precise habitat requirements of this species. In NSW it is generally found in grassy dry sclerophyll woodland on clay loam or sandy soils, less commonly in heathland on sandy loam soils (Duncan 2010).
Leafless Tongue-orchid *Cryptostylis hunteriana*	V	V	Occurs in a range of communities, including swamp-heath and woodland.
Pterostylis gibbosa **Illawarra Greenhood**	E	E	Locally known from only five locations, including three sites in the Illawarra (two sites at Yallah and one at Albion Park). Associated vegetation is woodland dominated by Forest Red Gum (*Eucalyptus tereticornis*) and White Feather Honey-myrtle (*Melaleuca decora*) with an open, grassy understorey.
Pterostylis saxicola Sydney Plains Greenhood	E	E	Small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.
Kangaloon Sun-orchid *Thelymitra sp. Kangaloon (D.L.Jones 18108)*	CE	CE[3]	Restricted to the Fitzroy Falls/Robertson/Kangaloon area where it grows in seasonally swampy sedgeland (Threatened Species Scientific Committee 2008).

[1] OEH 2010b unless otherwise stated.
[2] In the Wollongong and Shellharbour LGA's.
[3] Preliminary determination.

Lowland Woollybutt-Melaleuca Forest is a component of the *TSC Act* listed endangered ecological community Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (hereafter referred to as Illawarra Lowlands Grassy Woodland).

Four "disturbed landscapes" are also indicated as occurring being:

- Weeds and Exotics;
- Acacia Scrub;
- Artificial Wetlands; and
- Cleared Land.

Figure 2 illustrates the distribution of these communities on site.

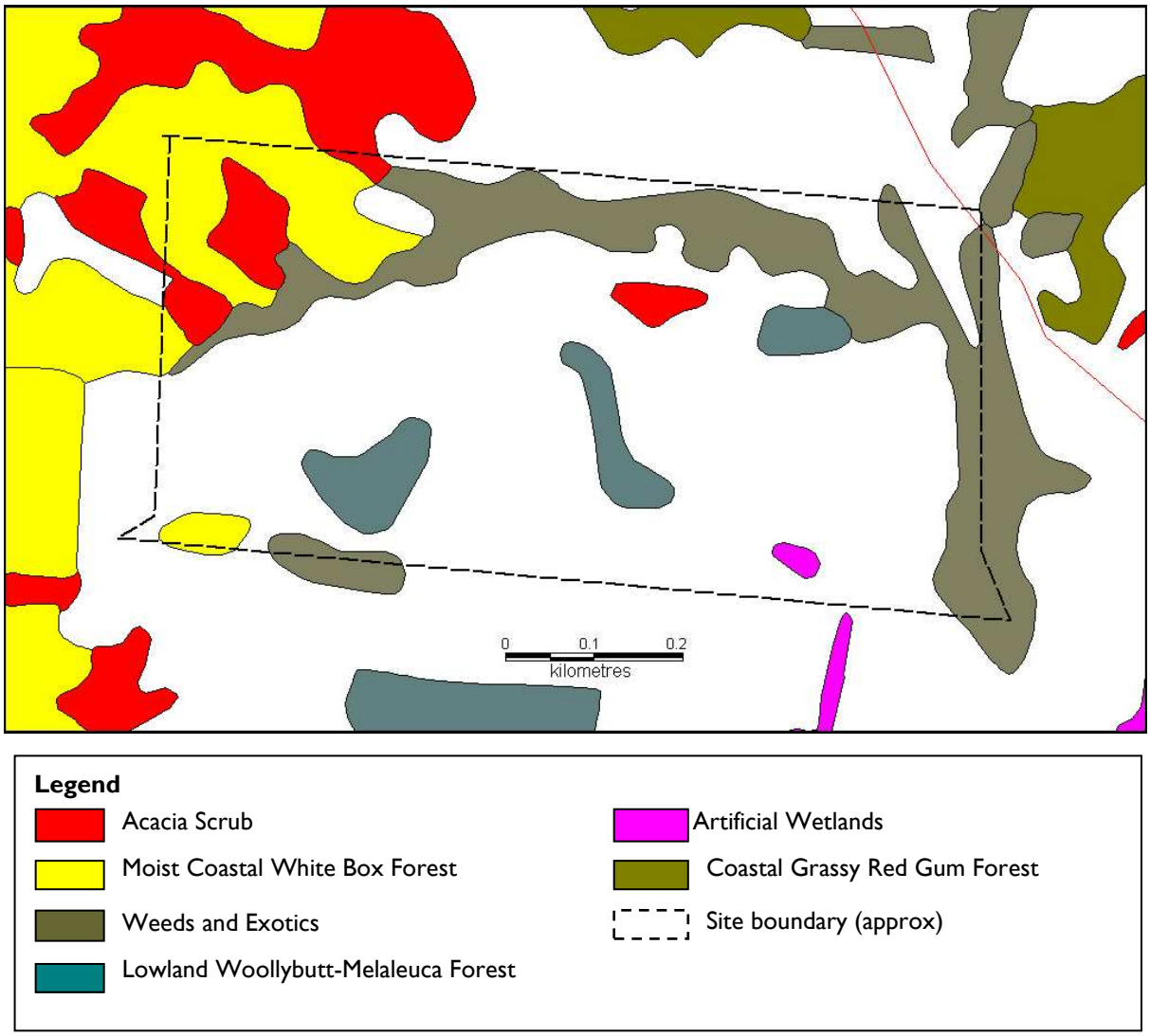


Figure 2. Extract from Illawarra region mapping (DECC 2088).

The vegetation of south-east NSW (Tozer *et al.* 2010) synthesised mapping and classification from a number of studies including NPWS (2002) and DECC (2008). It indicates the following communities as occurring at the subject site:

- South Coast Lowland Swamp Woodland;
- South Coast Grassy Woodland; and
- Warm Temperate Layered Forest (Figure 3).

Both Illawarra Lowland Swamp Woodland and South Coast Grassy Woodland are components of the *TSC Act* listed endangered ecological community Illawarra Lowlands Grassy Woodland.

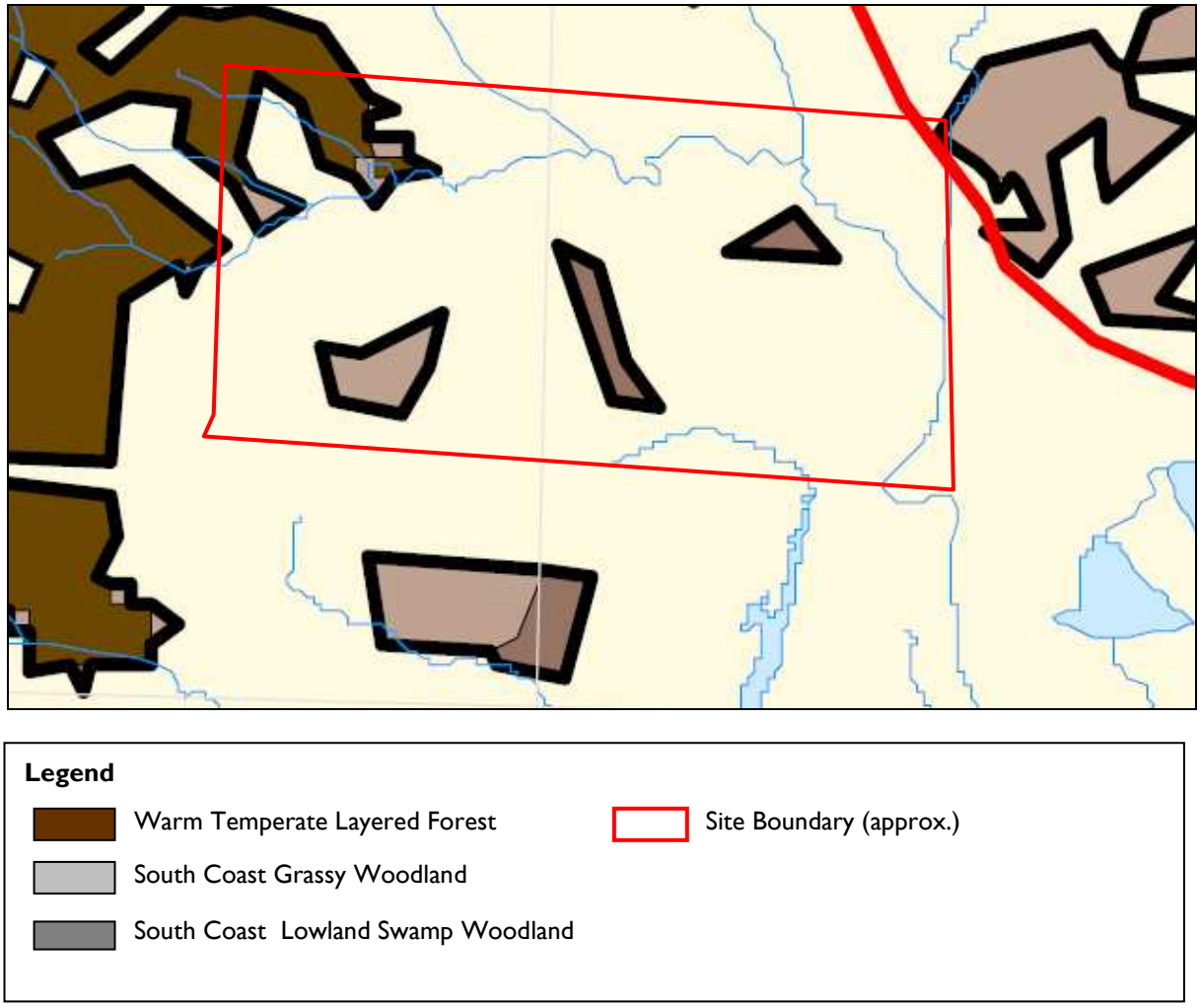


Figure 3. Extract from SE NSW mapping (Tozer *et al.* 2010).

Table 3 summarise the relationships between regional vegetation classifications and those at a State scale.

4.1.2. Fauna.

Consultation of the OEH and DSEWPC databases (OEH 2011a, DSEWPC 2011), and previous ecological investigations undertaken within the study region, indicates that 14 state and/or nationally listed threatened species have been previously recorded within a 10km radius of the subject site (Appendix 2). For reference, the habitat requirements of those threatened species previously recorded in the surrounding region are provided in Appendix 3. Appendix 3 also provides a consideration of the "likelihood of occurrence" of these animals occurring as a resident population within the subject site.

Table 3. Relationship between vegetation classification systems.

Classification			Endangered Ecological Community?
Illawarra DECC (2008)	SE NSW Tozer *et al* 2010	State Keith 2004	
Moist Coastal White Box Forest	Warm Temperate Layered Forest	North Coast Wet Sclerophyll Forests	No
Lowland Woollybutt-Melaleuca Forest	South Coast Grassy Woodland	Coastal Valley Grassy Woodlands	Yes –Illawarra Lowlands Grassy Woodland (*TSC Act* only)
	Illawarra Lowland Swamp Woodland	Coastal Valley Grassy Woodlands	

5. Field survey methods.

Surveys of the study area were undertaken by Paul Burcher $_{(B.App.\ Sc)}$ (botanist) on the 23rd of June, and by Deryk Engel $_{(B.Env.Sc.HONS)}$ (zoologist) on the 8th, 11th and 14th of July, 2011.

The weather conditions experienced during the diurnal site investigations were:

- 23rd June – clear skies, mild temperatures (21°C) and light winds from the southeast;
- 8th July – clear skies, mild temperatures (18°C) and light southerly winds;
- 11th July – clear skies, cool temperatures (16°C) and still; and
- 14th July – clear skies, cool temperatures (14°C) and still.

The strategy adopted for the survey was to conduct foot traverses across the subject site, during which time the structure of the vegetation communities and fauna habitats present were recorded. The diversity of plants and animals present within, or in close proximity to, the subject site was also noted. The purpose of the field investigation was to locate any plants, animals or vegetation communities that are of regional, state, and/or national conservation significance. The 'Random Meander Method' (as per Cropper 1993) (or a modification of this that is applicable to fauna surveys) was employed during the field investigations. This method is suitable for covering large areas and for locating any rare species (and their associated vegetation communities/habitat types) that may occur within a project site.

The survey methods employed during the field investigations were:

- The direct observation of any fauna species present within, or adjacent to, the subject site;
- The identification of all plants within the areas of likely disturbance, including both direct and indirect impacts;
- The identification of the structure of those vegetation communities and fauna habitats present;
- Diurnal and nocturnal call identifications of fauna species with all calls being identified in the field;
- Spotlighting;
- Call playbacks targeting the state listed Powerful (*Ninox strenua*) and Sooty (*Tyto tenebricosa*) Owls;
- Use of a Reconyx™ infrared camera;
- Use of a Wildlife Acoustics SM2 Song Meter™;
- Echolocation detection targeting insectivorous bats (microchiropterans);
- The identification of any indirect evidence such as tracks/scratchings that would suggest the presence of any fauna species; and
- Ground debris, leaf litter and tree bark searches for sheltering reptiles and frogs.

Where required, further details on the above survey methods are provided below.

For reference, Table 4 presents the method employed, and the survey effort accumulated by the completion of the field investigations.

Table 4. Cumulative survey effort.

Method	Total effort
Botanical survey	5 hours
Call playbacks	1 hour
Spotlighting	2 hours
Infrared camera	3 days
Song Meter	12 hours
Echolocation	36 hours

Whilst conducting the fauna survey, efforts were made to document the diversity, structure and value of those habitats present within the area surveyed for those protected and threatened species recorded or potentially occurring. This involved assessing the structure of the fauna habitats present and determining their significance for native species. Whilst conducting the habitat assessments, efforts were made to identify features such as known feed trees, mature trees with hollows, connectivity of fauna corridors, aquatic environments and other habitat features important to the life cycle needs of those threatened species known or likely to occur in the study region.

5.1. Study limitations.

It is acknowledged that the field investigations were undertaken during the winter months, when temperatures experienced on site ranged from 9 to 18 degrees. Several species, such as the reptiles, frogs and microchiropterans, hibernate during these months or have migrated north (i.e. migratory birds). In addition, some plants are not exhibiting above ground growth or flowers. To overcome this limitation, if habitat suitable for a threatened species was observed, a precautionary approach was adopted. This approach assumes that, if suitable habitat is present, then a threatened species (be it flora or fauna) is likely to occur.

No limitations due to adverse climatic conditions (i.e. rain or strong winds) were encountered during the course of the field surveys.

Some portions of the site that are present along the northern creekline were difficult to access due to the dense growth of Lantana (*Lantana camara*). However, this area is well beyond the footprint of the proposed development and is unlikely to be affected by the proposal. South of the creekline, no limitations in regards to site access were encountered.

5.2. Call playbacks.

On the 8th of July call playbacks targeting the presence of the Powerful and Sooty Owls were carried out at two (2) locations (Figure 4). The coordinates of the call playback locations were recorded with a Global Positioning System (GPS)[4], these being:

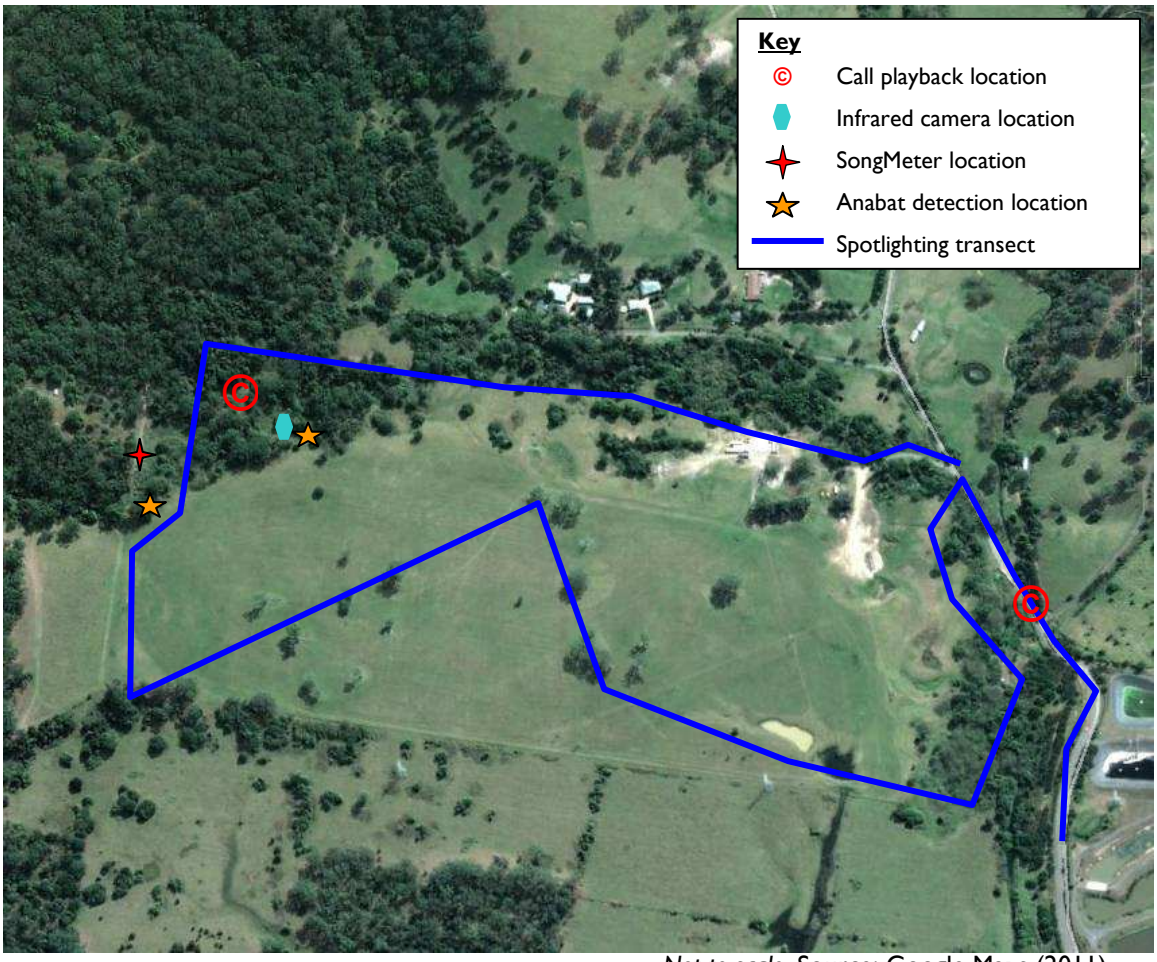
- Location 1, north western limits of subject site: Easting [E] 296699; Northing [N] 6184696; and
- Location 2, Reddalls Road: E297499; N6184529.

The playback sessions involved broadcasting characteristic calls of both the Powerful and Sooty Owl through a loud hailer that was connected to an iPod™. Prior to undertaking the call playbacks, a ten minute listening period was undertaken to determine if either of these species were present. The calls (which were taken from either Stewart 1999 or Buckingham and Jackson 1990) were then broadcast

[4] GPS system used is WGS84. Accuracy ranged from ±3m to 6m.

for 5 minutes per species. To detect any responses to the call playbacks, a ten minute listening period was undertaken at the completion of the playback session.

In total an individual call playback session lasted 30 minutes.



Not to scale. Source: Google Maps (2011).

Figure 4. Indicative locations where specific survey methods were employed.

5.3. Spotlighting.

Spotlighting (using 163 lumen hand-held spotlights) was undertaken during the nocturnal search conducted on the 8th of July. Spotlighting was undertaken either on foot or by motor vehicle, with those tracks, clearings and access ways present within the subject site being targeted.

5.4. Infrared camera.

One Reconyx™ infrared camera was set within the study area (Figure 4). For reference, the GPS coordinates of this location was E296765; N6184636.

The camera employs active infrared (AIR) systems, this requiring an animal to "break" an invisible "beam". The camera operates diurnally and nocturnally. The camera was placed out on the site on the 11th of June and collected four days later.

The camera was set to a sensitivity of high and a photo interval of 3/ten seconds. The camera was placed at a height of around 1.5m above ground level and angled slightly downwards (as per the directions provided in the unit's instruction manual).

To entice animals into the camera's field of view, a lure scented with truffle oil was used. This was placed at a distance of around 5m in front of the camera and secured to the ground by a large steel peg. This distance was selected as it is within the unit's motion detector coverage range. The lure is constructed from 250mm long PVC piping, into which has been drilled a number of holes. Foam is placed in the piping and into this the truffle oil is poured.

Based on a review of the unit's date stamp, it was possible to determine if the camera was still operating at the time of collection.

5.5. Song Meter.

A Wildlife Acoustics SM2 Song Meter™ was placed out on the site on the 11th of June and collected four days later. This unit was programmed to record calls during four scheduled intervals, these being from:

- 7pm to 8pm;
- 9pm to 10pm;
- Midnight to 1am; and
- 3am to 4am.

The Song Meter was placed at one location within the site (Figure 4), this being in the north western corner of the property adjacent to the northern feeder creek. The GPS coordinates of this site was E296586; N6184574.

Calls were analysed in-house using Cornell Laboratory of Ornithology's program "Raven Lite 1.0™".

5.6. Echolocation.

Two Anabat ZCAIM™ echolocation detectors were used during the site investigations. These detectors were used to identify the possible presence of any microchiropterans that may be present. The detectors were established at two sites (Figure 4), the units being turned on the 11th of June. The detectors were left in place and collected four days later (i.e. three nights of echolocation recording being accumulated). The units were calibrated at the time of collection to ensure that they were still operating. The GPS coordinates of the detection locations were:

- Western limits of site: E296586; N6184574; and
- Central northern portion of the site: E296774; N6184636.

The echolocation sites were selected as they corresponded to those habitats likely to be used by microchiropterans during their foraging and dispersal periods (i.e. woodlands and habitat ecotones) or as roosting sites (i.e. dense vegetation was present).

Any calls recorded were analysed in house using Anabat 6.3 computer software.

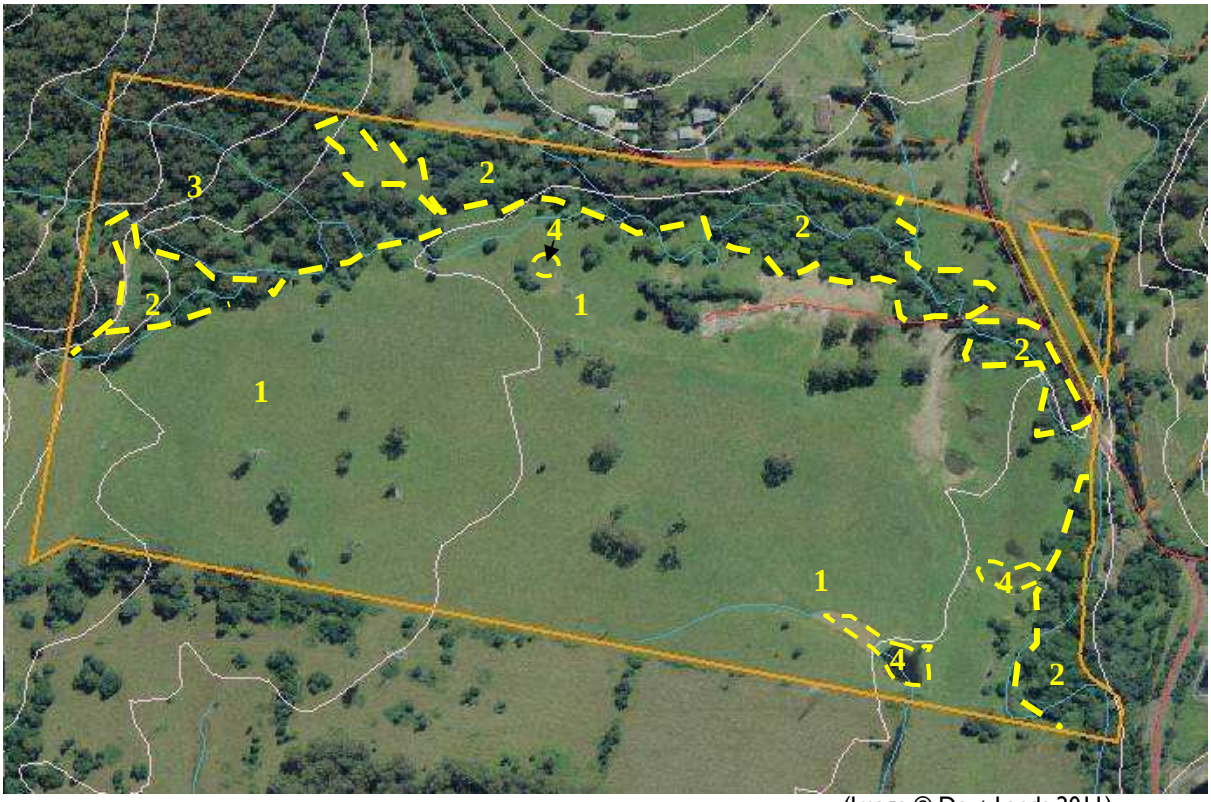
6. Flora results.

6.1. Vegetation description.

Three vegetation communities were recorded within the subject site, these being:

- Cleared land;
- Wattle Scrub/Weeds and Exotics;
- Moist Coast White Box Forest; and
- Artificial Wetlands.

A brief description of each follows whilst their distribution on site is shown on Figure 5.



(Image © Dept Lands 2011)

Legend

1 - Cleared land
2 - Wattle Scrub/Weeds & Exotics
3 - Moist Coast White Box Forest
4 - Artificial Wetlands

Vegetation community boundary
Drainage line
Site boundary

Figure 5. Site vegetation.

Cleared land

For some time, most of the site has been used for cattle grazing. The site has been cleared of native vegetation and oversown with pasture grasses such as Narrow-leafed Carpet Grass (*Axonopus fissifolius*), Paspalum (*Paspalum dilatatum*), Couch (*Cynodon dactylon*), Parramatta Grass (*Sporobolus africanus*), and Kikuyu (*Pennisetum clandestinum*) along with herbs such as Clover (*Trifolium repens*) and Groundsel (*Senecio madagascariensis*). Some eucalypts have been kept to shade stock including Cabbage Gum (*Eucalyptus amplifolia*), Forest Red Gum (*E.tereticornis*), Blackbutt (*E.pilularis*), Coast White Box (*E.quadrangulata*), Woolybutt (*E.longifolia*) and White Feather-myrtle (*Melaleuca decora*). These trees range in height from 10m to 25m tall. Near the entrance track there is a row of planted Tallowwoods (*E.microcorys*) and a Flooded Gum (*E.grandis*).

Wattle Scrub/Weeds and Exotics

What would have been moist eucalypt open forest along the creekline in the north of the site appears to have been cleared some decades ago. In its place is a scrub/closed forest dominated by Maiden's Wattle (*Acacia maidenii*) and Black Wattle (*A.mearnsii*) that is to 10m tall. Associated species in the canopy are Cheese Tree (*Glochidion ferdinandi*), Red Ash (*Alphitonia excelsa*), Guioa (*Guioa semiglauca*) and the introduced Coral Tree (*Erythrina x sykesii*), which is particularly common in the south-east corner of the property. The understorey is dominated by the introduced Lantana (*Lantana camara*) that is to 2m in height. The groundcover tends to be sparse, apart from in gaps, which have a dense

growth that is variously dominated by pasture grasses, Mist Flower (*Ageratina riparia*), the sedge *Carex longebrachiata*, Scurvy Weed (*Commelina cyanea*) and Stinging Nettle (*Urtica incisa*).

Moist Coast White Box Forest

In the north-western section of the site the native vegetation is more intact. Here there is open forest dominated by Coast White Box to 30m occurring above those native species that form the canopy of the Wattle Scrub. Further up the creek other rainforest species such as Lilly Pilly (*Acmena smithii*), Flintwood (*Scolopia braunii*) and Cabbage Tree Palm (*Livistona australis*) are present. Lantana is present in patches and the groundcover tends to be dominated by *Carex longebrachiata*, Mat-rush (*Lomandra longifolia*), Native Raspberry (*Rubus parvifolius*), Weeping Meadow Grass (*Microlaena stipoides*), Rasp Fern (*Doodia aspera*), and Maidenhair Fern (*Adiantum aethiopicum*). Twiners such as Wonga Wonga Vine (*Pandorea pandorana*) and Monkey Vine (*Parsonsia straminea*) are common.

Artificial Wetlands

Margins of a dam in the south-east of the site and small depressions and drainage swales elsewhere on site are vegetated with a variety of wetland plant species such as Common Rush (*Juncus usitatus*), Knotweeds (*Persicaria* spp) and the sedge, *Cyperus eragrostis*. In the deeper water of the dam, Spike Rush (*Eleocharis sphacelata*) and Water Primrose (*Ludwigia peploides subsp. montevidensis*) are present.

6.2. Plant species.

A total of 80 plants were detected during the survey, 35 of which are introduced species (Appendix 4).

6.2. (a) Threatened species.

No species listed as threatened on either the *TSC* or *EPBC Acts* were detected. Of those threatened species listed in Table 2, there are two that may occur in the site's Moist Coast White Box Forest these being *Solanum celatum* and White-flowered Wax Plant (*Cynanchum elegans*). Though potentially present, these plants were not detected as this community was not intensively surveyed. As the site's Moist Coast White Box Forest would be retained and is unlikely to be affected by the proposed development, it is considered there are unlikely to be any impacts on these species should they be present.

6.2. (b) Noxious weeds.

Two species listed on the *Noxious Weeds Act 1993* as noxious weeds in the Wollongong LGA occur at the subject site. These are Lantana and Blackberry (*Rubus fruiticosus* spp.agg), both of which occur along the northern creekline with Lantana being a dominant understorey species. Both species are also weeds of national significance under the Australian Weeds Strategy (Natural Resource Management Ministerial Council 2006).

Under the *Noxious Weeds Act*, the control category for both of these weeds is "4", which requires that "the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed." It is recommended that these species be controlled as part of a plan for overall site vegetation management.

6.3. Conservation significance of the vegetation.

Whilst most of what is now cleared land on the site would have been what is now termed Illawarra Lowlands Grassy Woodland, there are no intact, viable remnants of this *TSC Act* listed endangered ecological community at the subject site. Remnant trees that characterise this community (Cabbage Gum, Blackbutt, Forest Red Gum, Woolybutt and White Feather-myrtle) are present and a number

of them are of a significant size and age and bear hollows suitable for habitation by a range of fauna species. Therefore, efforts should be made to retain as many of these trees as possible.

The site's Moist Coast White Box Forest is part of the Warm Temperate Layered Forest of Tozer *et al.* (2010). This community has some conservation significance as it is estimated that only 17% of its extant distribution within the Illawarra region is reserved (Lemmon 2010). However, it is not an endangered ecological community listed on the *TSC* or *EPBC Acts*. Furthermore, it is unlikely that the proposal would have any impact on this community as it occurs well beyond the development footprint.

The site's Wattle Scrub/Weeds and Exotics, Artificial wetlands and those parts of the Cleared Land that do not have remnant trees are considered to have no conservation significance for flora.

7. Fauna results.

7.1. Species recorded.

By the completion of the field investigation, seven native mammals, forty-three native birds, one reptile and one frog had been recorded (Appendix 2). In addition, a number of introduced species were also detected (Appendix 2).

In regards to the detection of those native species recorded:

- The Common Brushtail Possum (*Trichosurus vulpecula*) was spotlit occupying the vegetation that lines the feeder creek during the nocturnal investigation;
- Calls of the Sugar Glider (*Petaurus breviceps*) were obtained through use of the SongMeter;
- The microchiropterans, Eastern Horseshoe-bat (*Rhinolophus megaphyllus*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Little Forest Bat (*Vespadelus vulturnus*) and Eastern Bentwing Bat (*Miniopterus* (*schreibersii*) *orianae oceanensis*), were identified from the analysis of echolocation recordings obtained;
- All of the native birds recorded were either seen or heard calling within, adjacent to or flying over the subject site;
- A deceased Eastern Blue-tongued Lizard (*Tiliqua scincoides*) was found whilst traversing the site; and
- The Common Eastern Froglet (*Crinia signifera*) was heard calling from each of the water bodies (drainage lines and dams) present.

In regards to those specific survey methods employed:

- The Common Brushtail Possum was the only species spotlit;
- No owls responded to the call playbacks. Similarly no owls were spotlit or heard calling during the nocturnal session;
- Images of the introduced Rusa Deer (*Cervus timorensis*) were the only species obtained through use of the infrared camera;
- Calls of the Eastern Horseshoe-bat, Gould's Wattled Bat, Chocolate Wattled Bat, Little Forest Bat and Eastern Bentwing Bat, were obtained through use of the echolocation detectors; and
- Calls of the Sugar Glider (*Petaurus breviceps*), Common Eastern Froglet (*Crinia signifera*) and several common birds were obtained through use of the SongMeter.

Of those species recorded, one, the Eastern Bentwing Bat (*Miniopterus* (*schreibersii*) *orianae oceanensis*), is listed as Vulnerable under the *TSC Act*. During the course of the field surveys, no species listed under the *EPBC Act* were detected.

The Eastern Bentwing Bat is primarily a cave-dwelling bat, though it will also occupy human created environments such as abandoned mines and road culverts (authors field notes, Churchill 2008). This species is distributed along the east coast and ranges of Australia from south-eastern South Australia through to Cape York in Queensland (Churchill 2008, Van Dyck and Strahan 2008). Estimates of

home ranges for the Eastern Bentwing Bat are in the order of 65km, a distance this species may travel from its roosting site during its foraging periods (Churchill 2008). This species forages within habitats that are well timbered, though they have been recorded in heavy developed urban areas (author's field notes) and open grasslands (Churchill 2008). Annually, discrete populations of females will travel great distances to a maternity cave where the temperature, humidity and physical dimensions permit breeding and rearing of young (Churchill 2008). Nursery caves may support up to 100,000 females and juveniles and these may be used by a number of groups year after year (Churchill 2008, Van Dyck and Strahan 2008).

Within the subject site, no caves or suitable cave substitutes are present. The Eastern Bentwing Bat is expected to have been detected whilst foraging over or within the subject site, as opposed to roosting in this area. Given the proximity of the Illawarra Escarpment and its associated sandstone cliff lines, this microbat is expected to be roosting in these adjacent environments, as opposed to the subject site itself. The Eastern Bentwing Bat was recorded through use of the echolocation detector that was placed within the north western corner of the site. Within this area suitable insect attracting plants are present. These plants would provide foraging opportunities for this and other insectivorous microchiropterans. As noted this vegetation would be retained within the site's layout. Due to its tolerance of developed areas, combined with the retention of the vegetation that lines those drainage lies present within the subject site, it is not considered that this species would be adversely affected by the scope of the works proposed. The redevelopment of the subject site would not remove any Eastern Bentwing Bat roosting, foraging or breeding habitat. As such, the development would not present a significant effect on the local viability of this species.

Though the proposal is considered unlikely to have a significant effect on the Eastern Bentwing Bat, an assessment using the criteria provided under Section 5A of the *Environmental Planning and Assessment Act 1979* has been undertaken (refer to section 7.1.2).

During the course of the field survey three hollow utilising microbats, Gould's Wattled Bat, Chocolate Wattled Bat and Little Forest Bat, were detected. As noted in Section 5.1, the field surveys were undertaken during the winter months. Within the subject site hollow-bearing trees were recorded. As such, there is the potential that these animals maybe roosting (and possibly breeding) on site. As hollow-dependent microchiropterans were recorded, and as the study was undertaken during winter, there is the potential that, during the summer months, other hollow utilising microbats could be present. Within the study region an additional eight hollow-dependent microchiropterans have been recorded (Appendix 2). Two of these, the Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*), are listed as Vulnerable under the *TSC Act*. Given the winter timing of the study, and as resources are present within the subject site for these species, it is considered applicable to adopt a precautionary approach. Therefore, an assessment using the criteria provided under Section 5A of the *Environmental Planning and Assessment Act 1979* has been undertaken (refer to section 8.2).

The remainder of the native species recorded are protected, as defined by the NSW *National Parks and Wildlife Act 1974*, but considered to be common to abundant throughout the surrounding region. These animals would be regularly recorded in the surrounding region in association with their documented habitat types. These animals would not be solely reliant upon the habitats present within the disturbed/cleared portions of the subject site such that the removal or further disturbance of these would threaten the occurrence of these species. The species recorded are all expected to be present within both the subject site and surrounding region post-development.

Due to their ability to adapt to, and be tolerant of, modified environments, none of the native species recorded would be adversely affected, such that the viability of a local population of that animal would be placed at risk of extinction.

It is noted that five of the species recorded, being the Pacific Black Duck (*Anas superciliosa*), Chestnut Teal (*Anas castanea*), Australian Wood Duck (*Chenonetta jubata*), Masked Lapwing (*Vanellus miles*) and Black-shouldered Kite (*Elanus axillaris*), are listed as occurring within a Family (Families as in the Taxonomic classification system) of birds listed as migratory under the *EPBC Act*. These birds were recorded within, adjacent to or in the vicinity of the subject site in association with their documented habitat types (i.e. the ducks were recorded either on the farm dams, from Dapto Creek or in the adjacent recycling facility's ponds whilst the Black-shouldered Kite was observed perched on a

transmission stanchion). Although listed as occurring within a Family of migratory birds, these species are not considered to be migratory within Australia. As such, no further assessment (giving consideration to the Significant Impact Guidelines provided in association with the *EPBC Act* for a migratory species) is required.

7.1. (b) Rusa Deer (*Cervus timorensis*).

As noted images of the introduced Rusa Deer (*Cervus timorensis*) were obtained through use of the infrared camera. The images obtained included bucks, does and fawns (Appendix 1). During the field survey evidence of vegetation trampling and grazing, and ground disturbance, by this species was obtained. The occurrence of this animal is considered to be having a negative impact on the quality of the native vegetation present.

"Herbivory and environmental degradation caused by feral deer" is listed as a key threatening process under the *TSC Act*. Though the management of this introduced pest is beyond the abilities and obligations of the proponent, minimising the influence of this species within the subject site is feasible. By erecting exclusion fencing around the stands of vegetation to be retained, thereby preventing access to these areas by the Rusa Deer, and through the undertaking of rehabilitation works, the quality of these bushland stands can be improved.

Enhancement of this vegetation, particularly that which is present either side of the feeder creek, would increase the value of this bushland link, thereby maintaining and improving an east-west fauna corridor across the site.

7.2. Habitat types available for native fauna species.

Four habitat types available to native fauna were recorded within the subject site, these being:

- A grassland;
- Eucalypt forest;
- Tall shrubland; and
- Aquatic environment.

For reference, descriptions of each of these are provided below. It is recommended these descriptions be read in conjunction with reference to the photographic record provided (Appendix 1).

7.2.1. Grassland.

This habitat type dominates the subject site. The grassland is the result of clearing that was undertaken to permit grazing. Within the grassland a mixture of exotic grasses, forbs and weeds are present, all of these being heavily grazed.

Within this area the occasional isolated regenerating shrub is present, these being between 2m and 3m in height. Isolated mature trees or clumps of similar plants are also present, these being to 25m in height. These trees support a number of hollows, between 3 and 8 hollows per plant, these having diameters that range from 50mm to 200mm. Dead stags are also present. In total, 42 trees/dead stags are present within this habitat type.

Portions of the grassland have been raised due to the importation of fill material. Other portions have been leveled and contoured, whilst others are being used for the storage of demountable sheds, machinery and construction materials. Scattered farm sheds, spoil mounds of dirt and rubble, and exposed dirt patches are also present.

This is the main habitat type that would be disturbed due to the undertaking of the proposal.

With regards to those plans provided, it is noted that all of the hollow-bearing trees would be removed.

7.2.2. Eucalypt forest.

This habitat type is present within the north western corner of the subject site. The eucalypt forest supports trees that are up to 30m in height, several of the plants present being hollow-bearing (hollow diameter 50mm to 100mm). The forest supports a middle storey of mesic plants these being of a medium to high density and around 20m in height. The understory is to 5m and of a medium to sparse density. The ground cover is open or composed for grasses and ferns. Vines are present.

This habitat type would not be affected due to the redevelopment of the site. Recommendations are presented to ensure that the management and treatment of this vegetation occurs.

7.2.3. Tall Shrubland.

The tall shrubland is present adjacent to both the unnamed feeder creek and Dapto Creek. This habitat supports a mixture of native and exotic plants, these being around 10m in height. These plants are of a medium to high density depending on the influence of past disturbances. The understory is of a high density and composed of native and exotic shrubs whilst the ground cover is composed of grasses and weeds. The ground cover varies from a high to sparse density depending on the development of the overstory vegetation. Within this habitat several open grassland patches are present.

As with the eucalypt forest, this habitat type is unlikely to be disturbed due to the undertaking of the proposal. Recommendations to manage those weeds present would improve the quality and connectivity of this habitat type.

7.2.4. Aquatic environments.

Two aquatic environments were observed within the study area, these being;

- Drainage lines; and
- Farm dams.

A description of each of these follows.

Drainage lines

Dapto Creek and the unnamed feeder creek are around 10m and 4m wide respectively. Both support earthen banks and beds, with some deposited and exposed rock material being present. Some floating and emergent aquatic vegetation was observed, particularly in association with Dapto Creek. Flood borne debris is also common. The depth of these water bodies is around 300mm.

At the time of the field survey both Dapto Creek and the unnamed drainage line were flowing.

During the course of the field survey, no fish were observed within either drainage line.

Neither drainage line would be significantly disturbed or modified due to the undertaking of the proposal.

Farm dams

Within the study area, two dams are present, both of which have been disturbed by grazing livestock. These dams are approximately 70m x 30m and 30m x 30m in size respectively and both support earthen banks. Both are open expanses of water, the smaller dam supporting some clumps of emergent aquatic plants. No submerged or exposed snags were observed.

8. Ecological assessments.

8.1. Commonwealth - *Environment Protection and Biodiversity Conservation Act 1999*.

No threatened animals, plants or endangered ecological communities listed on this Act were recorded within the subject site. Therefore, there is no need to conduct assessments to determine whether the proposed action is a controlled action requiring a determination by the Minister for the Environment.

8.2. State - *Environmental Planning and Assessment Act 1979*.

No threatened flora species, endangered flora populations or endangered ecological communities listed on the schedules to the *TSC Act* occur at the subject site. Therefore, there is no need to conduct "seven-part tests" under Section 5A of the *EP&A Act* in relation to botanical matters.

One threatened species, the Eastern Bentwing Bat (*Miniopterus orianae oceanensis*), was recorded during the course of the field survey. In addition, as hollow-dependent microchiropterans were detected, there is the potential that the Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*), could also be present.

The potential impacts associated with the proposal on these species are considered with reference to the assessment criteria provided in Section 5A of the *Environmental Planning and Assessment Act 1979*. These criteria are designed to determine whether there is likely to be a significant effect on these threatened species, or their habitats, and consequently whether a Species Impact Statement is required.

In line with the guidelines provided by the DECC on the seven-part test (DECC 2007), due to the similarity of their habitat requirements, an assessment has been undertaken on "hollow-dependent microchiropterans" as opposed to individual assessments being carried out on the Eastern Falsistrelle and Greater Broad-nosed Bat.

8.2. (a) Eastern Bentwing Bat (*Miniopterus orianae oceanensis*) – Seven part test.

(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…"*

No caves or suitable cave substitutes were recorded within the subject site. As such, no roosting or breeding sites suitable for the Eastern Bentwing Bat would be removed.

The development of the site would include the retention of the vegetation that lines both the unnamed feeder creek and Dapto Creek, this totalling around 6.4ha. Within this vegetation, the Eastern Bentwing Bat was recorded. The retention and management of this vegetation within the subject site would ensure that foraging opportunities are maintained for this species. As such, no significant reduction in the extent of foraging opportunities available to this microbat would arise.

The proposal is therefore not considered to have an adverse effect on the life cycle of the Eastern Bentwing Bat, such that the local population of this species would 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…"*

An 'endangered population' is defined as a "population specified in Part 2 of Schedule 1" of the *TSC Act*. No cave-dependent microchiropterans are listed under Part 2, Schedule 1 of the *TSC Act*.

(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

(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..."

No cave-dependent microchiropterans are listed as an endangered ecological community.

(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 remove any caves or suitable cave substitutes. The proposal would result in the removal of 42 trees (insect attracting plants) from the central portion of the subject site.

(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 Eastern Bentwing Bat can easily negotiate open areas and has been recorded flying over/foraging through built up environments (author's field notes). As such, the loss of some vegetation from the subject site, combined with the retention of the vegetation along both drainage lines, is not expected to result in the disturbance to this species' dispersal or movement patterns. The Eastern Bentwing Bat would be able to easily negotiate/traverse the site post-development. Therefore, no further isolation or fragmentation of this species' necessary habitats would arise.

(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 caves or suitable cave substitutes would be removed. The removal of 42 trees, compared to the extent of similar resources being retained within the subject site (6.4ha), is not considered to limit the overall extent of foraging resources available to the Eastern Bentwing Bat. The vegetation that is to be removed is not considered important for the foraging needs of this microchiropteran.

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

No critical habitat would be adversely affected by the proposal. The subject site is not listed as critical habitat under Part 3 Division 1 of the *TSC Act*.

(f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan…"*

No recovery plans have been prepared for any species of cave-dependent microchiropteran. Whilst this is the case, a number of priority actions have been identified to assist the recovery of these species (DECC 2005). Within the subject site, no suitable caves or cave substitutes are present, as

such, none of the recovery strategies proposed for these species would be relevant to the current proposal.

(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..."*

Currently 32 Key Threatening Processes for mainland NSW are listed under Schedule 3 of the *TSC Act*. Of these, the "clearing of native vegetation" may be considered applicable to the presence of the Eastern Bentwing Bat. Whilst this is the case, the removal of 42 trees compared to the extent of similar resources in both the subject site and surrounding region (including the Illawarra Escarpment State Conservation Area), is not considered to constitute or increase the impact of a Key Threatening Process such that it would adversely affect the presence or long term survival of this species.

8.2. (b) Expected impact on the Eastern Bentwing Bat.

The redevelopment and occupation of the subject site would not disturb, remove, modify or fragment any habitats critical to the life cycle requirements of the Eastern Bentwing Bat. A small number of insect-attracting plants would be removed. This, when compared to the extent of similar resources being retained both within the subject site itself and surrounding locality, is not considered significant. Given the likely scope of works proposed, the redevelopment of the subject site would not have an impact on any Eastern Bentwing Bat dispersal or movement corridors, nor would it adversely affect any significant areas of this species' local or regional habitat. Therefore, based on the results of the field survey combined with the consultation of known literature sources, it is not considered that the proposal would have a significant impact on the Eastern Bentwing Bat or its habitat. Therefore, the preparation of a Species Impact Statement that further considers the impacts of the proposal on the Eastern Bentwing Bat is not required.

8.2. (c) Hollow-dependent Microchiropterans – Seven part test.

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Though hollow utilising microchiropterans were recorded during the course of the field survey, no species listed under the *TSC* or *EPBC Acts* were detected.

The redevelopment of the subject site would require the removal of 42 mature hollow-bearing trees. Whilst these plants would be cleared, similar stands of woodland that support hollow-bearing trees are present both within, and adjacent to, the subject site, including within the nearby Illawarra Escarpment State Conservation Area. The loss of those hollow-bearing trees present when compared to the number observed adjacent to, and beyond the limits of the subject site, is not considered to disrupt the local populations of those threatened microchiropterans previously recorded in the study region, such that they are placed at risk of extinction.

The development of the subject site would include the retention and management of 6.4ha of vegetation, including several hollow-bearing trees. A number of the plants present within this vegetation are insect-attracting. As such, foraging and sheltering opportunities for insectivorous bats would be retained within the subject site.

The loss of 42 trees would not limit the extent of sheltering opportunities available to those threatened microchiropterans previously recorded in the study region. Within both the subject site and surrounding region, similar resources are present, these considered to meet the life cycle requirements of those threatened microchiropterans previously detected. As such it is not considered that the proposals would disrupt the life cycle of a viable population of any of those hollow-dependent threatened microchiropterans previously recorded in the study region such that they would 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

An 'endangered population' is defined as a "population specified in Part 2 of Schedule 1" of the *TSC Act*. No hollow-dependent microchiropterans are listed under Part 2, Schedule 1 of the *TSC Act*.

(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

(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,

No hollow-dependent microchiropterans are listed as an endangered ecological community.

(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 redevelopment of the subject site would require the removal of 42 mature hollow-bearing trees. In addition, some isolated shrubs (insect-attracting plants) would also be cleared.

(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

Hollow-dependent microchiropterans can easily negotiate open areas and have been recorded flying over both open spaces and expanses of water (author's field notes). As such, the loss of some vegetation from the study area, combined with the retention of the vegetation along both drainage lines, is not expected to result in the disturbance to these species' dispersal or movement patterns, these animals being able to easily negotiate/traverse across the site post-development. Retention of the vegetation along the feeder creek would provide an east-west corridor that is suitable for the movement patterns of this group of animals. Therefore, no further isolation or fragmentation of these species' necessary habitats would arise.

(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 resources present within the portion of the subject site that is to be cleared are not considered to be unique to this locality. Within both the subject site itself, and in the surrounding bushland areas (including the nearby Illawarra Escarpment State Conservation Area) similar resources (i.e. hollow-bearing trees and insect attracting plants) are present. The importance of the subject site is therefore considered to be limited. The vegetation and habitats to be removed/further disturbed are therefore not considered important for the long-term survival of any of the threatened hollow-dependent microchiropterans known to occur within the study region.

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

No critical habitat would be adversely affected by the proposal. The subject site is not listed as critical habitat under Part 3 Division 1 of the *TSC Act*.

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

No recovery plans have been prepared for any species of microchiropteran. Whilst this is the case, a number of priority actions have been identified to assist the recovery of these species (DECC 2005). Of these the following is relevant: "prepare [environmental impact assessment] guidelines which address the retention of hollow-bearing trees maintaining diversity of age groups, species diversity, and structural diversity. Give priority to largest hollow-bearing trees".

Hollow-bearing trees occur beyond the scope of works proposed in association with vegetation that is structurally diverse. These areas would not be directly or indirectly affected by the scope of works proposed.

Recommendations have also been presented that pertain to the retention of several of the hollow-bearing plants that occur within the central portion of the subject site.

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

Currently 32 Key Threatening Processes for mainland NSW are listed under Schedule 3 of the *TSC Act*. Of these, the "clearing of native vegetation", "loss of hollow-bearing trees" and "removal of dead wood and dead trees" would be applicable to the proposal. Whilst it is acknowledged that the proposal would result in the loss of 42 hollow-bearing trees, it is not considered that the clearance that would take place would constitute a significant Key Threatening Process such that the life cycle requirements of any hollow-dependent threatened microchiropterans would be compromised.

8.2. (d) Expected impact on hollow-dependent microchiropterans.

The undertaking of the proposed works would not disturb, remove, modify or fragment any habitats critical to the life cycle requirements of any hollow-dependent threatened microchiropterans. The works would not result in the significant loss of any hollow-bearing trees, or any major occurrences of any insect attracting plants. Based on the occurrence of those better, well developed stands of bushland that support hollow-bearing trees beyond the limits of impact (including within the subject site itself), the local presence of those hollow-dependent microchiropterans previously recorded in the surrounding region is considered to be ensured. Therefore, based on the results of the field survey combined with the consultation of known literature sources, it is not considered that the proposal would have a significant impact on any hollow-dependent threatened microchiropterans or their habitats. Therefore, the preparation of a Species Impact Statement that further considers the impacts of the proposal on those hollow-dependent microchiropterans previously recorded in the study region is not required.

8.3. State - State Environmental Planning Policy No. 44 (SEPP 44) – Koala Habitat Protection.

SEPP 44 seeks to encourage the proper conservation and management of areas that provide habitat for Koalas. The Wollongong City Council LGA is listed under Schedule 1 – Local Government Areas of SEPP 44.

Within the study area, two eucalypt species listed under Schedule 2 of SEPP 44 as Koala Feed Tree were recorded, these being Tallowwood (*Eucalyptus microcorys*) and Forest Red Gum (*Eucalyptus tereticornis*). As noted the Tallowwoods have been planted and the Forest Red Gums are present within the cleared portion of the site. Combined, technically, these plants constitute more than 15% of the trees present on the affected land. Therefore, in accordance with the definitions provided under SEPP 44, the subject site could be considered to constitute potential Koala habitat. Given that no Koalas were detected and no scats or scratchings characteristic of this species were observed at the study site, it is not considered to constitute core Koala habitat. As such, the proposal could

proceed as planned without requiring the preparation of a Plan of Management for the conservation and management of areas of Koala habitat.

9. Conclusions.

No species or ecological communities listed under the *EPBC Act* were recorded within the subject site. Therefore, referral of the matter to the Federal Minister for Sustainability, Environment, Water, Population and Communities for further consideration and approval is not required

By the completion of the field investigations, one species listed as under the *TSC Act* had been recorded, this being the Eastern Bentwing Bat (*Miniopterus orianae oceanensis*). In addition, as hollow-dependent microchiropterans were detected and as hollow-bearing trees are to be removed, it was considered appropriate to adopt a precautionary approach in regards to the presence of the state listed Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). The potential impacts associated with the proposal on these microbats was considered with reference to the assessment criteria provided in association with Section 5A of the *Environmental Planning and Assessment Act 1979*. These criteria are designed to determine whether there is likely to be a significant effect on these threatened species or their habitats, and consequently whether a Species Impact Statement is required. With reference to these assessment criteria, it was not considered that any of the threatened microchiropterans recorded or potentially occurring would be adversely affected by the redevelopment of the subject site. The development of the site is not considered to have a significant effect on any threatened species, populations, ecological communities or their habitats. As such, the preparation of a Species Impact Statement is not recommended.

Though identified as "potential" Koala habitat, the subject site is not considered to constitute core Koala habitat. As such, the proposal could proceed as planned without requiring the preparation of a Plan of Management for the conservation and management of areas of Koala habitat.

Based on the results of the flora and fauna surveys, and the review of known literature and database sources, it is not considered that there are any ecological constraints to the redevelopment of Lot 2, DP 561484, Reddalls Road, Kembla Grange, New South Wales proceeding as planned. The proposal would not significantly affect any populations of any native plants or animals such that they are placed at risk of extinction. Similarly the development of the site would not remove, isolate, fragment or significantly affect any habitats of local, regional, state or national conservation concern.

10. Recommendations.

The following recommendations are presented to ensure that the proposal is undertaken in an ecologically sustainable manner.

- Consideration should be given to retaining several of the mature hollow-bearing trees that are present within the central portion of the subject site. The retention of these plants should be considered when determining the development envelopes. Retained trees should be incorporated into property boundaries, landscaping and open space areas (e.g. power line/services easements) and/or road verges.

- Should isolated trees be retained, temporary fencing should also be erected around these during the course of the sites construction activities. This fencing should be placed at the outer limits of the trees canopy.

- An ecologist should be present on site during the removal of any hollow-bearing trees. The ecologist should:

    - provide information on the most suitable removal method; and
    - be on site during the removal process to check any hollows (once the tree has been felled) for sheltering animals.

- Nesting boxes (2 per hollow-bearing tree removed) should be erected to compensate for the loss of those hollow-bearing trees that are to be removed. Any nesting boxes erected should be monitored for a period of no less than twenty four months with any that are damaged being replaced. A suitable monitoring frequency would be twice a year. Similarly, if any nesting boxes are identified as being occupied by exotic species (e.g. birds or bees), these should be removed or replaced.

- The nesting boxes should be erected on site within the retained stands of vegetation that line either Dapto Creek or its unnamed feeder creek.

- A bushland plan of management should be developed for the site that aims at enhancing the ecological quality of the vegetation that lines both Dapto Creek and its feeder creek. The bushland plan should include aspects such as revegetation of the retained stands with native plants.

- A weed control plan should be prepared as part of bushland plan of management to ensure that those noxious and environmental weeds identified on the subject site are controlled to a degree such that their spread is unlikely to be exacerbated. This should be done in accordance with the regulations set out under the *Noxious Weeds Act 1993* and relevant regional control plans that have been prepared for these species.

- Retained vegetation should be fenced to prevent egress by the introduced Rusa Deer.

- Fencing should be undertaken prior to any further development of the site. The fencing is to be used to identify the limits of the retained vegetation.

- Any dead wood or natural ground debris removed as part of the proposal should be collected and placed elsewhere in those wooded portions of the site that are to be retained.

- Vehicles and machinery should not be stored or parked in those bushland portions of the site that are to be retained.

- The location of all bushland stands that occur beyond the limits of the works should be provided to the construction contractor, these areas being identified on both the development plans and on site through the erection of temporary fencing.

- Construction huts, parking lots, stockpiles, access routes and the like should be located in those portions of the site that have been previously cleared or degraded.

- During construction activities, construction vehicles should be restricted in their movements to the delineated construction zone.

- Newly exposed surfaces should be stabilised as soon as possible in order to reduce the potential for soil erosion.

- An erosion and sedimentation control plan should be developed to ensure that both Dapto Creek and its unnamed feeder line are not affected by the development of the subject site. Erosion and sedimentation control structures should be regularly monitored, replaced and cleared, particularly after periods of heavy rainfall.

- Runoff from the development area should not be directed straight into the natural drainage system but should be treated prior to its discharge. Inclusion of sedimentation basins, or similar engineering solutions to treat storm-water runoff, into the development layout is recommended.

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Appendix 1: Photographic record of the survey area.

Plate 1: Character of the cleared land (grassland) that dominates the subject site. Note the isolated mature trees.

Plate 2: The character of the Wattle Scrub (Tall shrubland).

Plate 3: The character of the Moist Coast White Box Forest (Eucalypt forest).

Plate 4: The character of the smaller of the two farm dams present.

Plate 5: The character of the unnamed feeder creek.

Plate 6: Images of the Rusa Deer present on site captured through use of the infrared camera.

Appendix 2: Fauna species recorded or known to occur in the vicinity of the subject site.

Source of Records
1 = Species recorded during present study.
2 = OEH (2011a).
3 = LesryK Environmental Consultants (2011).
4 = LesryK Environmental Consultants (2009).
5 = LesryK Environmental Consultants (2002).
6 = LesryK Environmental Consultants (2001).
7 = LesryK Environmental Consultants (1997).
8 = LesryK Environmental Consultants (1993).

Key
A - Indicates species listed under the *EPBC Act*.
F - Migratory Family listed under the *EPBC Act*.
M - Species listed as migratory listed under the *EPBC Act*.
B - Indicates species listed under the *TSC Act.*
C - Species is Critically Endangered.
E - Species is Endangered.
V - Species is Vulnerable.
* - indicates introduced species.

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
		MAMMALS									
			Phascolarctidae								
	V	Koala	*Phascolarctos cinereus*		x						
			Tachyglossidae								
		Short-beaked Echidna	*Tachyglossus aculeatus*		x					x	
			Dasyuridae								
V	V	Spotted-tailed Quoll	*Dasyurus maculatus*		x						
		Brown Antechinus	*Antechinus stuartii*		x						
			Peramelidae								
		Long-nosed Bandicoot	*Perameles nasuta*		x						
			Vombatidae								
		Common Wombat	*Vombatus ursinus*		x						
			Petauridae								
		Sugar Glider	*Petaurus breviceps*	x							
			Pseudocheiridae								
		Greater Glider	*Petauroides volans*		x						
		Common Ringtail Possum	*Pseudocheirus peregrinus*		x						
			Acrobatidae								
		Feathertail Glider	*Acrobates pygmaeus*		x						
			Phalangeridae								
		Common Brushtail Possum	*Trichosurus vulpecula*	x	x						
			Macropodidae								
		Eastern Grey Kangaroo	*Macropus giganteus*		x						
		Red-necked Wallaby	*Macropus rufogriseus*		x			x			
		Swamp Wallaby	*Wallabia bicolor*		x		x			x	x
			Pteropodidae								
V	V	Grey-headed Flying Fox	*Pteropus poliocephalus*		x	x					
			Rhinolophidae								
		Eastern Horseshoe-bat	*Rhinolophus megaphyllus*	x							
			Vespertilioidae								

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
		Gould's Wattled Bat	*Chalinolobus gouldii*	x	x	x	x	x			
		Chocolate Wattled Bat	*Chalinolobus morio*	x	x		x	x			
	V	Eastern Falsistrelle	*Falsistrellus tasmaniensis*			x					
		Gould's Long-eared Bat	*Nyctophilus gouldi*		x						
		Lesser Long-eared Bat	*Nyctophilus geoffroyi*		x						
	V	Greater Broad-nosed Bat	*Scoteanax rueppellii*					x			
		Eastern Broad-nosed Bat	*Scotorepens orion*		x			x			
		Large Forest Bat	*Vespadelus darlingtoni*		x		x	x			
		Southern Forest Bat	*Vespadelus regulus*		x						
		Little Forest Bat	*Vespadelus vulturnus*	x	x	x	x	x			
			Miniopteridae								
	V	Eastern Bentwing Bat	*Miniopterus* (*schreibersii*) *orianae oceanensis*	x	x			x			
			Molossidae								
		Freetail Bat	*Mormopterus* sp. 2				x				
		White-striped Freetail Bat	*Austronomus australis*		x		x	x			
			Muridae								
		* House Mouse	*Mus musculus*		x						x
		Bush Rat	*Rattus fuscipes*		x						
		Swamp Rat	*Rattus lutreolus*		x						x
		* Black Rat	*Rattus rattus*		x						x
			Canidae								
		Dingo	*Canis lupus dingo*								
		* Fox	*Vulpes vulpes*		x	x				x	x
		* Dog	*Canis familiaris*		x					x	
			Felidae								
		* Feral Cat	*Felis catus*		x						
			Leporidae								
		* Rabbit	*Oryctolagus cuniculus*	x	x	x					x
			Bovidae								
		* Goat	*Capra hircus*		x						
			Cervidae								
		* Rusa Deer	*Cervus timorensis*	x	x		x				
		BIRDS									
			Megapodiidae								
		Australian Brush Turkey	*Alectura lathami*		x						
			Phasianidae								
		Stubble Quail	*Coturnix pectoralis*		x						
			Pelecanidae								
		Australian Pelican	*Pelecanus conspicillatus*	x	x		x		x	x	x
			Anhingidae								
		Darter	*Anhinga melanogaster*		x						
			Phalacrocoracidae								
		Little Pied Cormorant	*Phalacrocorax melanoleucos*		x		x				
		Great Cormorant	*Phalacrocorax carbo*		x						
		Little Black Cormorant	*Phalacrocorax sulcirostris*		x						
			Podicipedidae								
		Hoary-headed Grebe	*Poliocephalus poliocephalus*		x						
		Australasian Grebe	*Tachybaptus novaehollandiae*	x					x		

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
F			**Anatidae**								
		Black Swan	*Cygnus atratus*		x						
		Australian Shelduck	*Tadorna tadornoides*		x						
		Pacific Black Duck	*Anas superciliosa*	x	x		x		x		
		* Mallard	*Anas platyrhynchos*		x						
		Grey Teal	*Anas gracilis*		x						
		Chestnut Teal	*Anas castanea*	x	x	x			x		
		Australasian Shoveler	*Anas rhynchotis*		x						
		Pink-eared Duck	*Malacorhynchus membranaceus*		x						
		Hardhead	*Aythya australis*		x						
		Australian Wood Duck	*Chenonetta jubata*	x	x	x	x		x		
	V	Freckled Duck	*Stictonetta naevosa*		x						
		Musk Duck	*Biziura lobata*		x						
			Rallidae								
		Buff-banded Rail	*Gallirallus phillippensis*		x						
		Eurasian Coot	*Fulica atra*						x		
		Dusky Moorhen	*Gallinula tenebrosa*		x				x		x
		Purple Swamphen	*Porphyrio porphyrio*	x	x				x		
			Ardeidae								
		White-necked Heron	*Ardea pacifica*		x						
		White-faced Heron	*Egretta novaehollandiae*	x	x				x		x
M		Cattle Egret	*Ardea ibis*						x		x
M		Great Egret	*Ardea alba*		x						
		Little Egret	*Egretta garzetta*	x	x						
			Threskiornidae								
		Australian White Ibis	*Threskiornis molluca*	x	x		x		x		x
		Straw-necked Ibis	*Threskiornis spinicollis*		x						
		Royal Spoonbill	*Platalea regia*		x						
		Yellow-billed Spoonbill	*Platalea flavipes*		x						
F			**Scolopacidae**								
M		Ruddy Turnstone	*Arenaria interpres*		x						
M		Eastern Curlew	*Numenius madagascariensis*		x						
M		Common Greenshank	*Tringa nebularia*		x						
M		Latham's Snipe	*Gallinago hardwickii*		x						
M		Bar-tailed Godwit	*Limosa lapponica*		x						
M		Sharp-tailed Sandpiper	*Calidris acuminata*		x						
F			**Charadriidae**								
		Masked Lapwing	*Vanellus miles*	x	x	x					x
		Double-banded Plover	*Charadrius bicinctus*		x						
		Red-capped Plover	*Charadrius ruficapillus*		x						
F			**Recurvirostridae**								
		Black-fronted Dotterel	*Elseyornis melanops*		x						
		Black-winged Stilt	*Himantopus himantopus*		x						
			Laridae								
		Silver Gull	*Larus novaehollandiae*	x	x		x		x		x
		Crested Tern	*Sterna bergii*		x						
F			**Accipitridae**								
		Black-shouldered Kite	*Elanus axillaris*	x	x			x			x
		Whistling Kite	*Haliastur sphenurus*		x						
		White-bellied Sea-eagle	*Haliaeetus leucogaster*		x						

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
		Wedge-tailed Eagle	*Aquila audax*	x	x						x
		Collared Sparrowhawk	*Accipiter cirrhocephalus*		x						
		Brown Goshawk	*Accipiter fasciatus*		x						
		Grey Goshawk	*Accipiter novaehollandiae*		x						
		Swamp Harrier	*Circus approximans*								x
F			**Falconidae**								
		Peregrine Falcon	*Falco pergrinus*		x						x
		Brown Falcon	*Falco berigora*		x						
		Australian Hobby	*Falco longipennis*		x						x
		Nankeen Kestrel	*Falco cenchroides*		x		x				
			Columbidae								
		Topknot Pigeon	*Lopholaimus antarcticus*		x						
		White-headed Pigeon	*Columba leucomela*		x						
		* Spotted Turtle-dove	*Streptopelia chinensis*	x	x	x					x
		Brown Cuckoo-dove	*Macropygia amboinensis*	x	x					x	
		Emerald Dove	*Chalocophaps indica*		x						
		Common Bronzewing	*Phaps chalcoptera*		x					x	
		Brush Bronzewing	*Phaps elegans*		x						
		Crested Pigeon	*Ocyphaps lophotes*		x	x					
		Wonga Pigeon	*Leucosarcia melanoleuca*		x					x	
			Cacatuidae								
	V	Glossy Black-Cockatoo	*Calyptorhynchus lathami*		x						
		Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*		x		x			x	
	V	Gang-Gang Cockatoo	*Callocephalon fimbriatum*		x						
		Galah	*Eolophus roseicpilla*	x	x	x					x
		Little Corella	*Cacatua sanguinea*		x	x		x			
		Sulphur-crested Cockatoo	*Cacctua galerita*		x	x		x			
			Psittacidae								
		Rainbow Lorikeet	*Trichoglossus haematodus*	x	x	x					
		Australian King Parrot	*Alisterus scapularis*	x	x			x			
		Crimson Rosella	*Platycercus elegans*		x			x		x	
		Eastern Rosella	*Platycercus eximius*	x	x						
			Cuculidae								
		Brush Cuckoo	*Cuculus variolosus*		x						
		Pallid Cuckoo	*Cuculus pallidus*		x						
		Fan-tailed Cuckoo	*Cuculus flabelliformis*		x		x			x	
		Shining Bronze-Cuckoo	*Chrysococcyx lucidus*		x						x
		Channel-billed Cuckoo	*Scthrops novaehollandiae*		x						
			Strigidae								
	V	Powerful Owl	*Ninox strenua*		x						
		Southern Boobook	*Ninox novaeseelandiae*		x						
			Tytonidae								
	V	Sooty Owl	*Tyto tenebricosa*		x						
			Podargidae								
		Tawny Frogmouth	*Podargus strigoides*		x						
			Caprimulgidae								
		White-throated Nightjar	*Eurostopodus mysticalis*		x						
			Aegothelidae								
		Australian Owlet-nightjar	*Aegotheles cristatus*		x						
			Apodidae								

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
M		White-throated Needletail	*Hirundapus caudacutus*		x						
			Alcedinidae								
		Azure Kingfisher	*Alcedo azurea*		x						
			Halcyonidae								
		Laughing Kookaburra	*Dacelo naxaeguineae*	x	x	x	x	x		x	x
		Sacred Kingfisher	*Todiramphus sanctus*		x						
			Coraciidae								
		Dollarbird	*Eurystomus orientalis*		x						
			Menuridae								
		Superb Lyrebird	*Menura novaehollandiae*		x					x	
			Climacteridae								
		White-throated Treecreeper	*Cormobates leucophaeus*		x	x				x	
		Red-browed Treecreeper	*Climacteris erythrops*		x						
			Maluridae								
		Superb Fairy-wren	*Malurus cyaneus*	x	x	x	x	x	x	x	x
		Variegated Fairy-wren	*Malurus lamberti*		x						x
		Southern Emu-wren	*Stipiturus malachurus*		x						
			Pardalotidae								
		Spotted Pardalote	*Pardalotus punctatus*		x		x			x	
		Striated Pardalote	*Pardalotus striatus*		x						
			Acanthizidae								
		Pilotbird	*Pycnoptilus floccosus*		x						
		Rock Warbler	*Origma solitaria*		x						
		Large-billed Scrubwren	*Sericornis magnirostris*		x						
		White-browed Scrubwren	*Sericornis frontalis*	x	x	x	x			x	x
		Yellow-throated Scrubwren	*Sericornis citreogularis*		x						
		Weebill	*Smicrornis brevirostris*		x						x
		Brown Gerygone	*Gerygone mouki*		x						x
		White-throated Gerygone	*Gerygone olivacea*		x						
		Brown Thornbill	*Acanthiza pusilla*	x	x					x	x
		Yellow Thornbill	*Acanthiza nana*	x	x	x	x				x
		Striated Thornbill	*Acanthiza lineata*		x		x				
		Buff-rumped Thornbill	*Acanthiza reguloides*		x						
		Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		x						
			Meliphagidae								
		Red Wattlebird	*Anthochaera carunculata*	x		x		x			
		Little (Brush) Wattlebird	*Anthochaera chrysoptera*	x	x		x				
		Noisy Friarbird	*Philemon corniculatus*		x						
		Noisy Miner	*Manorina melanocephala*	x		x		x		x	
		Lewin's Honeyeater	*Meliphaga lewinii*	x	x	x	x	x		x	x
		Yellow-faced Honeyeater	*Lichenostomus chrysops*	x	x	x					x
		White-eared Honeyeater	*Lichenostomus leucotis*		x						
		Brown-headed Honeyeater	*Melithreptus brevirostris*		x						
		Scarlet Honeyeater	*Myzomela sanguinolenta*		x						
		White-naped Honeyeater	*Melithreptus lunatus*		x						
		Crescent Honeyeater	*Phylidonyris pyrrhoptera*		x						
		White-cheeked Honeyeater	*Phylidonyris nigra*		x						
		New Holland Honeyeater	*Phylidonryis novaehollandiae*		x		x	x			x
		Tawny-crowned Honeyeater	*Phylidonryis melanops*		x						
		Eastern Spinebill	*Acanthorhynchus tenuirostris*	x	x	x	x				x

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
		White-fronted Chat	*Epthianura albifrons*		x						
			Orthonychidae								
		Logrunner	*Orthonyx temminckii*		x						
		Eastern Whipbird	*Psophodes olivaceus*	x	x		x	x			x
			Cinclosomatidae								
		Spotted Quail-thrush	*Cinclosoma punctatum*		x						
			Petroicidae								
		Rose Robin	*Petroica rosea*		x						
		Eastern Yellow Robin	*Eopsaltria australis*	x	x		x			x	x
		Jacky Winter	*Microeca fascinans*		x						
			Pachycephalidae								
		Crested Shrike-tit	*Falcunculus frontatus*		x						
		Grey Shrike-thrush	*Colluricincla harmonica*	x	x		x	x		x	x
		Golden Whistler	*Pachycephala pectoralis*		x			x		x	x
		Rufous Whistler	*Pachycephala rufiventris*		x						
			Dicruridae								
		Grey Fantail	*Rhipidura fuliginosa*	x	x	x				x	x
M		Rufous Fantail	*Rhipidura rufifrons*		x						x
		Willie Wagtail	*Rhipidura leucophrys*	x	x	x	x				x
		Leaden Flycatcher	*Myiagra rubecula*		x						
		Restless Flycatcher	*Myiagra inquieta*		x						
M		Black-faced Monarch	*Monarcha melanopsis*		x						x
		Magpie Lark	*Grallina cyanoleuca*	x	x	x		x	x	x	x
			Oriolidae								
		Olive-backed Oriole	*Oriolus sagittatus*		x						
			Ptilonorhynchidae								
		Green Catbird	*Ailuroedus crassirostris*		x						
		Satin Bowerbird	*Ptilonorhychus violaceus*	x	x						
			Campephagidae								
		Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		x		x			x	
		Cicadabird	*Coracina tenuirostris*		x						
		White-winged Triller	*Lalage sueurii*		x						
			Artamidae								
		White-browed Woodswallow	*Artamus superciliosus*		x						
		Dusky Woodswallow	*Artamus cyanopterus*		x						
		Grey Butcherbird	*Cracticus torquatus*	x	x		x				
		Australian Magpie	*Gymnorhina tibicen*	x	x	x	x	x	x	x	x
		Pied Currawong	*Strepera graculina*	x	x					x	x
		Grey Currawong	*Strepera versicolor*		x					x	
			Corvidae								
		Australian Raven	*Corvus coronoides*	x	x	x	x	x	x	x	x
			Hirundinidae								
		Welcome Swallow	*Hirundo neoxena*	x	x	x	x		x		x
		Tree Martin	*Hirundo nigricans*								
		Fairy Martin	*Hirundo ariel*								
			Motacillidae								
		Richard's Pipit	*Anthus naovaeseelandiae*								x
F			**Sylviidae**								
		Clamorous Reed-warbler	*Acrocephalus stentoreus*		x						x
		Golden-headed Cisticola	*Cisticola exilis*						x		x

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
			Ploceidae								
		Red-browed Finch	*Neochmia temporalis*		x	x	x				x
		Beautiful Firetail	*Stagonopleura bella*		x						
			Dicaeidae								
		Mistletoebird	*Dicaeum hirundinaceum*		x						x
			Zosteropidae								
		Silvereye	*Zosterops lateralis*	x		x	x	x			x
			Passeridae								
		* House Sparrow	*Passer domesticus*						x		
			Fringillidae								
		* European Goldfinch	*Carduelis carduelis*		x						
			Pycnonotidae								
		* Red-whiskered Bulbul	*Pycnonotus jocosus*	x	x	x	x				x
F			**Muscicapidae**								
		Bassian (Ground) Thrush	*Zoothera lunulata*		x						
		* Common Blackbird	*Turdus merula*	x							
			Sturnidae								
		* Common Starling	*Sturnus vulgaris*	x	x				x	x	x
		* Common Myna	*Acridotheres tristis*		x	x	x		x		x
		REPTILES									
			Chelidae								
		Eastern Snake-necked Turtle	*Chelodina longicollis*		x	x	x				x
			Gekkonidae								
		Lesueur's Velvet Gecko	*Oedura lesueurii*		x						
		Broad-tailed Gecko	*Phyllurus platurus*		x						
			Agamidae								
		Jacky Lizard	*Amphibolurus muricatus*		x						
		Eastern Water Dragon	*Physignathus lesueurii*		x		x				x
		Mountain Dragon	*Tympanocryptis diemensis*		x						
			Pygopodidae								
		Common Scaly-foot	*Pygopus lepidopodus*		x						
			Varanidae								
		Lace Monitor	*Varanus varius*		x			x			
			Scincidae								
		Red-throated Skink	*Bassiana platynota*		x						
		Striped Skink	*Ctenotus robustus*		x						
		Copper-tailed Skink	*Ctenotus taeniolatus*		x						
		"No Common Name"	*Cyclodomorphus michaeli*		x						
		Cunningham's Skink	*Egernia cunninghami*		x						
		Black Rock Skink	*Egernia saxatilis*		x						
		White's Skink	*Egernia whitii*		x						
		Yellow-bellied Skink	*Eulamprus tenuis*		x						
		Eastern Water Skink	*Eulamprus quoyii*		x		x				x
		Grass Skink	*Lampropholis delicata*		x	x	x				x
		Garden Skink	*Lampropholis guichenoti*		x	x					
		McCoy's Skink	*Nannoscincus maccoyi*		x						
		Weasel Skink	*Saproscincus mustelinus*		x						
		Three-toed Skink	*Saiphos equalis*		x						
		Eastern Blue-tongued Lizard	*Tiliqua scincoides*	x	x						

A	B	COMMON NAME	FAMILY AND SCIENTIFIC NAME	1	2	3	4	5	6	7	8
		Three-toed Skink	*Hemiergis decresiensis*		x						
			Boidae								
		Diamond Python	*Morelia spilota spilota*		x						
			Colubridae								
		Common Tree Snake	*Dendrelaphis punctulata*		x						
			Elapidae								
		Golden Crowned Snake	*Cacophis squamulosus*		x						
		Black-bellied Swamp Snake	*Hemiaspis signata*		x						x
		Eastern Small-eyed Snake	*Rhinoplocephalus nigrescens*		x						
		Eastern Tiger Snake	*Notechis scutatus*		x						
		Red-bellied Black Snake	*Pseudechis porphyriacus*		x	x	x				
		Eastern Brown Snake	*Pseudonaja textilis*		x						
		AMPHIBIANS									
			Myobatrachidae								
		Common Eastern Froglet	*Crinia signifera*	x	x	x	x			x	
V	V	Giant Burrowing Frog	*Heleioporus australiacus*		x						
		Eastern Banjo Frog	*Limnodynastes dumerilii*		x						
		Striped Marsh Frog	*Limnodynastes peronii*		x		x		x		x
		Spotted Grass Frog	*Limnodynastes tasmaniensis*		x						
		Haswell's Frog	*Paracrinia haswelli*		x						
		Brown Toadlet	*Pseudophryne bibronii*		x						
	V	Red-crowned Toadlet	*Pseudophryne australis*		x						
		Smooth Toadlet	*Uperoleia laevigata*		x		x				x
			Hylidae								
		Blue Mountains Tree Frog	*Litoria citropa*		x						
		Bleating Tree Frog	*Litoria dentata*		x						
		Eastern Dwarf Tree Frog	*Litoria fallax*				x				x
		Freycinet's Frog	*Litoria freycineti*		x						
		Jervis Bay Tree Frog	*Litoria jervisiensis*		x						x
		Lesueur's Tree Frog	*Litoria lesueuri*		x						x
		Peron's Tree Frog	*Litoria peronii*		x						x
		Leaf Green Tree Frog	*Litoria phyllochroa*		x						
		Tyler's Tree Frog	*Litoria tyleri*								x
		Verreaux's Tree Frog	*Litoria verreauxii*		x						

Appendix 3. Threatened fauna species previously recorded in the study region and a consideration of their 'likelihood of occurrence' within the subject site.

Key
*Churchill (2008), Frith (2007), Cogger (2004), Van Dyck and Strahan (2008), OEH (2011b) and/or the NSW Scientific Committee (2011), with other references used being identified in the bibliography.

Common Name ***Genus species***	**Habitat***	**Likelihood of Occurrence[5]**
MAMMALS		
Koala *Phascolarctos cinereus*	The Koala occupies areas of acceptable food trees in open eucalypt forests and woodlands. Areas of preferred feed trees appear to be restricted to sites that support high nutrient soils, areas that have historically been converted to farmland.	Low. No suitable habitat present.
Spotted-tailed Quoll *Dasyurus maculatus*	The Spotted-tailed Quoll occurs within a variety of habitats including wet and dry sclerophyll forests through to rainforests. The Quoll is nocturnal and shelters in tree hollows, dense undergrowth, hollow logs or under rock outcrops. Home range sizes for this species are known to be considerably large (between 3 and 15 km^2/night).	Low. Area too disturbed and cleared to be suitable for this species.
Grey-headed Flying-fox *Pteropus poliocephalus*	The Grey-headed Flying-fox is a canopy-feeding frugivore, blossom-eater and nectarivore that inhabits a variety of habitats. Roosts and breeds communally in 'camps', with these camps containing between 500 to 5,000 individuals. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring. Foraging occurs opportunistically on both native and exotic plants, often at distances between 30 and 70km from camps.	Low. May fly over site or forage within riparian vegetation on occasion.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Usually roosts in hollow trunks of eucalypt trees although they have also been known to roost in caves and buildings. They usually inhabit sclerophyll woodlands with insect attracting plants, a relatively continuous canopy. They prefer wet habitats with trees of more than 20m. They have been known to forage 12km from roosting sites.	High based on adoption of precautionary approach. Hollow-bearing trees and other hollow-dependent microchiropterans present.
Greater Broad-nosed Bat *Scoteanax rueppellii*	Preferring habitats which range from rainforests through to woodlands, this species usually roosts in tree hollows, though some individuals have been found in the roof spaces of old buildings. Feeding on large insects such as beetles, and is also known to take small vertebrates such as mice and other small bats.	*As above*
Eastern Bentwing Bat *Miniopterus orianae oceanensis*	This species is the dominant cave-dwelling bat in south-eastern Australia. Occurs in a variety of habitats and roosts in caves, storm water channels, mines and houses. Feeds on insects caught on the wing from within eucalypt woodlands and forests.	High. Recorded during field investigation.

[5] As a resident population.

Common Name ***Genus species***	**Habitat***	**Likelihood of Occurrence[5]**
BIRDS		
Freckled Duck *Stictonetta naevosa*	The preferred habitat of the Freckled Duck is freshwater swamps or creeks that support a rich source of plankton, and a heavy growth of Lignum, cumbungi or tea-tree. This species breeds between June and September, however breeding may be out of season if the conditions are favourable. Post-breeding, and in times of drought, this species appears to disperse to open permanent fresh or saline water bodies, a number of which are exposed and have little vegetation.	Low. No suitable water bodies present.
Black Bittern *Ixobrychus flavicollis*	Terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Feed at dusk and during the night on invertebrates, reptiles, fish and so on. Roosts during the day in trees or on the ground amongst dense reeds. Builds its nests on a branch overhanging water. When not breeding, generally solitary.	*As above.*
Glossy Black-Cockatoo Calyptorhynchus lathami	The Glossy Black-Cockatoo nests and roosts within hollows of large eucalypt trees and can spend up to 88% of each day foraging. This species Inhabits eucalypt woodland and feeds almost exclusively on Casuarina fruits. This species shows strong preference for individual trees with a high seed to cone ratio. Breeding occurs between March and August.	Low. Although this species has the potential to fly across the study area, this animal is not considered to be reliant on the limited amount of vegetation proposed to be removed. In addition no crushed Casuarina cones were observed.
Gang-gang Cockatoo *Callocephalon fimbriatum*	During summer, the Gang-gang Cockatoo prefers the higher altitude tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. This species has also been observed within urban areas including gardens and parklands. During breeding, the Gang-gang Cockatoo utilises tree hollows that are located within the trunks or limbs of large trees, close to water.	Low. Although this species has the potential to fly across the study area, this animal is not considered to be reliant on the limited amount of vegetation proposed to be removed
Powerful Owl *Ninox strenua*	The Powerful Owl favours wet to dry eucalypt forests with a dense understorey. Nesting in large hollows, nearly always in the trunk or top of a mature eucalypt. When not breeding, this bird will roost during the day within the shelter provided by a dense understorey, such as a bushy eucalypt or vine forest.	Low. Did not respond to call playbacks. Although this species has the potential to fly across the study area, the habitat requirements of this species do not occur within the study area.
Sooty Owl *Tyto tenebricosa*	Inhabits tall, wet, old-growth forests on fertile soils with a dense understorey. Has a home range area of between 200 to 800 hectares in which a permanently bonded pair occurs. Breeds in the trunks of mature Eucalypts and appears to be loyal to nest sites. Prey species include mainly arboreal mammals.	*As above.*

Common Name ***Genus species***	**Habitat***	**Likelihood of Occurrence[5]**
AMPHIBIANS		
Giant Burrowing Frog *Heleioporus australiacus*	The Giant Burrowing Frog is mostly restricted to areas of Hawkesbury Sandstone. This association with sandstone outcrops appears to be quite important feature of this species ecology. This species lives in small semi-permanent to slightly flowing streams, breeding in sandy river bank burrows during the summer and autumn months. Breeding is also known to occur in man-made depressions, ditches and dams, though these must be in a non-polluted condition. Giant Burrowing Frogs are not found in creeks affected by stormwater or other pollutants, and this species of frog is not found in urbanised areas.	Low. No sandstone outcrops and no suitable water bodies/unpolluted habitats present.
Red-crowned Toadlet *Pseudophryne australis*	The Red-crowned Toadlet is confined to drainage lines in areas of Hawkesbury Sandstone, especially those that support weathered shale lenses. This species shelters under stones, vegetation or logs and is highly susceptible to pollutants, storm water runoff from urban areas and weed infested areas	*As above.*

Appendix 4: Flora species recorded during the field survey.

Key
* - indicates introduced species.
P – indicates species that is planted.
[N] - indicates species listed under the *Noxious Weeds Act 1993*.

SCIENTIFIC NAME	COMMON NAME
FILICOPSIDA	**FERNS**
ADIANTACEAE	
Adiantum aethiopicum	Maidenhair
ASPLENIACEAE	
Asplenium flabellifolium	Necklace Fern
BLECHNACEAE	
Doodia aspera	Rasp Fern
CYATHEACEAE	
Cyathea australis	Rough Tree Fern
DENNSTAEDTIACEAE	
Pteridium esculentum	Bracken
DICKSONIACEAE	
Calochlaena dubia	Rainbow Fern
SINOPTERIDACEAE	
Pellaea falcata	Sickle Fern
THELYPTERIDACEAE	
Christella dentata	Binung
MAGNOLIOPSIDA	**FLOWERING PLANTS**
MAGNOLIIDEAE	**DICOTYLEDONS**
APIACEAE	
Dichondra repens	Kidney weed
APOCYNACEAE	
*Araujia sericifera**	Moth Plant
Parsonsia straminea	Monkey Vine
ASTERACEAE	
*Ageratina adenophora **	Crofton Weed
*Ageratina riparia**	Mist Flower
*Bidens pilosa **	Cobblers Pegs
*Cirsium vulgare**	Thistle
*Conyza sp**	Fleabane
*Hypochaeris radicata**	Catsear
*Senecio madagascariensis **	Fireweed
*Taraxacum officinale**	Dandelion
BASELLACEAE	
*Anredera cordifolia**	Potato Vine
BIGNONIACEAE	
Pandorea pandorana	Wonga Wonga Vine
*Tecoma capensis**	Cape Honeysuckle
CARYOPHYLLACEAE	
*Cerastrum glomeratum**	Chickweed
DILLENIACEAE	
Hibbertia scandens	Twining Guinea Flower
EUPHORBIACEAE	
*Euphorbia peplus**	Petty Spurge
Glochidion ferdinandi	Cheese Tree
*Ricinus communis**	Castor Oil Plant
FABACEAE	
Sub-Family Caesalpinioideae	
*Senna coluteoides var glabrata**	Cassia

SCIENTIFIC NAME	COMMON NAME
Sub-Family Faboideae	
*Erythrina x sykesii**	Coral Tree
Glycine clandestina	
*Trifolium repens**	Clover
Sub-Family Mimosoideae	
Acacia binervata	Two-veined Hickory
Acacia maidenii	Maiden's Wattle
Acacia mearnsii	Black Wattle
LAMIACEAE	
*Mentha sp**	Mint
MALVACEAE	
*Modiola caroliniana**	Red-flowered Mallow
*Sida rhombifolia**	Paddy's Lucerne
MORACEAE	
Maclura cochinchinensis	Cockspur Thorn
MYRTACEAE	
Acmena smithii	Lilly Pilly
Callistemon salignus	Willow Bottlebrush
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus grandis	Flooded Gum (P)
Eucalyptus longifolia	Woollybutt
Eucalyptus microcorys	Tallowwood (P)
Eucalyptus pilularis	Blackbutt
Eucalyptus quadrangulata	Coast White Box
Eucalyptus saligna	Sydney Blue Gum
Eucalyptus tereticornis	Forest Red Gum
Melaleuca decora	White Feather-myrtle
OLEACEAE	
PITTOSPORACEAE	
Pittosporum pauciflorus	Orange Thorn
Pittosporum undulatum	Sweet Pittosporum
PLANTAGINACEAE	
*Plantago lanceolata**	Plantain
POLYGONACEAE	
*Acetosa sagittata**	Turkey Rhubarb
Persicaria decipiens	Knotweed
*Rumex crispus**	Dock
RHAMNACEAE	
Alphitonia excelsa	Red Ash
ROSACEAE	
Rubus parviflorus	
*Rubus ulmifolius**	Blackberry
RUBIACEAE	
Morinda jasminoides	
SAPINDACEAE	
Guioa semiglauca	Guioa
SOLANACEAE	
*Solanum mauritianum**	Wild Tobacco
*Solanum nigrum**	Nightshade
STERCULIACEAE	
Commersonia fraseri	Brush Kurrajong
ULMACEAE	
Trema aspera	Native Peach
VERBENACEAE	
*Lantana camara**	Lantana
*Verbena bonariensis**	Purple-top

SCIENTIFIC NAME	COMMON NAME
LILIIDEAE	**MONOCOTYLEDONS**
ARECACEAE	
Livistona australis	Cabbage Tree Palm
CYPERACEAE	
Carex longebrachiata	
*Cyperus eragrostis**	
Eleocharis sphacelata	Spike-rush
LOMANDRACEAE	
Lomandra longifolia	Spiky Mat-rush
PHILESIACEAE	
Geitonoplesium cymosum	
POACEAE	
*Axonopus fissifolius**	Narrow-leaf Carpet Grass
Cynodon dactylon	Couch
Microlaena stipoides	Weeping Meadow Grass
Oplismenus imbecillis	Basket Grass
*Paspalum dilatatum**	Paspalum
*Pennisteum clandestinum**	Kikuyu
*Setaria sp **	Pigeon Grass
*Sporobolus africanus**	Parramatta Grass
*Stenotaphrum secundatum**	Buffalo Grass