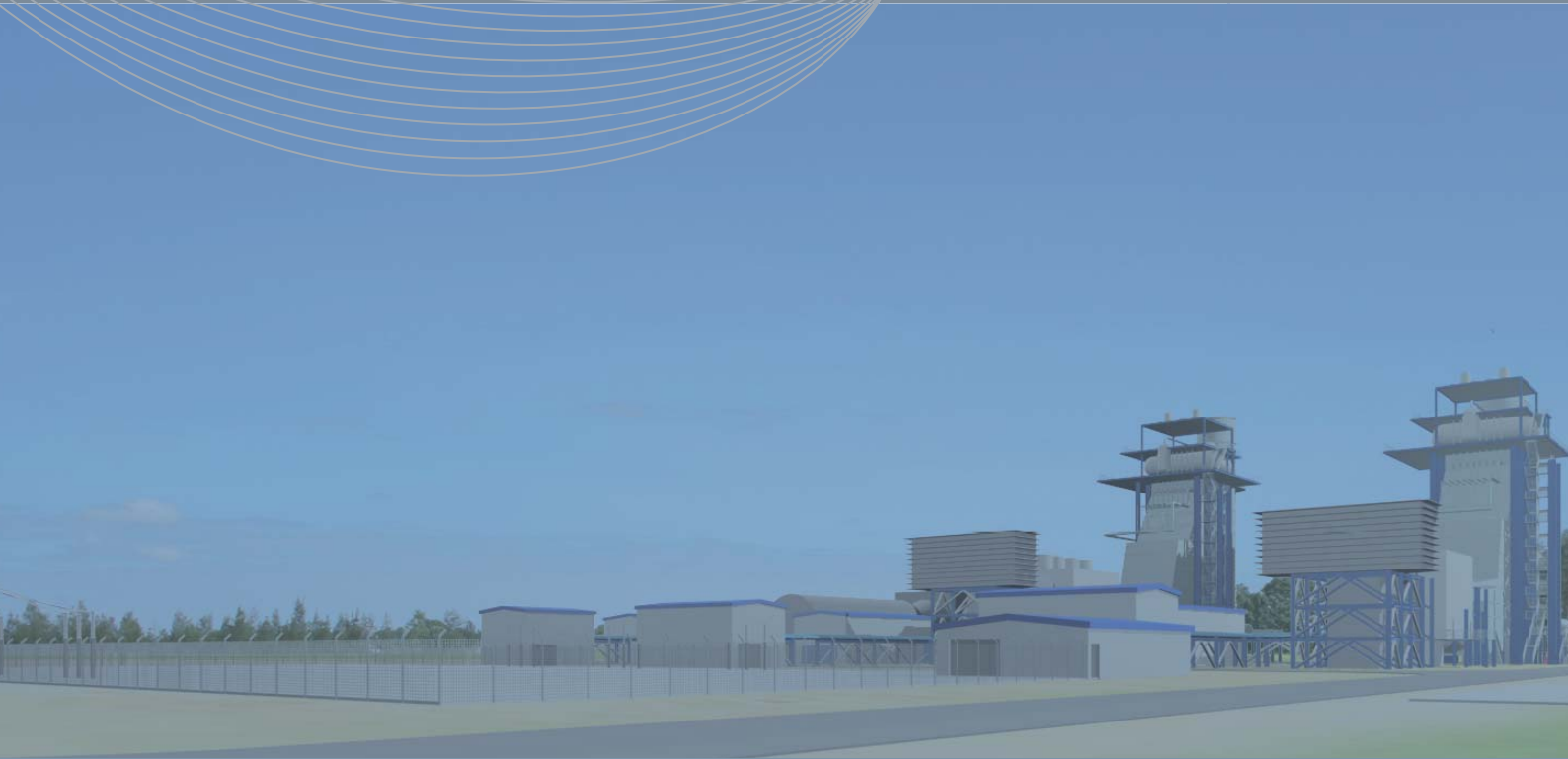
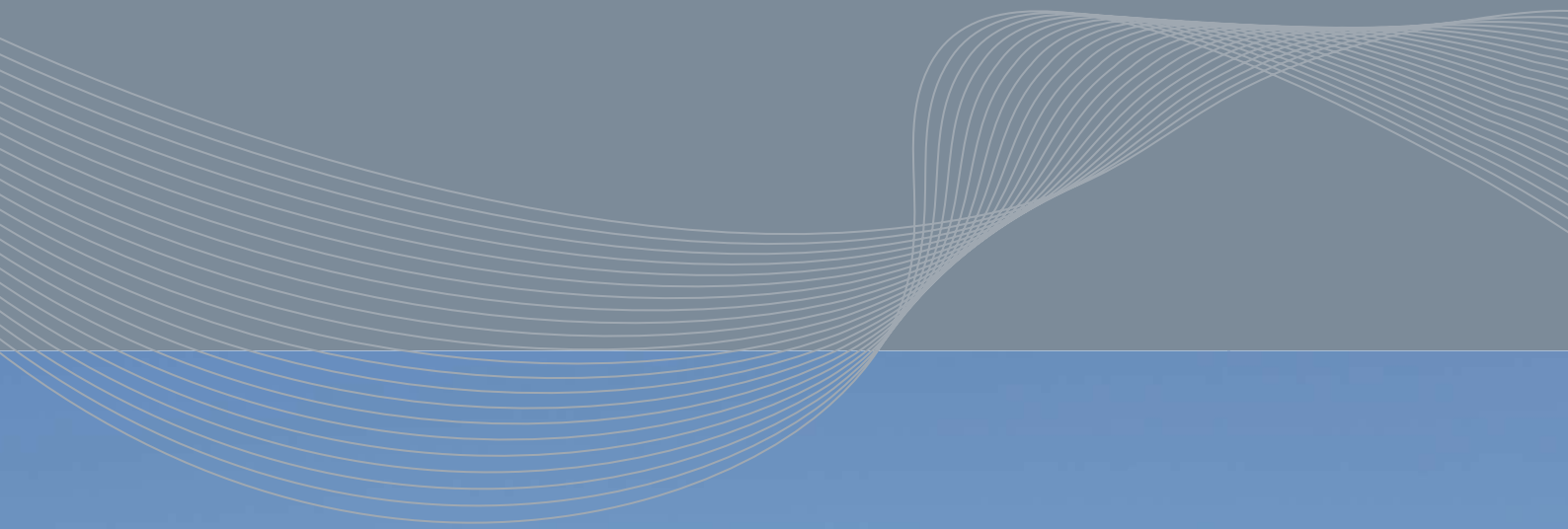




CLIENTS | PEOPLE | PERFORMANCE



Appendix E

Ecological assessment (GHD)





CLIENTS | PEOPLE | PERFORMANCE

Delta Electricity

Bamarang Gas Fired Power Facility

Ecological Assessment

Report

April 2006



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Appendices

- A Flora Species List
- B Fauna Species List



1. Introduction

1.1 Purpose

The Purpose of this report is to assess the potential direct and indirect impacts of construction and operation of a proposed gas fired power facility and associated transmission lines on threatened species and endangered ecological communities within the study area and locality. An assessment of likely impacts from the installation of a gas pipeline between the proposed gas fired power facility and current Eastern Gas Pipeline has also been made. Key ecological issues that required clarification for this assessment included:

- ▶ The potential for endangered ecological communities, threatened species and/or their habitat listed under the NSW *Threatened Species Conservation 1995* (TSC Act) to occur within the study area;
- ▶ The potential presence of any Matters of National Environmental Significance (NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- ▶ Any potential corridor, conservation and vegetation management options.

1.2 Background

The study area is located at Bamarang approximately 8 km south west of Nowra on the NSW South Coast within the Shoalhaven Local Government Area (LGA) (Figure 1). The proposed gas fired power facility is to be located south of Yalwal Road on a site currently supporting an unused abattoir and areas of native vegetation (Figure 2). Yalwal Road and part of Bamarang Nature Reserve bind this area to the north and Crown Land supporting native vegetation occurs to the east, south and west. The Shoalhaven River is situated to the north-west of the study area and the Bamarang Reservoir is situated approximately 0.5 km to the south-west.

The 132 kV transmission lines are proposed along the southern side of Yalwal Road from Flat Rock Creek and connecting to the current transmission line easement north of Yalwal Road near the junction of Bamarang and Yalwal Roads. The assessment was based on a vegetation removal of approximately 1 m either side of the current transmission line easement and approximately 12 m from the edge of the current vegetation along Yalwal Road would be required. The proposed transmission line route covers approximately 7.2 km. Since this time, the estimated total area of clearing for the transmission line has been reduced to an area of approximately 2.7 ha.

Installation of a 900 m gas pipeline to fuel the gas fired power facility is also required and is proposed to run perpendicular to the gas fired power facility site and join the Eastern Gas Pipeline. This area is currently vegetated and supports vegetation similar to that within the disused abattoir site. A strip of vegetation approximately 10 m wide would need to be removed for installation of the pipeline.



The footprint of the gas fired power facility would require the removal of approximately 1 ha of vegetation for Stage 1 and 0.5 ha for Stage 2. An additional 3.5 ha would need to be totally or partially cleared for Asset Protection Zones (APZ) during Stage 1 and 1.2 ha during Stage 2. The gas fired power facility will operate on a 24 hour basis over seven days. The facility will emit noise and light above current ambient levels. Construction activities will occur over a approximately 14 months for Stage 1 and 17 months for Stage 2 will include the operation of heavy machinery Monday to Saturday during daylight hours. Details of noise emission are outlined in the separate Noise Impact Statement report.

The majority of the study area supports native vegetation and the proposal will pass through part of the Triplarina Nature Reserve and Bamarang National Park. A number of drainage lines also occur throughout the study area.

In this report the gas fired power facility site is referred to as 'the site,' the areas required for the transmission lines are referred to as 'the easement,' the area proposed for the gas pipeline are referred to as the 'pipeline route' and all areas proposed for development combined are referred to as the 'study area'.

Geology, Soils and Topography

The study area is located in the Sydney Basin Bioregion. Soils within the study area comprise predominantly sandy loam and are well drained in most places except along drainage lines and creeks.

The study area has a slightly undulating topography with a number of drainage lines crossing throughout. No steep escarpment areas occur in the area with the nearest escarpments occurring to the north and east of the study area near the Shoalhaven River.

Hydrology

A number of creeks and tributaries occur throughout the study area with the following occurring along the proposed easement:

- ▶ Flat Rock Creek;
- ▶ Sandy Creek;
- ▶ Cabbage Tree Creek; and
- ▶ Two other unnamed drainage lines.

Two tributaries of Sandy Creek also run east to west adjacent to each other across the proposed gas fired power facility site.



1.3 The proposal

The proposal consists of the construction and operation of a gas fired gas fired power facility on the disused abattoir site, installation of transmission lines mostly along current easements or road reserves and a gas pipeline linking the facility with the Eastern Gas Pipeline. The footprint of the facility and alignment of the transmission lines have been sited to take advantage of previously cleared areas to avoid large scale vegetation clearance.

The proposal would be developed in two stages:

- ▶ Stage 1: Installation of open cycle gas turbines for a peaking facility; and
- ▶ Stage 2: Conversion to a combined cycle power station to meet intermediate/ base load demands.

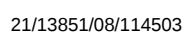
The staged approach has been developed to ensure that Delta is able to respond to increased electricity demands in a timely manner. Stage 1 would ensure that the power generation plant is able to meet demands during peak periods on the national electricity grid. This would result in the plant only operating during periods when electricity demands peak. As the overall demand for electricity increases, it is anticipated that the project would operate over longer periods of time, resulting in Stage 2 operating conditions, which would see it producing electricity to meet base load demands.

Key features of the proposal would include:

- ▶ Two gas turbines in an open cycle configuration including a control building and cooling system in Stage 1;
- ▶ In Stage 2 the addition of a Heat Recovery Steam Generator (HRSG) to each gas turbine and the addition of a steam generator to form a Combined Cycle Gas Turbine Configuration (CCGT);
- ▶ A switchyard;
- ▶ Gas supply (underground) connected to the Eastern Gas Pipeline (located approximately 1 km to the east of the site);
- ▶ Electrical transmission lines to connect to the Integral Energy 132 kV lines (located approximately 6 km to the east); and
- ▶ Condenser cooling plant (wet cooling).

The proposed layout and features to be constructed during each stage are shown in Figure 3 and Figure 4 and include the required Asset Protection Zones (APZs).

Construction of the transmission lines will involve installation of power poles and a 132 kV transmission line. Power poles will be positioned outside of drainage lines and riparian areas.



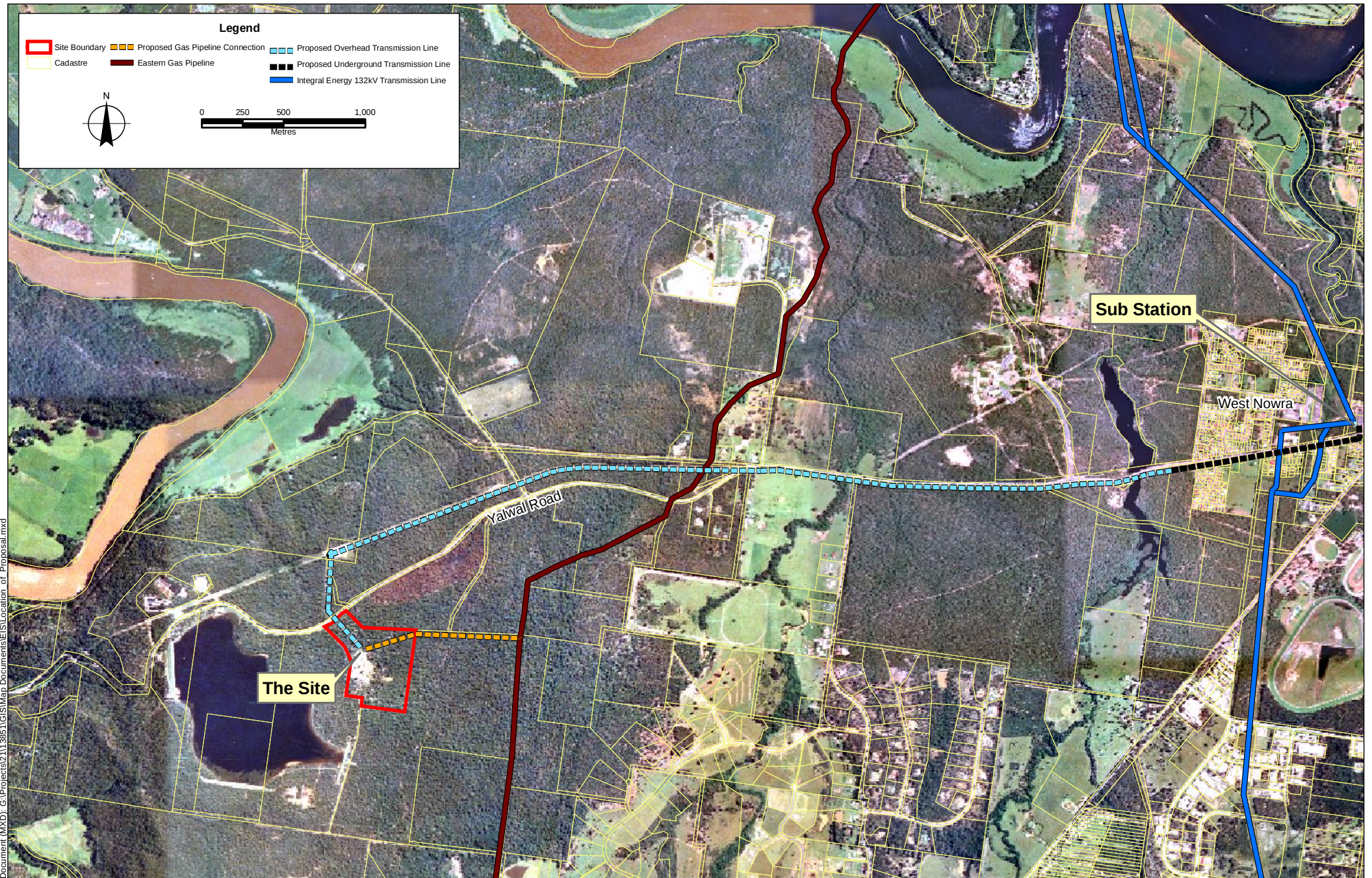


Figure 2 Transmission Line and Gas Pipeline Routes

Legend

Site Features

Plant

Road

Site Boundary

Asset Protection Zone

Perimeter Fire Trail

Passing Bays

N

0

25

50

100

Metres

Figure 3 - Proposed Gas Fired Power Facility (Stage 1)



Figure 4 - Proposed Gas Fired Power Facility (Stage 2)



2. Methods

2.1 Literature Review

Available literature and database records regarding the environmental features of the study area and locality (i.e. 10 km radius) were reviewed and those of particular relevance are listed below, whilst a full list is detailed in Section 7.

- ▶ Department of Environment and Conservation (DEC) Threatened Species Database Search for threatened species recorded within the locality;
- ▶ Department of Environment and Heritage (DEH) Protected Matters Search Tool for Matters of National Environmental Significance likely to occur in the locality;
- ▶ Royal Botanic Gardens Threatened Flora Database Records;
- ▶ Birds Australia Atlas of Threatened Species Records;
- ▶ Proposed Gas Turbine Power Station at Bamarang, Nowra – Preliminary Flora and Fauna Assessment (Parsons Brinckerhoff 2002);
- ▶ Shoalhaven City Council Statement of Environmental Effect Vegetation Mapping (2004);
- ▶ Recovery Plan for the Nowra Heath-myrtle (*Triplarina nowraensis*) (DEC 2003); and
- ▶ *Pterostylis gibbosa* (R.Br.) Illawarra Greenhood Recovery Plan (DEC 2002).

2.2 Field Surveys

Consultation with DEC was undertaken prior to the surveys and the methodology designed to meet the requirements of the DEC *Draft Threatened Biodiversity Survey and Assessment* Guidelines (2005). Surveys for threatened species were undertaken by two ecologists over a five day period from 8 August to 12 August 2005. The survey effort for each component of these surveys is listed in Table 1.

2.2.1 Flora

Vegetation Mapping

Mapping of the communities within the study area was undertaken across the proposed gas fired power facility site and approximately 20 m either side of Yalwal Road and the current transmission line easement. Vegetation communities were identified based on the dominant canopy species and the boundaries marked using a Global Positioning System (GPS).

General Flora

Vegetation surveys were stratified to vegetation communities. Two 20 m x 20 m vegetation quadrats were haphazardly placed in some of the vegetation types present at the site (see Figure 5). Given that previous detailed studies of the proposed easement had been undertaken (Parsons Brinckerhoff 2002), vegetation quadrats focused on the proposed gas fired power facility site where there had been no previous surveys. One quadrat was also located in the area identified as supporting River Flat Forest during past surveys (James 2005), an endangered ecological community under the TSC Act. All species and their cover abundance were recorded for each quadrat. Evidence of past clearing, disturbance soil and other disturbance were also noted. Opportunistic flora records were also taken from across the site. Those species that could not be verified in the field were sampled and identified later in accordance with Harden (1990, 1991, 1992, 1993) or sent to the Sydney Royal Botanic Gardens for identification. Potential RoTAP and threatened species, or those of local significance were also sent to the Herbarium at the Royal Botanic Gardens for confirmation.

Threatened Flora

The Shoalhaven is known to support a number of threatened flora species and has the potential to provide habitat for others. James (2005) identified the Nowra Heath-myrtle (*Triplarina nowraensis*) as being present within the study area whilst our scoping assessment identified the presence of potential habitat for the Illawarra Greenhood Orchid (*Pterostylis gibbosa*). We undertook targeted surveys for each of these species and these are detailed below.

Targeted Searches for Nowra Heath-myrtle (*Triplarina nowraensis*)

Targeted searches for Nowra Heath-myrtle were undertaken using the Random Meander technique (Cropper 1993) along drainage lines at the site and proposed easement both north and south of Yalwal Road. Locations where this species was recorded were marked using a GPS and subsequently mapped. Estimates of the number of individuals within each area were also noted. The search area for each location is illustrated in Figure 5 and the overall level of survey effort is listed in Table 1.

Targeted Searches for Illawarra Greenhood (*Pterostylis gibbosa*)

Targeted searches for the Illawarra Greenhood were conducted using the Random Meander technique (Cropper 1993). Searches were conducted in areas supporting poorly drained soils of a loam to clay loam texture combined with a grassy understorey or with an open shrub layer. The search area for each location is illustrated in Figure 5 and the overall level of survey effort is detailed in Table 1.

2.2.2 Fauna

The study site has the potential to provide habitat for a range of fauna and consequently a number of methods were employed to ascertain the potential importance of this area for native fauna, and in particular threatened species.

Habitat Assessment

A general fauna habitat assessment was undertaken to identify areas of potential habitat within the study area. Specific resources such as shelter, basking, roosting, nesting and foraging sites for amphibians, birds, bats, arboreal mammals, ground-dwelling mammals and reptiles were noted.

Animal scats found during the surveys were collected and sent to Barbara Triggs (Dead Finish) for analysis and identification. In addition, any indirect evidence of fauna (i.e. feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash) was recorded.

Avifauna

General

Surveys were conducted in the early morning or late afternoon using sample plot counts involving a 20 minute auditory and visual search within a 1 ha area. All species heard or sighted during this period were recorded and the location of any threatened species was mapped. The search area for each location is illustrated in Figure 5 and the overall level of survey effort is listed in Table 1.

Glossy Black Cockatoo Feeding Habitat

The Glossy Black Cockatoo is listed as vulnerable on the TSC Act and is frequently recorded within the Shoalhaven area where it known to feed on the cones of *Allocasuarina* species. To ascertain the potential for the study area to provide foraging habitat for this threatened species, areas supporting stands of Black She-oak (*Allocasuarina littoralis*) or *Allocasuarina distyla* were mapped using GPS and aerial photography.

Mammals

In addition to the fauna habitat assessment spotlighting was conducted to detect the presence of any nocturnal arboreal mammals, some of which are listed as threatened under the TSC Act and EPBC Act. Spotlighting was conducted along the length of the proposed and current powerline easements and across the proposed gas fired power facility site for at least one person hour per site.

Hollow-bearing Tree Counts

Hollow-bearing trees are a vital resource for the many native fauna species which are dependent on this resource for roost, nest and den sites, including microchiropteran bats, arboreal mammals and birds. A number of transects approximately 100 m x 10 m wide were traversed at the proposed gas fired power facility site, along the gas pipeline and easements to assess the density of hollow-bearing trees. At the time of



the survey it was not known if the proposed transmission lines would be placed north or south of Yalwal Road. Therefore surveys were undertaken on both sides of the road to determine if either side supported higher densities of hollow-bearing trees. Surveys were also undertaken along both sides of the current transmission line easement as the exact alignment of the new easement had not been decided.

Details recorded along each transect included:

- ▶ Tree Species;
- ▶ Height;
- ▶ Number of hollows; and
- ▶ Average hollow diameter.

The location of each of the transects is shown in Figure 5 and the overall survey effort is outlined in Table 1.

Ultrasonic Anabat Detection

The disused abattoir has the potential to provide roosting habitat for microchiropteran bats and in particular the Bentwing-bat. In an effort to assess the potential importance of this habitat, a Z-caim Anabat was set within the abattoir on 31 January 2006. The Anabat was activated and retrieved the following morning. All bat calls recorded were then sent to Glenn Hoye (Fly By Night) for analyses.

Opportunistic Records

Incidental records of bird, amphibian and mammal species were collected during the entire survey period.

2.2.3 Weather conditions

Weather conditions during the survey period were fine, cool and sunny. However strong winds were experienced on 10 August 2005 and the morning of 11 August 2005 which may have reduced the effectiveness of bird and spotlighting surveys on these days. The night of 31 January 2006 was warm and clear.

2.2.4 Survey Effort

The effort expressed in person hours for each of the aforementioned surveys is outlined below in Table 1.

Table 1 Survey Effort

Group/Species	Technique	Sample Unit	Total Hours
Flora			
<i>Triplarina nowraensis</i>	Random Meander	Person Hours	21
<i>Pterostylis gibbosa</i>	Random Meander	Person Hours	3.2
<i>Pterostylis gibbosa</i>	Searches for suitable habitat	Person Hours	5.5
Fauna			
Avifauna	20 minute search over 1 ha	Person Hours	7.5
Mammals	Nocturnal spotlighting	Person Hours	8.5

2.2.5 Limitations

Surveys were undertaken outside the optimal survey period for some species and therefore it is possible that some species utilise the study area but were not detected during the survey period. These species are likely to include cryptic species and threatened flora such as orchids, which are not in flower during winter. Some fauna species are also mobile and transient in their use of resources. Consequently, it is likely that not all species either resident or transitory to the site would have been recorded during the site inspection. Mammal activity is also known to decrease during the colder months and therefore the detection potential for these species may have been somewhat reduced.

Consequently, this survey was not designed to detect all species, either resident or transitory to the study area. Instead it was aimed at providing an overall assessment of the ecological values of the site and study area with particular emphasis on threatened species to allow an assessment of the impacts of the proposal.

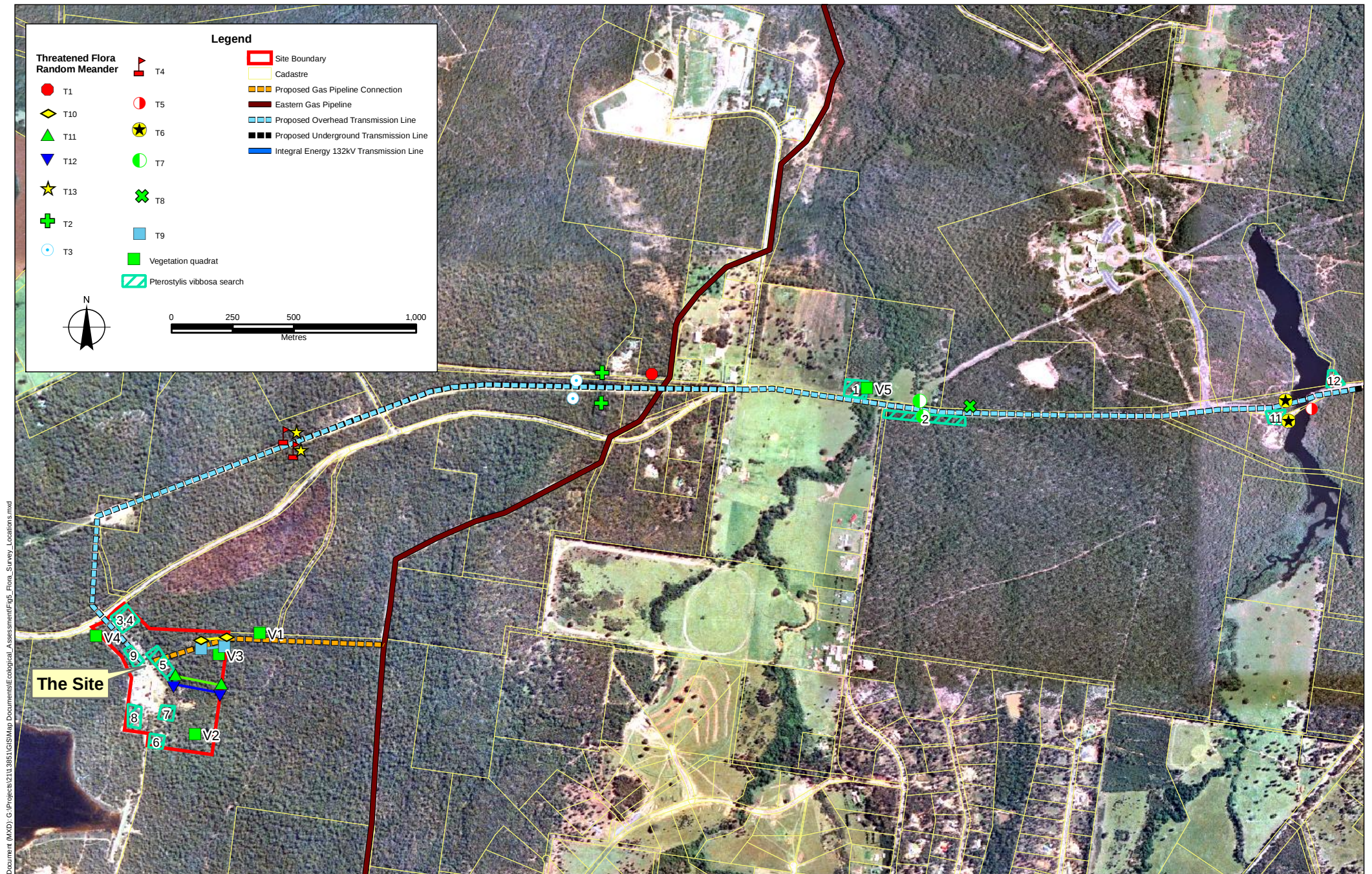


Figure 5 Flora Survey Locations

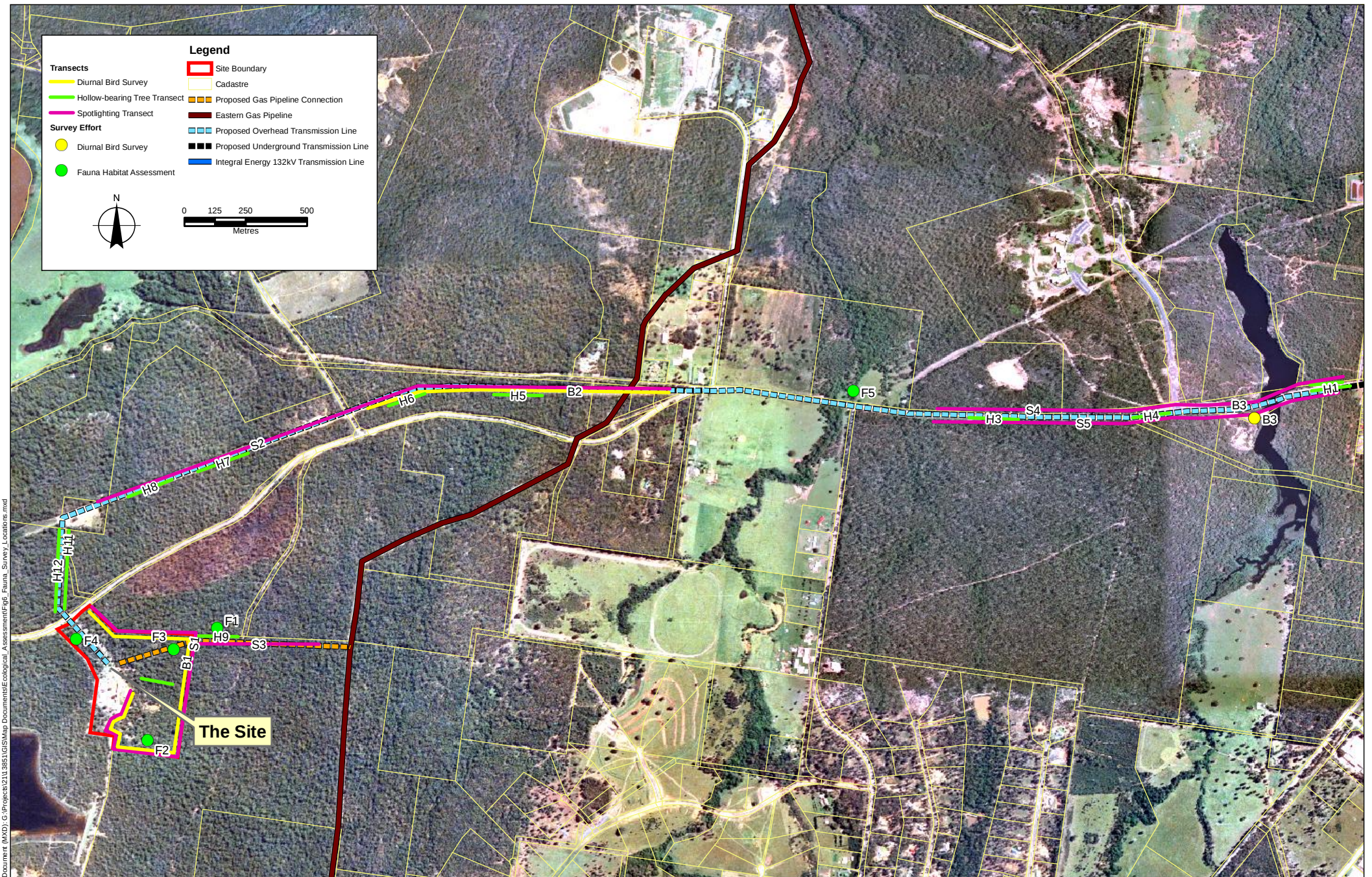


Figure 6 Fauna Survey Locations

3. Results

3.1 Literature Review

Results of the literature review indicated that a number of threatened flora and fauna had been recorded within the locality or had the potential to occur within the locality. The results of the DEC, Royal Botanic Gardens and Birds Australia Database searches are shown in Figure 7 and Figure 8. Those threatened species previously recorded within the study area included:

Flora

- ▶ Nowra Heath-myrtle (*Triplarina nowraensis*).

Fauna

- ▶ Yellow-bellied Glider (*Petaurus australis*);
- ▶ Glossy Black Cockatoo (*Calyptorhynchus lathami*);
- ▶ Black Bittern (*Ixobrychus flavicollis*); and
- ▶ Pink Robin (*Petroica rodinogaster*).

In addition, a number of threatened and/or Rare or Threatened Australian Plants (RoTAP) and endangered or regionally significant ecological communities were identified within the study area during the Parsons Brinckerhoff (2005) study and included:

Ecological Communities

- ▶ River-flat Eucalypt Forest (endangered under the TSC Act); and
- ▶ Northern Foothills Spotted Gum – Blackbutt Moist Shrub Forest (regionally significant).

Flora

- ▶ Nowra Heath-myrtle (endangered under the TSC Act)
- ▶ *Leptospermum epacridoideum* (RoTAP); and
- ▶ *Grevillea linearifolia* - *parviflora* intergrade (known but unresolved taxon).

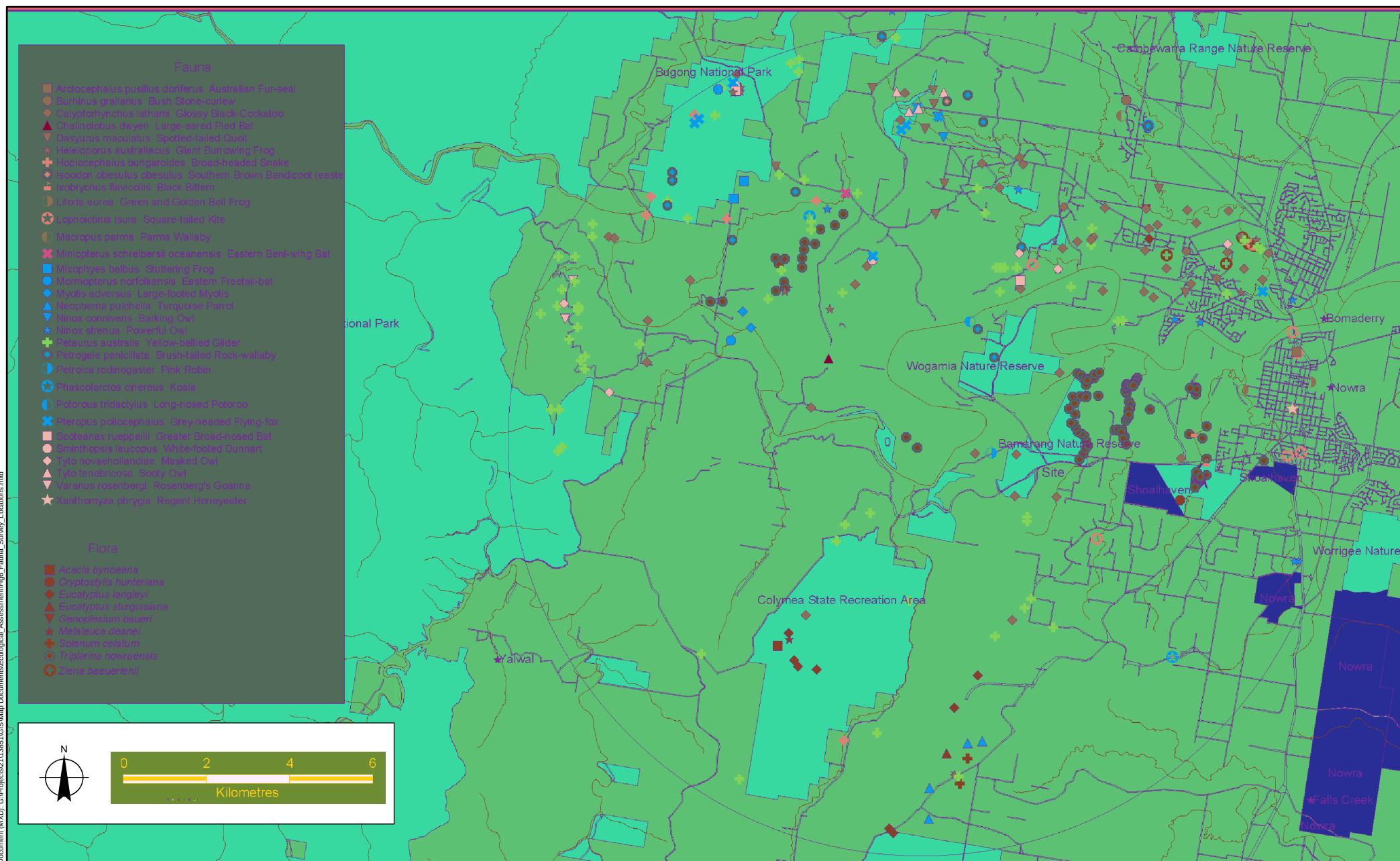


Figure 7 DEC Threatened Species Recorded within the Locality

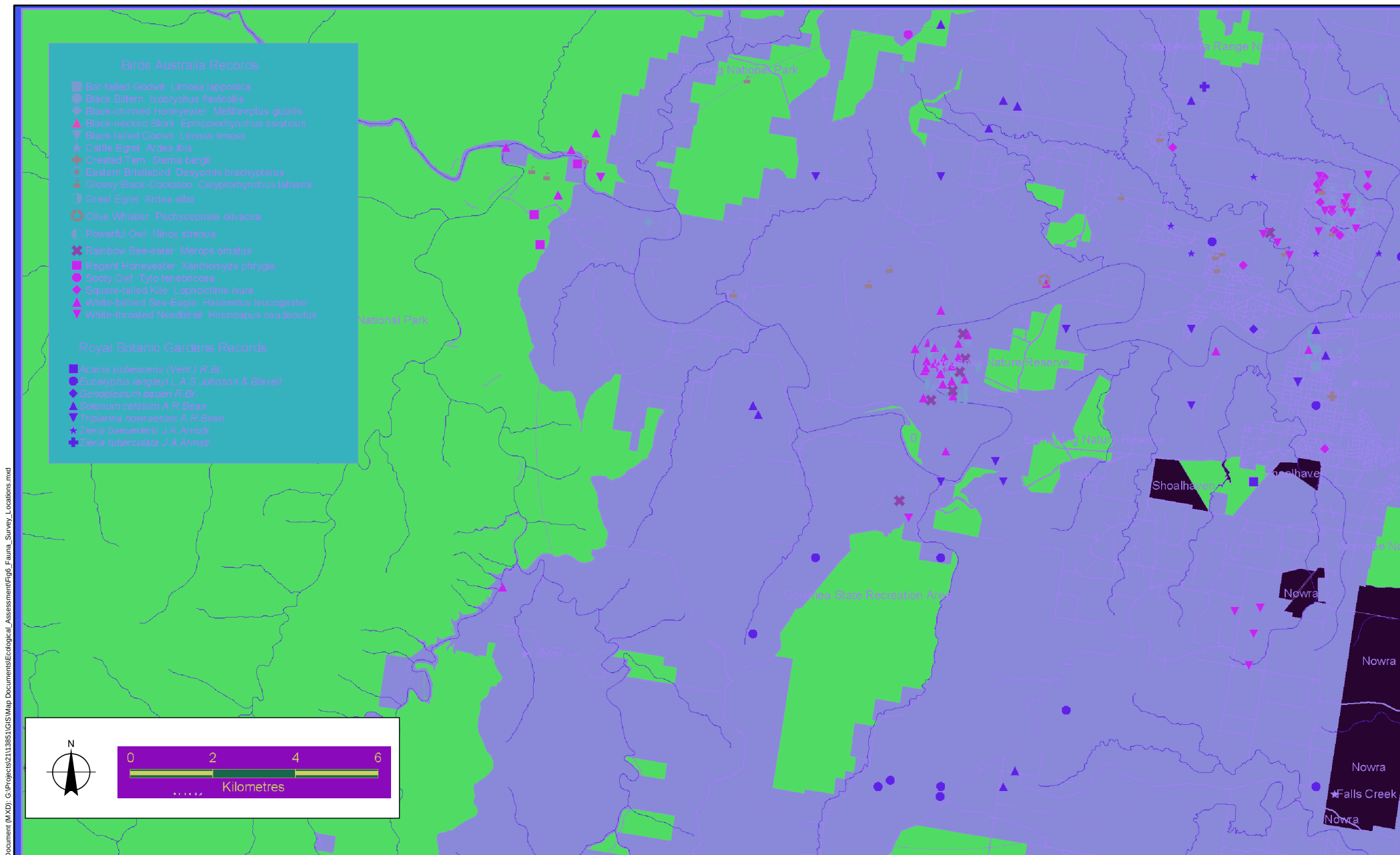


Figure 8 Birds Australia and Royal Botanic Gardens Records within the Locality

3.2 Vegetation

The site of the proposed gas fired power facility is on a disused abattoir. Much of the vegetation on the western side of the site appears to have been cleared during the construction phase. However, scattered native trees remain and the groundcover comprises mainly native grasses. A fire trail approximately 4 m wide has been maintained around the perimeter and informal tracks are also evident through some of the site.

The current transmission line easements are regularly slashed and vegetation is maintained as a grassy cover. Road reserves along Yalwal Road are also regularly slashed.

Weed invasion was limited throughout the study area with the only major occurrences recorded along Cabbage Tree Creek on the southern side of Yalwal Road and within pasture areas.

3.2.1 General Vegetation Communities

Ten ecological communities were recorded within the study area. These are listed below and their locations are shown on Figure 9. A flora species list has also been included in Appendix A.

1. Red Bloodwood/Scribbly Gum/White Stringybark Forest ($\pm$ Blackbutt, $\pm$ Grey Gum)

This community occurred along the current transmission line easement and was characterised by the presence of Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus sclerophylla*) and White Stringybark (*Eucalyptus globoidea*) with occasional occurrences of Blackbutt (*Eucalyptus pilularis*) and Grey Gum (*Eucalyptus punctata*). The midstorey was dominated by patches of Black She-oak (*Allocasuarina littoralis*) and the shrub layer comprised regenerating *Eucalyptus* spp., Spiny Bossiaea (*Bossiaea obcordata*), Mountain Devil (*Lambertia formosa*), *Platylobium formosum*, Round Leaf Tea-tree (*Leptospermum rotundifolium*), Hairpin Banksia (*Banksia spinulosa*), Tick Bush (*Kunzea ambigua*), Needlebush (*Hakea sericea*) Broad-leaved Geebung (*Perseonia leavis*), Slender Rice Flower (*Pimelea linifolia*) and Flax-leaved Paperbark (*Melaleuca linariifolia*). The groundcover was grassy in parts, with moister sections dominated by Bracken Fern (*Pteridium esculentum*) and *Gahnia* sp.. Other groundcover and climber species included species such as False Sarsparilla (*Hardenbergia violacea*), *Cassytha pubescens*, Wiry Panic (*Entolasia stricta*), Coral Heath (*Epacris microphylla*) and Grass Tree (*Xanthorrhoea* sp.). Areas of this community with a recent intense fire history had a large amount of *Eucalyptus* sp. regeneration. A small section of this community was also present between Filter Road and Flat Rock Creek (see Figure 9).

Nowra Heath-myrtle was recorded along the drainage lines within this community and is listed as Endangered under the TSC Act.

2. Spotted Gum/Grey Gum Forest

This community occurred in small sections east and west of Flat Rock Creek (Figure 9). Characteristic species included Spotted Gum (*Corymbia maculata*) and Grey Gum in the canopy, with a midstorey dominated by Black She-oak. The shrub layer was scattered, with occurrences of Spiny Bossiaea, Tick Bush, Sydney Golden Wattle (*Acacia longifolia*), Cherry Ballart (*Exocarpus cupressiformis*), Needlebush, Large-leaf Hopbush (*Dodonaea triquetra*), Bracelet Honey-myrtle (*Melaleuca armarillis*), Wallum Heath (*Epacris pulchella*), Sweet Pittosporum (*Pittosporum undulatum*) and Scented Paperbark (*Melaleuca squarrosa*).

Nowra Heath-myrtle was also recorded in this community on the eastern side of Flat Rock Creek.

3. Red Bloodwood/Thin-leaved Stringybark Forest (±Grey Gum, ±Scribbly Gum)

This community occurred west of Flat Rock creek and had a canopy layer dominated by Red Bloodwood and Thin-leaved Stringybark (*Eucalyptus euginoides*, with occasional occurrences of Grey Gum and Scribbly Gum (Figure 9). The midstorey was dominated by Black She-oak with occasional *Allocasuarina distyla*. The shrub layer was dominated by Tick Bush, Hairpin Banksia, Needlebush, Conesticks (*Petrophile pulchella*), *Pultenaea daphnoides*, and *Acacia terminalis*.

4. Cabbage Gum/Forest Red Gum Forest (River-flat Eucalypt Forest)

This community occurred adjacent to Cabbage Tree Creek and was characteristic of a modified remnant of River-flat Eucalypt Forest, an Endangered Ecological community under the TSC Act (Figure 9). The canopy was dominated by Cabbage Gum (*Eucalyptus amplifolia*) and Forest Red Gum (*Eucalyptus tereticornis*), with patchy Prickly-leaved Paperbark (*Melaleuca stypheloides*) and Snow-in-summer (*Melaleuca lineariifolia*) in the midstorey. The shrub layer was sparse and dominated by Flax-leaved Paperbark (*Melaleuca hypericifolia*) and Blackthorn (*Bursaria spinosa*). Dominant species in the understorey included *Cheilanthes sieberi*, Weeping Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda australis*) Spiny Mat Rush (*Lomandra longifolia*) and Kidney Weed (*Dichondra repens*). Many of these species are characteristic of the TSC Act listed River-flat Eucalypt Forest.

5. Spotted Gum/White Stringybark (±Grey Gum Forest)

This community was characterised by Spotted Gum and White Stringybark in the canopy, with a midstorey of Black She-oak. The shrub layer is sparse, with main species including Needlebush, Gorse Bitter Pea (*Davesia ulicifolia*), Broad-leaved Geebung (*Persoonia levis*), Conesticks and Cherry Ballart. Groundcover species include *Aristida* sp., *Dianella longifolia* and Many-flowered Mat-rush (*Lomandra multiflora*).

6. Red Bloodwood/Thin-leaved Stringybark/Grey Gum Forest (±Blackbutt, ±Scribbly Gum)

This community was present across the proposed gas fired power facility site and gas pipeline route (Figure 9). It was characterised by Red Bloodwood, Thin-leaved Stringybark and Grey Gum, with Blackbutt and Scribbly Gum scattered throughout but

rarely together in the canopy layer. The midstorey was dominated by patches of Black She-oak, with a shrub layer comprised of Box-leaf Wattle (*Acacia buxifolia*), Slender Rice-flower (*Pimelia linifolia*), *Dillwynia retorta*, Spiny Bossiaea, Gorse Bitter Pea, Tick Bush, Brown's Wattle (*Acacia brownii*), Silky Purple Flag (*Patersonia sericea*), Large Wedge Pea (*Gompholobium grandiflorum*), and Erect Guinea Flower (*Hibbertia riparia*). Groundcover species included Kangaroo Grass (*Themeda australis*), Barbed-wire Grass (*Cymbopogon refractus*), Dusky Coral Pea (*Kennedia rubicunda*), False Sarsparilla (*Hardgenbergia violacea*), *Austrodanthonia* sp. and Purple Wiregrass (*Aristida ramosa*).

This community also occurred north of the site along the north-south section of the proposed transmission line easement. James (2005) identified an intergrade between this community and the regionally significant Northern Foothills Spotted Gum – Blackbutt Moist Shrub Forest in this area. Spotted Gum was not present within the proposed clearance area and immediate vicinity and therefore the potential impact area does not represent a stand of this community. However, it is likely that Northern Foothills Spotted Gum – Blackbutt Moist Shrub Forest occurs further to the north outside the study area (James 2005).

7. Red Bloodwood/Scribbly Gum/Thin-leaved Stringybark Open Woodland

A small patch of this community occurred in the south eastern portion of the proposed gas fired power facility site (Figure 9). It was characterised by species similar to that of the remainder of the site but had a more open woodland structure. Dominant canopy species included Red Bloodwood, Scribbly Gum and Thin-leaved Stringybark with occasional occurrences of White Stringybark and a grassy understorey. This community recorded the highest diversity of orchids in the study area. Kangaroo Grass dominated the groundcover, with patches of shrubs such as Tick Bush.

8. Heath

Only small areas of this community occurred within the study area adjacent to Flat Rock Creek. As the name suggests the canopy layer in this community was absent and vegetation cover was dominated by tall shrubs including Tick Bush, Hillock Bush (*Melaleuca hypericifolia*), *Leucopogon lanceolatus* and *Calytrix tetragona*.

9. Disturbed Riparian Vegetation

South of Yalwal Road along Cabbage Tree Creek was comprised mainly of exotic riparian species indicative of a high level of disturbance including *Cotoneaster pannosus* and Privett (*Ligustrum sinense*).

10. Pasture

Pasture areas occurred to the west and east of Cabbage Tree Creek on the northern side of Yalwal Road and to the west on the south side (Figure 9). This community has been historically cleared and dominated by exotic pasture species such as *Paspalum dilatatum*, Kikuyu (*Pennisetum clandestinum*) and Little Quaking Grass (*Briza minor*).

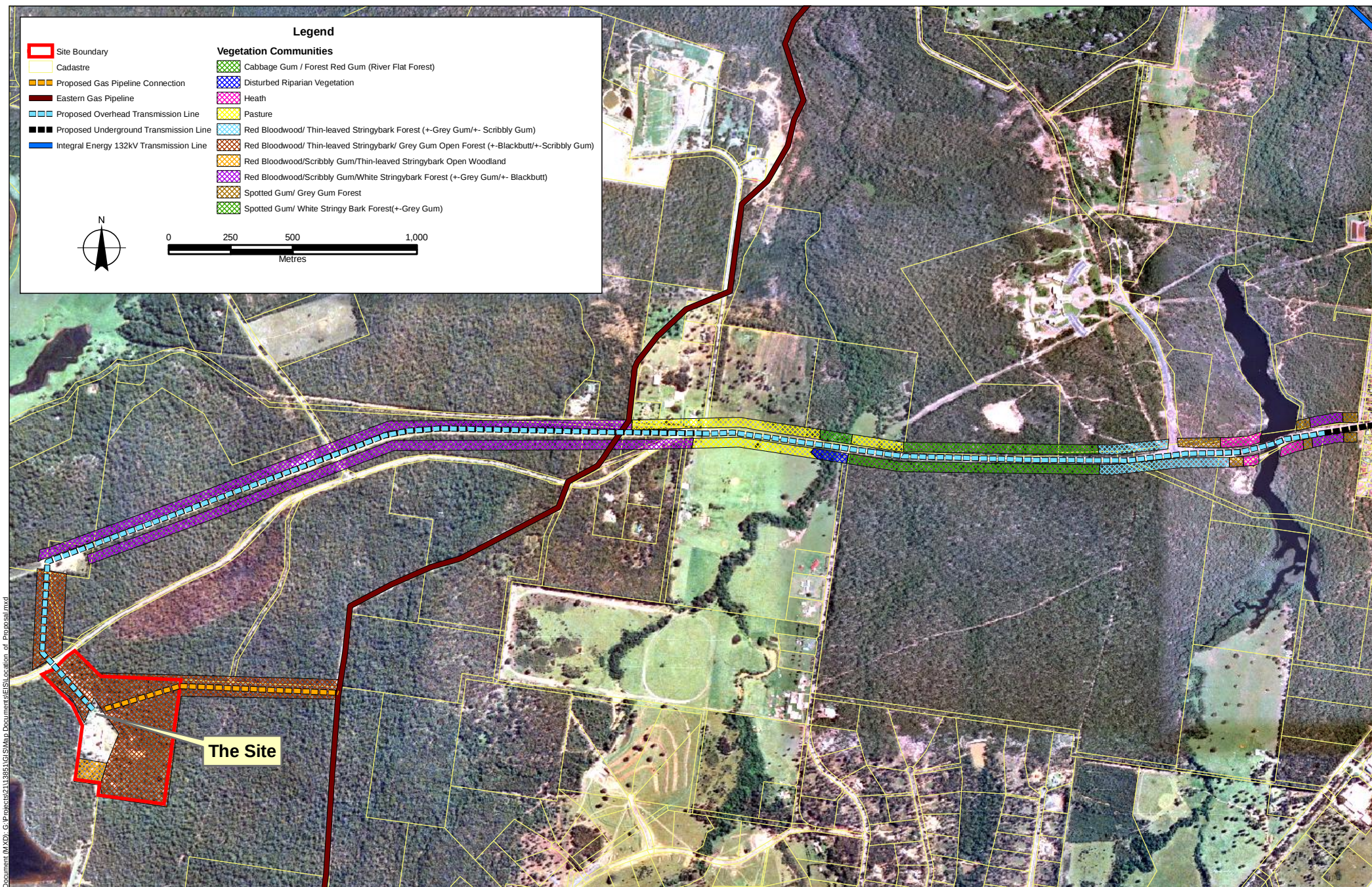


Figure 9 Vegetation Communities

3.2.2 Endangered Ecological Community

River-flat Eucalypt Forest is listed as an endangered ecological community under the TSC Act. This community is associated with silt, clay-loams and sandy-loams, on periodic alluvial flats, drainage lines and river terraces associated with coastal floodplains. The structure varies from tall open forest to woodland and in disturbed areas the canopy may be reduced to scattered trees (NSW Scientific Committee 2004). A modified remnant characteristic of this community was recorded north of Yalwal Road along Cabbage Tree Creek but will not be directly impacted by the proposal.

3.2.3 Threatened Flora

Table 2 list those threatened flora that have been recorded in the locality, or are likely to occur within the locality, together with their conservation status and likelihood of occurring at the site (DEC, DEH and RBG, Figure 7 and Figure 8). Suitable habitat is present within the study area for a number of species. However, these surveys were undertaken outside the flowering period of some species making detection difficult as some are cryptic and can only be detected during their flowering period. Therefore the assessment of the likelihood of cryptic species occurring at the site has been based on the presence of potential habitat within the study area.

The heath and dry sclerophyll forest throughout the study area supported potential habitat for Bynoe's Wattle (*Acacia bynoeana*) and in particular the proposed gas fired power facility site as this species commonly occurs in disturbed areas including recently burnt open patches.

The woodland and forest areas of the site with a grassy or sparse understorey provided potential habitat for Leafless Tongue Orchid (*Cryptostylis hunteriana*) and those areas that are also poorly drained may provide habitat for Illawarra Greenhood (*Pterostylis gibbosa*). Targeted surveys were conducted for the Illawarra Greenhood. However, no individuals of this species were detected within the study area and it is considered unlikely that they would occur due to the dense understorey in most areas.

White-flowered Wax Plant (*Cynanchum elegans*) occurs in the ecotone between dry sclerophyll rainforest and sclerophyll communities. There is potential for this species to occur on the northern side of Yalwal Road within River Flat Eucalypt Forest.

Potential habitat is present throughout the study area for Ettrema Mallee (*Eucalyptus sturgissiana*). However, this species was not recorded during any previous surveys or this survey and is therefore considered unlikely to occur within the study area.

Limited habitat for Brittle Midge Orchid (*Genoplesium baueri*) occurs in the forest areas along Yalwal Road supporting a sparse understorey. Given that this species flowers between December and March there is potential for it to occur within the study area but to have not been detected during the survey.

Deane's Melaleuca (*Melaleuca deanei*) occurs in heath vegetation on sandstone and therefore has the potential to occur within the heath adjacent to Flat Rock Creek. However, this species was not recorded in this area during the survey.



Nowra Heath-myrtle was recorded within the study area along drainage lines and creeks along Yalwal Road and within the proposed easement. The location of these records is shown in Figure 10 and Table 2 lists the northing and eastings. The number of individuals within approximately 30 m of the road/ easement edge was also estimated.

Table 2 **Location and estimated number of Nowra Heath-myrtle plants**

Location	Northing and Easting (WGS 84, Zone 56)	Estimated Number of Individuals
T3 (southern side easement)	E275664 N6136113	3
T5 (northern side Yalwal Road)	E278762 N6136227	12
	E278754 N6136214	12
	E278732 N6136197	1
T5 (southern side of Yalwal Road)	E278655 N6136063	10
	E278678 N6136072	16
	E278682 N6136102	12

Note: Locations of random meander transects shown in Figure 5.



Table 3 Threatened flora that have been recorded in the locality, or have the potential to occur within the locality

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at Site
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	Potential habitat present throughout majority of study area.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Potential habitat present in areas supporting moist heath and open areas within the eucalypt forests.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Limited potential habitat for this species within River-flat Eucalypt Forest area.
<i>Eucalyptus langleyi</i>	Albatross Mallee	V	V	Unlikely. No suitable habitat.
<i>Eucalyptus sturgissiana</i>	Ettrema Mallee	V		Potential habitat present within study area but not recorded during the surveys therefore unlikely to occur.
<i>Genoplesium baueri</i>	Brittle Midge Orchid	V		Potential habitat present in areas supporting open forest and within the mossy areas over sandstone on the western side of Flat Rock Creek
<i>Melaleuca deanei</i>	Deane's Melaleuca	V	V	Potential habitat present within heath vegetation adjacent to Flat Rock Creek.
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	Targeted searches undertaken in suitable habitat but not recorded within study area.
<i>Pterostylis pulchella</i>	Waterfall Greenhood	V	V	Unlikely. No suitable habitat within



Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at Site
				study area.
<i>Solanum celatum</i>	Violet Nightshade	E		Limited potential habitat north of Yalwal Road along Cabbage Tree Creek.
<i>Thesium australe</i>	Austral Toadflax	E	V	Unlikely. No suitable habitat.
<i>Triplarina nowraensis</i>	Nowra Heath-myrtle	E	E	Recorded along creeks and drainage lines at the site.
<i>Zieria baeuerlenii</i>	Bomaderry Creek Zieria	E	E	Unlikely. No suitable habitat present.

E = Endangered, V = Vulnerable

TSC Act = *Threatened Species Conservation Act 1995*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

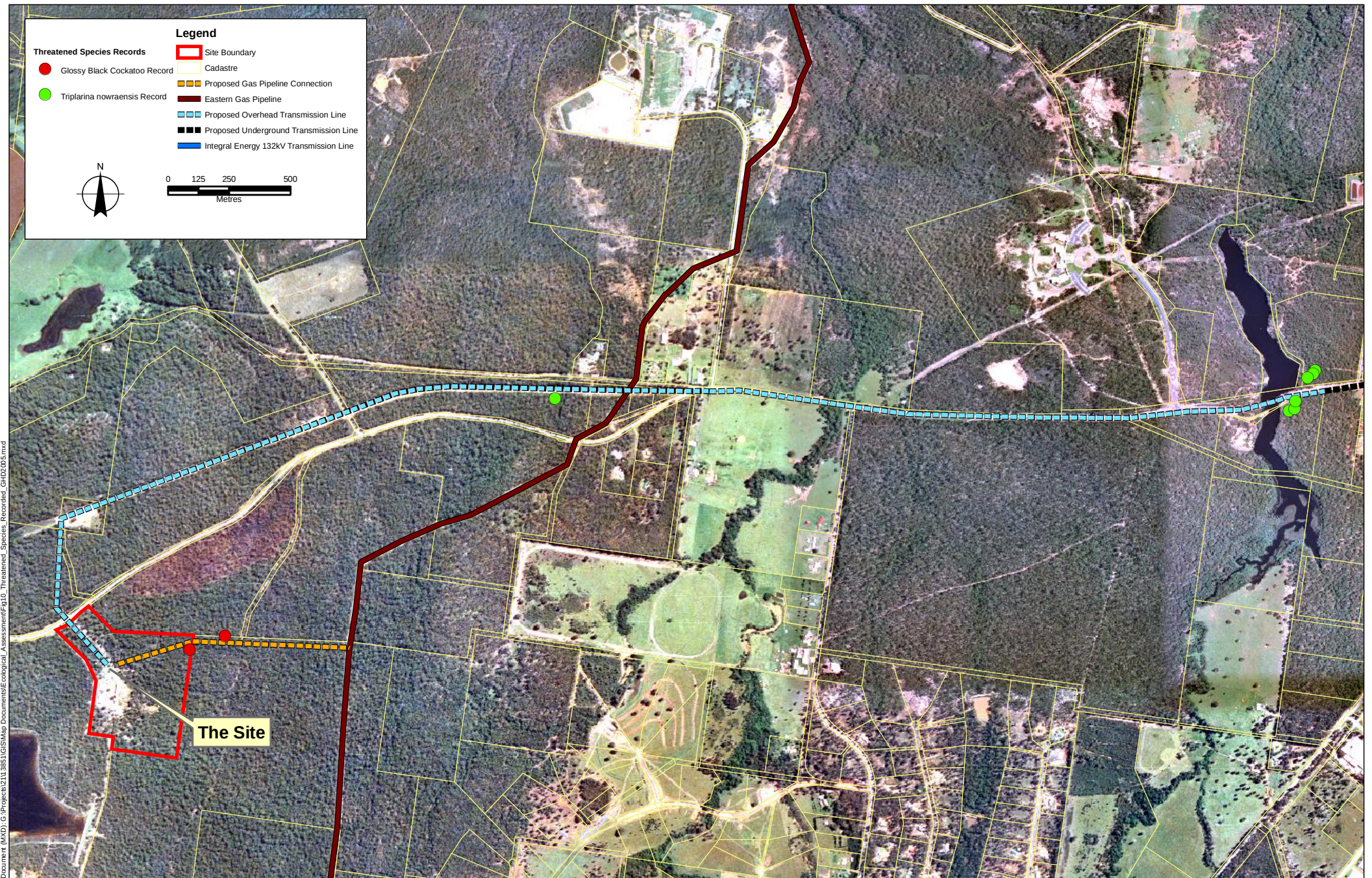


Figure 10 Threatened Species Recorded within the Study Area (GHD 2005)

3.2.4 Regionally Significant Flora

No RoTAP species were recorded during the surveys. However, *Leptospermum epacridoideum* has been recorded within the study area in the past along the current transmission line easement.

Grevillea linearifolia - parviflora intergrades were recorded in a number of locations across the site including:

- ▶ T13 on the northern side of the transmission line easement and other areas throughout the easement as shown in Figure 5; and
- ▶ Within the proposed gas fired power facility site in the northwest.

This species was sent to the Sydney Royal Botanic Gardens for verification as it is part of an unresolved complex of populations in the Nowra/Kangaroo Valley area.

3.3 Fauna

3.3.1 Fauna Habitat

Potential habitat for a variety of fauna was present within the study area due to the extensive areas of intact vegetation and presence of mature, hollow-bearing trees. Habitat was present for most bird species as the dense and heathy understorey provided potential shelter and nesting habitat for small birds whilst the large hollow-bearing trees scattered across the study area provided potential roosting habitat for larger birds such as owls and the Glossy Black Cockatoo (*Calyptorhynchus lathami*) which was recorded feeding at the site during the surveys.

Flat Rock Creek and the associated instream vegetation provided known habitat for the Black Bittern (*Ixobrychus flavicollis*) which has been recorded in the past along Flat Rock Creek (DEC 2005). However, all other creeks and drainage lines within the study did not support suitable habitat for bitterns. A complete list of birds species recorded during the surveys is included in Appendix B.

The sandy soils and heathy vegetation provided potential habitat for ground-dwelling mammals such as bandicoots and the threatened Eastern Pygmy Possum (*Cercartetus nanus*). The hollow-bearing trees, extensive areas of Red Bloodwood and intact and connected vegetation also provided habitat for arboreal mammals such as gliders. Two Greater Gliders (*Petauroides volans*) were recorded north of Yalwal Road during the surveys and one Common Brushtail Possum (*Trichosurus vulpecula*) to the south of Yalwal Road. Yellow-bellied Gliders (*Petaurus australis*) were not recorded during the current surveys but have been recorded within the study area in the past and potential habitat was present for this species throughout much of the study area.

The numerous drainage lines across the study area provided potential habitat for variety of common frog species as well as the threatened Giant Burrowing Frog (*Heleioporus australiacus*). Limited habitat was also present for the Green and Golden Bell Frog along Flat Rock Creek and the adjacent drainage line that supported

Eleocharis sphacelata. However given that the majority of the riparian vegetation along Flat Rock Creek supported a heath rather than grassy understorey, this is considered marginal habitat for the Green and Golden Bell Frog.

Given all of the proposed gas fired power facility site had been recently burnt, areas of potential habitat for reptiles had been reduced. However, the small rocky areas on the plateau are likely to provide habitat for small lizards and snakes. Vegetation along the proposed easement supported abundant leaf litter, rocky areas and fallen logs and is therefore likely to provide good habitat for common reptiles.

3.3.2 Threatened Fauna

A number of threatened fauna have been recorded within the locality (DEC 2005 Figure 7) and potential habitat is present within the study area for the majority of these species. Table 4 lists those species previously recorded in the locality, their conservation status and the likelihood that they would occur at the site. Four of the species listed have been recorded within the study area and include:

- Yellow-bellied Glider;
- Black Bittern;
- Glossy Black Cockatoo; and
- Pink Robin.

The Square-tailed Kite (*Lophoictinia isura*) and Regent Honeyeater (*Xanthomyza phrygia*) have been recorded in close proximity to the study area and are also likely to occur within the study area. The extensive areas of Spotted Gum (*Corymbia maculata*) present throughout the study area are likely to provide foraging habitat for the Regent Honeyeater as well as the endangered Swift Parrot (*Lathamus discolor*).

Potential habitat is also present throughout the study area for the Bush-stone Curlew (*Burhinus grallarius*). However, habitat for this species within the proposed gas fired power facility site is likely to be limited due to the recent fire.

Although not previously recorded within the locality (DEC 2005) extensive areas of potential habitat were present throughout the study area for the Eastern Pygmy Possum. This species feeds on pollen and nectar of *Banksia*, Eucalypts and understorey plants and is listed as vulnerable under the TSC Act (NSW Scientific Committee 2001).

An extensive area of potential habitat for the Eastern Pygmy Possum occurred within the proposed gas fired power facility site and this was comprised approximately 9.5 ha of vegetation with heath understorey. The heath understorey throughout much of this area would provide potential habitat for this species. The remaining vegetated areas of site have a grassy understorey which are less likely to provide habitat for the Eastern Pygmy Possum.

Potential habitat for the Southern Brown Bandicoot is also present throughout the majority of the study area. The dense heathy understorey across much of the study area, sandy soils and presence of groundcover species such as Spiny Mat Rush and

Grass trees (*Xanthorrhoea* sp.) have the potential to provide breeding habitat for this species while the areas of grassy understorey would provide foraging habitat.

Similarly, the Long-nosed Potoroo has the potential to occur across the study area and particularly in areas where there is a mosaic of heath for shelter and open areas for foraging.

Potential habitat for the White-footed Dunnart was present throughout the study area and in particular in areas where there was an open understorey such as the north western and south eastern parts of the proposed gas fired power facility site.

Extensive areas of potential feeding habitat for the Glossy Black Cockatoo were recorded within the study area within the proposed gas fired power facility site. Areas supporting potential habitat for this species were mapped and shown in Figure 11.

The study area provided extensive habitat for a number of threatened owls including the Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua*). However, no owls, owl wash or pellets were noted during the surveys.

Potential habitat for threatened bats occurred throughout the study area including the disused abattoir which could potentially provide roosting habitat for a number of microchiropteran bats, including the threatened Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*). Although the Eastern Bentwing-bat was not recorded at the site, a number of other microbats were detected through echolocation recordings and these species included:

Eastern Horseshoe Bat (*Rhinolophus megaphyllus*);

East Coast Freetail bat (*Mormopterus norfolkensis*);

Eastern Freetail Bat (*Mormopterus* sp.2);

Large-eared Pied Bat (*Chalinolobus dwyeri*);

Gould's Wattled Bat (*Chalinolobus gouldii*); and

Fishing Bat (*Myotis adversus*).

The East Coast Freetail Bat, Large-eared Pied Bat and Fishing Bat are all listed as threatened under the TSC Act and the Large-eared Pied Bat is also listed under the EPBC Act. Of these microbats all are known to utilise man-made structures for maternal roost sites and these species were recorded flying around the disused abattoir. A visual inspection of the interior of the abattoir failed to detect any bat colonies or bat guano which would indicate present and / or past usage by bats of this site for roosting.



Table 4 Threatened Fauna Recorded within the Locality (DEC 2005)

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at the Site
<i>Burhinus grallarius</i>	Bush Stone-curlew	E		Potential habitat present within proposed easement areas.
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo	V		Potential habitat present throughout forest and woodland areas.
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		Recorded at site during inspection and potential foraging and breeding habitat present throughout study area,
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Recorded at the site and potential roosting habitat present.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V		Potential habitat present within study area along Yalwal Road and the current transmission line easement.
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Potential habitat present throughout the majority of the study area except for pasture areas.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Unlikely. No suitable habitat present within study area.
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E	E	Potential habitat present throughout study area particularly in heath and open forest areas.
<i>Ixobrychus flavicollis</i>	Black Bittern	V		Previously recorded within the study area along Flat Rock Creek.



Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at the Site
				Not recorded during current surveys.
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Limited potential habitat in small drainage line adjacent to Flat Rock Creek. However, considered unlikely to occur.
<i>Lophoictinia isura</i>	Square-tailed Kite	V		Potential habitat present within forest and woodland areas and has been recorded in close proximity to study area. This species is likely to forage across study area.
<i>Macropus parma</i>	Parma Wallaby	V		Unlikely. No suitable habitat.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	V	Potential foraging habitat present across study area and potential roosting habitat within old abattoir building. However, not recorded within building during anabat survey.
<i>Mixophyes balbus</i>	Stuttering Frog	E		Unlikely. No suitable habitat within study area.
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		Recorded at the site and potential roosting habitat present.
<i>Myotis adversus</i>	Large-footed Myotis	V		Recorded the site and potential roosting habitat present.
<i>Neophema pulchella</i>	Turquoise Parrot	V		Limited potential foraging habitat within study area but considered unlikely to occur.



Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at the Site
<i>Ninox connivens</i>	Barking Owl	V		Potential foraging and roosting habitat within study area.
<i>Ninox strenua</i>	Powerful Owl	V		Potential foraging and roosting habitat within study area
<i>Petaurus australis</i>	Yellow-bellied Glider	V		Previously recorded within study area but not recorded during current surveys.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Unlikely. No suitable habitat.
<i>Petroica rodinogaster</i>	Pink Robin	V		Previously recorded within in vegetation adjacent to current transmission line easement but not recorded during current survey.
<i>Phascolarctos cinereus</i>	Koala	V		Potential habitat throughout study area.
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	Potential habitat present throughout study area and in particular where areas of both dense and open understorey occur together.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Potential foraging habitat present throughout study area.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		Unlikely. No suitable habitat present.
<i>Sminthopsis leucopus</i>	White-footed Dunnart	V		Potential habitat present throughout the study area in areas supporting open forest and heath.



Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurring at the Site
<i>Tyto novaehollandiae</i>	Masked Owl	V		Potential foraging and roosting habitat present throughout study area.
<i>Tyto tenebricosa</i>	Sooty Owl	V		Unlikely. No suitable habitat.
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V		Potential habitat present throughout study area.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E	Potential foraging habitat present and has been previously been recorded in close proximity to study area.

E = Endangered, V = Vulnerable, TSC Act = *Threatened Species Conservation Act 1995*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

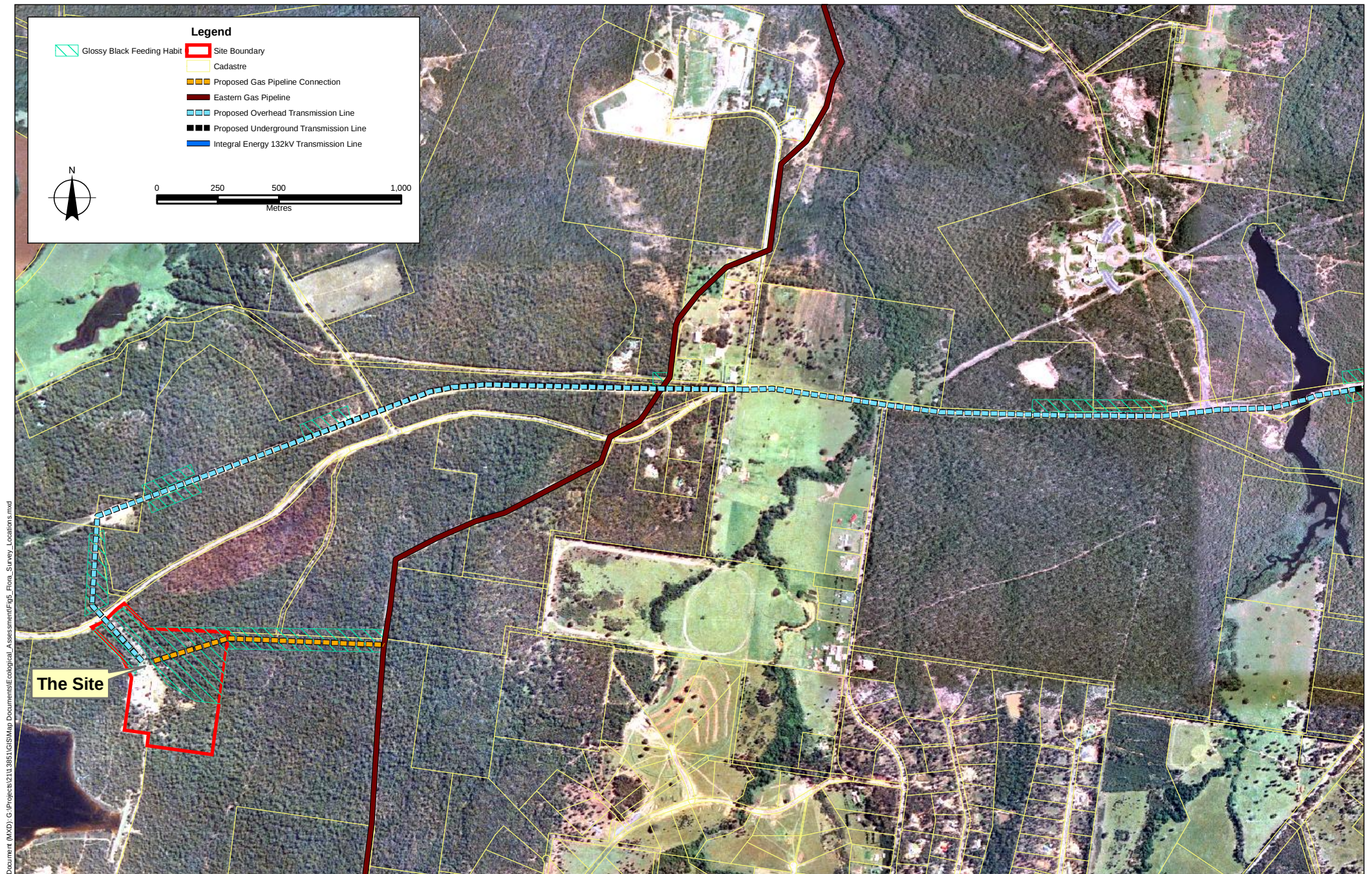


Figure 11 Potential Glossy Black Cockatoo Feeding Habitat

3.4 State Environmental Planning Policy 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) applies within the Shoalhaven LGA. Potential habitat for the Koala is present across the study area with Koala feed trees present in areas mapped as supporting Grey Gum (*Eucalyptus punctata*) and Forest Red Gum (*Eucalyptus tereticornis*) (Figure 9). Although detailed surveys were not undertaken to assess areas supporting Core Koala Habitat, it is likely that Vegetation Community 6 (Red Bloodwood/Thin-leaved Stringybark/Grey Gum Forest (±Blackbutt, ±Scribbly Gum) would represent potential Koala Habitat as Grey Gum was one of the dominant canopy species and was likely to constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

However, the area investigated supporting Forest Red Gum was unlikely to represent potential Koala Habitat as it would not constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Considering most recent record 1986 (DEC 2005) and the amount of survey effort that has been undertaken in that area in the recent past and the current farmland areas, it is considered unlikely that Koalas would inhabit the site and it would not represent Core Koala Habitat. Given that no Core Koala habitat was identified at the site. No further assessments or provisions under SEPP 44 need to be considered.

3.5 Hollow-bearing Tree Counts

Tree hollows provide potential habitat for a variety of fauna including the Yellow-bellied Glider, Owls, Microchiropteran Bats and numerous hollow-dependent bird species. Counts of hollow-bearing trees were conducted across the study area to determine the density and distribution of hollow-bearing trees and the likely number that would be cleared as a consequence of this proposal.

At the time of the survey it had not been decided whether the proposed transmission lines would be placed north or south of Yalwal Road and therefore surveys were undertaken on both sides of the road to determine which side would result in the loss of the least number of hollow-bearing trees.

Table 5 lists the total number of hollow-bearing trees, most common tree species that supported hollows and the average hollow diameter for each transect. Hollow-bearing trees were present across the majority of the study area. Hollows were most commonly recorded in Scribbly Gums with hollows also present in Grey Gum, Red Bloodwood and stags.

The area within the current transmission line easement between Longreach Road and the Mud Brick Property supported the highest densities of hollow-bearing trees. As only 1 m of vegetation clearance either side of the easement is required, it is unlikely that many of these would be cleared.

It is evident from the survey results that it is likely that approximately the same number of hollow-bearing trees would be required to be removed whether the transmission lines were placed on the northern or southern side of Yalwal Road.

Hollow-bearing trees were recorded within the proposed gas fired power facility site and gas pipeline route and some would also be removed for the proposal. The majority of hollows in these areas were between 8 cm and 10 cm diameter. Exact numbers of hollow-bearing trees that would need to be removed for the current proposal is unknown but where possible hollow-bearing trees would be avoided. The current proposed footprint for the gas fired power station has been located as far as possible within the already disturbed parts of the sites.

However, given technical constraints and requirements as outlined below, it was not possible to fully contain the facility within currently disturbed areas of the site as the configuration of the proposed facility is driven by the requirement to stage its development and standard configuration requirements. The location and onsite layout was driven by the need to maximise use of the existing cleared area; ensure that there is adequate space surrounding the proposed facility for asset protection zones; and to meet technical configuration requirements with respect to the location of key equipment items.

The proposed layout was developed to take into account the interconnection constraints and the existing cleared area. Other constraints/factors that influenced the layout (and resulted in a need to clear additional vegetation) included:

- ▶ The need for partial/total clearing for the bushfire asset protection, involving a 40 m clearance from any equipment with gas in it, and a 20 m clearance for other plant items.
- ▶ The cooling tower location and orientation (at the northeast of the site) was determined by the prevailing wind direction to avoid cooling tower drift falling onto the switchyard and other electrical equipment. Sufficient free space has been allowed around the cooling tower to minimise restriction to the free flow of air to the tower.
- ▶ The electrical switchyard is located to the north of the main plant as the transmission line corridor is planned along the main entry road, to minimise vegetation clearing and connect to the grid. A 20 m clearance on either side of the transmission line is required for safety and access reasons.

Where avoidance of hollow-bearing tree is not possible, hollow-bearing branches and trunks would be carefully removed and checked by an onsite ecologist for any fauna and then placed within the adjacent woodland area to provide habitat for other fauna species. Any fauna found within removed hollows would be captured and re-released at nightfall.

It is evident from the results of the survey that removal of some hollow-bearing trees at the site would not result in the removal of all potential habitat for hollow-dependent species at the site as hollow-bearing trees were also recorded in the adjacent areas.



Table 5 Numbers of hollow-bearing trees along transects

Transect Number	Location Description	Number of hollow-bearing trees	Most Common Hollow-bearing Tree Species	Average Height (m)	Average Hollow Diameter (cm)
H1	West of Filter Road on southern side of Yalwal Road.	2	Scribbly Gum	17.5	10
H2	East of Flat Rock Creek on northern side of Yalwal Road.	1	Scribbly Gum	15	7
H3	Vegetation Community 5 on the southern side of Yalwal Road.	0	N/A	N/A	N/A
H4	Intersection of George Evans Road and Yalwal Road on the southern side.	2	Scribbly Gum	20	12.5
H5	Current transmission line easement between Yalwal Road and Longreach Road on northern side.	1	Scribbly Gum	20	15
H6	Current transmission line easement between Yalwal Road and Longreach Road on southern side.	2	Scribbly Gum/Grey Gum	12.5	20



Transect Number	Location Description	Number of hollow-bearing trees	Most Common Hollow-bearing Tree Species	Average Height (m)	Average Hollow Diameter (cm)
H7	Current transmission line easement between Longreach Road and Mud Brick property on southern side.	7	Scribbly Gum/Grey Gum	11	14
H8	Current transmission line easement between Longreach Road and Mud Brick property on northern side.	4	Scribbly Gum	12	11
H9	Along proposed gas pipeline route.	5	Stag	15	15
H10	Parallel to southern drainage line of proposed gas fired power facility site.	3	Red Bloodwood/Scribbly Gum	22	11
H11	South of Mud Brick Property on eastern side of track.	3	Stag	23	12
H12	South of Mud Brick Property on western side of track.	2	Red Bloodwood/Blackbutt	18	8
Note: Transects 100 m x 10 m					



4. Impact Assessment

4.1 General Impacts

4.1.1 Vegetation Clearance

The study area supported a total of 10 vegetation communities with various degrees of disturbance mostly associated with edge effects and clearing for current easements, roads, tracks and the disused abattoir. Total vegetation clearance for Stage 1 of the proposal would be approximately 5.5 ha plus approximately 3.5 ha of partial clearing / hazard reduction for the Asset Protection Zones (APZ) (Table 6). For Stage 2 of the proposal vegetation clearance would be approximately 0.5 ha, plus approximately 1.2 ha of partial clearing / hazard reduction for the bushfire asset protection zones. None of the vegetation to be cleared is considered to be a part of an endangered ecological community.

Attempts have been made to limit the amount of vegetation clearance required through placement of the gas fired power facility on currently disturbed areas. However, given the large size of the structure some vegetation clearance is inevitable. In addition APZs and fire trails for fire protection would be required within the proposed gas fired power facility site and would therefore increase the area of vegetation disturbance required. Detailed bushfire management requirements have been outlined in a separate *Bushfire Risk Assessment* report (GHD 2005) but the areas of partial clearance required for the APZs and fire trail clearance have been outlined below in Table 6. The majority of the clearing for the APZs would be in the form of partial clearing to ensure a discontinuous canopy and to reduce fuel loads to acceptable levels and therefore would not result in clearance of all vegetation in these areas. The removal of vegetated areas would decrease the amount of potential fauna habitat present within the study area.

Table 6 Proposed clearance

Section	Section of Clearance/Partial Clearance	Hectares to be Cleared
Electricity Transmission Line		
Site to Yalwal Road	Corridor would be 25 m wide, 250 m long; acquisition required.	0.5
Yalwal Road to the existing corridor through Crown Land	Acquisition of a easement of 28 m wide and 400 m long would be required	0.5
Flatrock/Yalwal Road intersection to Cabbage Tree Lane	Existing easement (approximately 10 m wide) within private property serves as clearance zone for this section	0.1
Cabbage Tree Lane to George Evans Road (university access)	A section 5 metres wide for a distance of 1.4 km would need to be cleared within the proposed widening of road corridors to 40 m	0.7
George Evans Road to east of Flat Rock Creek	Council is proposing to widen the road corridor to 40 m. Within this corridor a section 5 m wide for a distance of 1.8 km would need to be cleared	0.9
Total for transmission lines		~2.7 ha
Gas Fired Power Facility		
Proposed gas fired power facility site	Approximately 1.5 ha of vegetation would be cleared in this area.	Stage 1: ~ 1.0 ha Stage 2: ~ 0.5 ha
Gas Pipeline		
Gas Pipeline Route	10 m strip south of National Park boundary.	0.9 ha
Fire Protection		
APZ - North of gas fired power facility	40 m from edge of structure	-
APZ - South of gas fired power facility	40 m from edge of structure.	-
APZ - West of gas fired power facility	40 m from edge of structure.	-

Section	Section of Clearance/Partial Clearance	Hectares to be Cleared
APZ - Any additional structure protruding from main structure	20 m from edge of structure.	-
Total Clearance for APZs		Stage 1: ~ 3.5 ha Stage 2: ~ 1.2 ha Total: ~ 4.7 ha of partial clearing
Fire trails (perimeter)	A passing bay 20 m (long) by 3 m (wide) (making minimum trafficable width 7 m). Required every 200 m	~ 0.9 ha

4.1.2 Loss of Habitat for Ground-dwelling Mammals

The proposal would result in the removal of potential habitat for a number of ground-dwelling mammals. Within the proposed transmission line easements vegetation would be slashed thereby enabling groundcover species and small shrubs to remain and regenerate which would reduce the potential impacts on this group. The largest clearance would occur within the proposed gas fired power facility site. Table 7 lists those threatened ground-dwelling mammals for which potential habitat would be lost, their estimated home range and the amount of habitat to be cleared or partially cleared for the proposal. The majority of the vegetation to be cleared would be along the margins of vegetated areas. In most cases extensive areas of potential habitat would remain adjacent to the study area and occur throughout the locality for all of these species. Potentially, some family groups of those species with small home ranges may be lost as a consequence of the proposal if present within the proposed development area. However, it is considered unlikely that the proposal would put a local population of any of these species at risk of extinction.

Table 7 Ground-dwelling mammal habitat within gas fired power facility site

Scientific Name	Common Name	Home Range	Amount of habitat		
			Cleared (ha)	Partially cleared (ha)	Remaining at the site (ha)
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	Females 0.35 ha	Stage 1 – 0.9 ha	Stage 1 – 1.9 ha	5.4
		Males 0.68 ha	Stage 2 – 0.3 ha	Stage 2 – 1.0 ha	
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	Males 5 – 20 ha	Stage 1 – 1.2 ha	Stage 1 – 2.8 ha	12.0
		Females 2 – 3 ha	Stage 2 – 0.4 ha	Stage 2 – 1.3 ha	
<i>Sminthopsis leucopus</i>	White-footed Dunnart	Females 80 m in length	Stage 1 – 1.2 ha	Stage 1 – 2.8 ha	12.0
		Males overlapping home ranges 100 m in length*	Stage 2 – 0.4 ha	Stage 2 – 1.3 ha	
<i>Potorous tridactylus</i>	Long-nosed Potoroo	2 – 5 ha	Stage 1 – 1.2 ha	Stage 1 – 2.8 ha	12.0
			Stage 2 – 0.4 ha	Stage 2 – 1.3 ha	

*Males are capable of making regular exploratory movements of up to 1 km, Partially cleared represent APZs.

4.1.3 Loss of Hollow-bearing Trees

Potential habitat for arboreal mammals, owls and microbats would also be lost for the proposal in the form of hollow-bearing trees. However the number of hollow-bearing trees to be removed would be minimised where possible. The proposal has been situated so as to avoid as much vegetation clearance as possible. However, it is not possible to contain the proposal wholly within currently disturbed areas for the following reasons:

The proposed layout was developed to take into account the interconnection constraints and the existing cleared area. Other constraints/factors that influenced the layout (and resulted in a need to clear additional vegetation) included:

- ▶ The need for partial/total clearing for the bushfire asset protection, involving a 40 m clearance from any equipment with gas in it, and a 20 m clearance for other plant items.
- ▶ The cooling tower location and orientation (at the northeast of the site) was determined by the prevailing wind direction to avoid cooling tower drift falling onto the switchyard and other electrical equipment. Sufficient free space has been allowed around the cooling tower to minimise restriction to the free flow of air to the tower.
- ▶ The electrical switchyard is located to the north of the main plant as the transmission line corridor is planned along the main entry road, to minimise vegetation clearing and connect to the grid. A 20 m clearance on either side of the transmission line is required for safety and access reasons.

Removal of hollow-bearing trees at the site would reduce the amount of potential den sites for the Yellow-bellied Glider which has been recorded within the study area in the past. However, this species has a large home range between 20 ha and 85 ha. Given that Yellow-bellied Gliders are territorial and do not have overlapping home ranges with other family groups there may be potential for this species to disperse to other hollow-bearing trees in the area if disturbed by the proposal.

Hollow-bearing trees at the site may also provide roosting and nesting habitat for microchiropteran bats and owls. Given that these species are highly mobile, have large home ranges and potential habitat in the form of hollow-bearing trees are present adjacent to the proposed development area it is considered unlikely that the proposal would place a local population of microchiropteran bats or owls at risk of extinction. Furthermore removal of hollow-bearing trees is not desirable and would be avoided wherever possible for the proposal to reduce the potential for impacts on these species.

4.1.4 Hydrological Changes

Given the proposal will result in vegetation clearance/slashing within and adjacent to drainage lines, some changes to hydrological regimes at the site are anticipated. However, given that within the transmission line easements the groundcover will be retained, such changes should be minimised.

The proposal also involves the establishment of a large impervious area at the gas fired power facility site. Impervious surfaces and changes to natural hydrological processes can have a number of potential effects including:

- ▶ limiting groundwater recharge by preventing rainwater from infiltrating through the ground;
- ▶ alter the ecology of an area including the vegetational composition and loss of fauna habitat;
- ▶ changes in soil moisture content; and
- ▶ may create conditions conducive to invasion by exotic species.

However, the majority of the area proposed for the gas fired power facility currently supports a disused abattoir and therefore it is likely that the hydrology of the site has already been altered as a consequence of development at the site and construction of the gas fired power facility is unlikely to result in additional significant changes other than those associated with the additional vegetation removal.

4.1.5 Erosion, Runoff and Sedimentation

Potential impacts on the adjacent vegetation including adjacent National Park are likely during construction from runoff and sedimentation if management measures are not implemented.

There is the potential for nutrients, pollutants and seeds of exotic species to be transported from the development area to the remaining vegetation within the site and to the adjacent National Park. Increased nutrient levels may create conditions more suitable for exotic species and therefore result in an increase in the level of weed invasion at the site. Given that the cleared areas of the site support some exotic species there is the potential for seeds of these species to spread to the retained vegetation as a consequence of the soil disturbance during construction works.

There is also the potential for indirect impacts on drainage lines within the study area and adjacent National Park if management measures are not implemented particularly within the proposed gas fired power facility site where construction works would occur in close proximity to drainage lines. Sedimentation can prevent growth of many groundcover species as covering the leaf surface with sediment can prevent leaf photosynthesis. Furthermore, in areas where sediment loads are high, sprouting of new seedlings may be prevented due to the layer of sediment. Therefore management measures to trap or filter runoff before it enters the retained and adjacent vegetation and drainage lines are recommended.

There is the potential for increase in erosion within the study area and adjacent National Park due to increased flows if stormwater and runoff are not managed at the site.

Provided appropriate stormwater, erosion and sediment detention systems are installed and runoff is managed to prevent uncontrolled high flows entering drainage lines or the adjacent National Park, it is considered that there are not likely to be any significant impacts on the retained vegetation, National Park, or drainage lines as a consequence of the proposal. Furthermore, flows of stormwater into the adjacent National Park is unpreventable, 'best practice' stormwater treatment measures should be implemented to maximise:

- ▶ Onsite pollutant retention and removal; and
- ▶ Infiltration and sub-surface discharge of stormwater.

Power poles and gas fired power facility structures would be constructed outside the drainage lines and riparian areas to avoid impacts on these ecosystems.

4.1.6 Edge Effects/Boundary Encroachments on National Park

Vegetation clearance is proposed along the fringes of vegetation for the most part and would include those areas currently impacted by edge effects from previous clearing. Therefore the influence of any edge effects would be shifted further within the current stands of vegetation as a consequence of the proposal. However, little weed invasion was evident along the current transmission line easements which may indicate that potential edge effects are likely to be minimised in these area.

Edge effects are more likely at the proposed gas fired power facility site where exotic species are present and the soil in some areas has been disturbed in the past. Those areas currently on the fringes of the native vegetation already support exotic species, as these areas are more open and susceptible to indirect impacts from uncontrolled runoff and sedimentation. If indirect impacts such as the spread of exotic seeds are not controlled at the site, it is likely that edge effects would increase at the site with weed invasion spreading further into the remaining native vegetation and potentially into the adjacent National Park. In order to reduce the potential for enhancement of edge effects it is recommended that weeds are managed at the site to prevent their spread.

There is the potential for the proposal to also have indirect impacts through edge effects on the adjacent Bamarang National Park particularly where the proposed gas pipeline route will pass through currently undisturbed vegetation along the National Park boundary. However, provided that stringent management measures as outlined in Section 5 are implemented during and post construction, it is considered unlikely that the proposal would have detrimental impacts on the adjacent National Park.

4.1.7 Corridor Values / Isolation

The study area and surrounds is heavily vegetated but is bisected by a number of roads including Yalwal Road, Bamarang Road and a number of smaller arterial roads. The proposed vegetation clearance is located on the fringes of this vegetation and therefore is unlikely to greatly increase isolation between the current vegetated areas.

Isolation between the vegetation to the west of the proposed gas fired power facility site would only increase marginally as a consequence of the proposal and APZs as the area is already highly modified. No further isolation would result between areas to the south and east of the site and adjoining lands as a consequence of the proposal.

The proposed gas pipeline would result in isolation of two currently connecting areas of vegetation between the National Park and land to the south. The proposed clearance width of 10 m is unlikely to prevent movement and dispersal of any fauna species although it may make some species more prone to predation during movement across the cleared area. It is recommended that management measures be implemented along the proposed pipeline route to ensure the isolation and disturbance does not result in the invasion of exotic species or increased erosion, sedimentation and runoff. Such measures are outlined in Section 5.

An important potential east – west movement corridor for fauna is present within the study area. However, it is not anticipated that the proposal would sevre this corridor.



All areas currently connected to the east, south and west of the proposed gas fired power facility would remain and potential corridors to the north currently isolated by Yalwal Road would not be further isolated as consequence of the proposal. All riparian corridors currently present within the study area would also remain.

4.1.8 Alteration of Light, Noise And Dust Levels

Artificial noise and light levels are likely to increase during construction. During the construction phase, altered noise, dust and light levels would result in disturbance to some species during daylight hours.

Continual noise will be generated from the proposed gas fired power facility once constructed. While operation noise is predicted to exceed noise criteria at Bamarang during Stage 1 developments and also at Bamarang during Stage 2 development, it is expected that by implementing a noise control strategy including suggestions outlined in the assessment, it is expected operational noise can be significantly mitigated and potentially meet project specific noise goals.

Little is known of the impacts of noise on most species. However, in general short, sharp noises, such as those associated with sirens or the use of compressed air, are thought to be more disturbing than low level background noise to which species can become habituated. Noise may disturb birds and mammals, and may result in some roosting and foraging areas close to the proposed development becoming unsuitable for ongoing habitation. This may be especially important for species that vocalise to establish territories (eg. Yellow-bellied Gliders) or to contact mates).

Alteration to the light regime on the site may change the way in which fauna use this area. Some species, such as insects and bats, may be attracted to light sources whilst other species will avoid lit areas. Light may impact on the behaviour of insects, some of which may be pollinators of plants on the subject site. Insectivorous bats may be attracted to the site through the increase in the number of insects gathering around light sources. Without appropriate measures, altered light regimes may disrupt the movement patterns of a number of species.

Airborne dust levels are likely to increase during the construction phase. Dust can smother plants and could result in the loss of some species. The accumulation of dust on the site during construction may be washed into streams during rain events causing increased levels of turbidity and impacts on aquatic fauna and wading birds.

4.1.9 Management Implications and Impacts for National Park

Vegetation would remain between the National Park and development within the proposed gas fired power facility and would therefore act as a buffer between the site and National Park. Furthermore, weeds would be managed within this buffer zone to prevent their spread into the adjacent National Park.

4.1.10 Fire

Fire management measures would be implemented at the site and have been outlined in the GHD (2005) Bushfire Assessment. Fire management measures would be implemented to protect both life and property and well as to reduce the likelihood of fire from within the proposed gas fired power facility site entering the National Park. Fire management measures include APZs, a perimeter fire trail and management of fuel loads.

4.1.11 Visual Impacts

Please refer to the GHD Environment Impact Assessment document (2005) for an assessment of potential visual impacts of the proposal.

4.1.12 Key threatening processes

The following key threatening processes are considered relevant to the proposal:

- ▶ Clearing of native vegetation (TSC Act) and land clearance (EPBC Act);
- ▶ Removal of dead wood and trees (TSC Act); and
- ▶ Predation by the European Red Fox (TSC Act & EPBC Act).

The Yellow-bellied Glider Recovery Plan lists clearing of native vegetation/land clearance as a key threatening process for this species (NPWS 2003b). Table 6 lists the total vegetation clearance required for each component of the project. Given that the project is to be undertaken in two stages clearing and modification of native vegetation and fauna habitat would be gradual. Gradual removal of vegetation would provide the opportunity for some fauna to relocate to adjacent areas although it is unlikely that territorial species could relocate.

Dead wood and dead trees would be removed as a consequence of the proposal and would result in removal of habitat for ground-dwelling and arboreal mammals as well as some bird species and reptiles. Removal of dead wood and trees is identified as a process posing a significant threat to the survival of Rosenberg's Goanna. In order to reduce the impact of vegetation removal on fauna it is recommended that wherever possible removal of these resources be undertaken outside the breeding season for key threatened species with the potential to occur throughout the study area and hollows are checked and resident fauna removed before clearing. This should be undertaken after consultation with DEC.

The proposal and in particular the vegetation clearance proposed for the gas pipeline, is likely to increase the threat of predation on native fauna from non-native species such as the European Red Fox (*Vulpes vulpes*). This species has the potential to significantly impact on both ground-dwelling and arboreal species including the Eastern Pygmy Possum, Bandicoots and the Yellow-bellied Glider. Passing across the cleared areas would increase the risk of predation for these species.

4.2 NSW Threatened Species Assessment

An assessment of the impacts of this proposal on species, populations and ecological communities listed Schedules 1, A1 and 2 of the TSC Act was undertaken. The proposal would be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2005).

The study area supported extensive areas of native vegetation including the endangered River-flat Eucalypt Forest community and potential and known habitat for a number of threatened flora and fauna species. However, not all of these species or their habitat are likely to be impacted by the proposal. Potentially impacted species are listed below in Table 8. Given the large number of fauna species, these have been separated into guilds for assessing impacts as in most cases species within each guild are likely to have similar habitat requirements. However, each flora species was considered separately due to their distinctive habitat requirements.

Table 8 Potentially threatened species

Flora	Woodland Birds & Owls
Bynoe's Wattle	Glossy Black Cockatoo
Leafless Tongue Orchid	Square-tailed Kite
Ettrema Mallee	Bush-stone Curlew
Deane's Melaleuca	Pink Robin
Brittle Midge Orchid	Regent Honeyeater
Illawarra Greenhood	Gang Gang Cockatoo
Nowra Heath-myrtle	Barking Owl
Violet Nightshade	Powerful Owl
Amphibians	Masked Owl
Giant Burrowing Frog	Ground-dwelling Mammals
Reptiles	Eastern Pygmy Possum
Rosenberg's Goanna	Spotted-tailed Quoll
Megachiropteran Bats	Southern Brown Bandicoot
Grey-headed Flying-fox	White-footed Dunnart
Microchiropteran Bats	Long-nosed Potoroo
Large-eared Pied Bat	Arboreal Mammals
Eastern Bent-wing Bat	Yellow-bellied Glider
Eastern Freetail-bat	Koala
Large-footed Myotis	

4.2.1 Flora

There is the potential for direct impacts on potential habitat for some of threatened flora species due to vegetation clearance such as displacement or disturbance, as well as indirect impacts including runoff, sedimentation, edge effects (opening up remnants to weed invasion), disruption to the pollination cycle (if clearing is undertaken during flowering periods), disturbance to dormancy periods and seed banks. Mitigation measures outlined in Section 5 will be implemented during construction to minimise such impacts. Therefore it is considered unlikely that the proposal would have a significant impact on the lifecycle of any flora species.

River-Flat Eucalypt Forest

One endangered ecological community, River Flat Eucalypt Forest was present within the study area along Cabbage Tree Creek on the northern side of Yalwal Road. Given that the development is proposed for the southern side of Yalwal Road no direct impacts on this community are anticipated. However, there is the potential for indirect from construction if sediment and runoff are not controlled. Given that these impacts would be managed during construction it is considered unlikely that the proposal would have a significant impact on this community.

Nowra Heath-myrtle

Only the Nowra Heath Myrtle was recorded on site during this and previous surveys, including that undertaken by Parsons Brinckerhoff (2005). This species is often found on moist soils or poorly drained soils such as watercourses and bedrock surfaces with impeded drainage although two populations are known to occur in drier sites. Forest communities where the species has been recorded in the past include Grey Gum – Stringybark Forest, Scribbly Gum – Bloodwood Woodland and Scribbly Gum – Grey Gum Woodland (NPWS 2003a). This species is known only from only five populations west of Nowra, all within a 20 km radius. Considering the localised records, the species is at the edge of its known distribution.

Nowra Heath-myrtle was recorded along the creeks and drainage lines adjacent to the current transmission line easement and Yalwal. The proposal will result in the removal of small areas of potential habitat for the Nowra Heath-myrtle along the creeks and drainage lines within the study area. However given that clearance of vegetation only 1 m either side of the current transmission line easement is required, no known individuals of this species would be removed. Furthermore, the only recorded individuals within the proposed 12 m clearance zone along Yalwal Road occurred on the northern side of the road. Given that the transmission line easement is to be constructed on the southern side of Yalwal Road, no known individuals along the road would be removed as a consequence of the proposal.

Given the proximity of some of the individuals of this species to the proposed construction areas, it is likely that indirect impacts on this species would be experienced if management measures to control runoff, sediment and weed invasion are not implemented.

The proposal is considered unlikely to have a significant impact on this species or affect the lifecycle such that it would place the local population at risk of extinction for the following reasons:

- ▶ No known individuals would be removed;
- ▶ Potential indirect impacts would be mitigated or managed; and
- ▶ The area of potential habitat is small and on the margins of potential habitat; and
- ▶ Other areas of known and potential habitat occur within the locality.

Bynoe's Wattle

Bynoe's Wattle occurs mainly in heath and dry sclerophyll forest (Harden, 1993), often preferring open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and recently burnt open patches. Trail margins and areas of recently burnt open patches persist at the proposed gas fired power facility site and along the existing transmission line easement. However, this species has not been recorded in any previous surveys undertaken on the site.

The proposal would remove small areas of potential habitat for this species and has the potential for indirect impacts on other areas of potential habitat. However, given that management measures would be implemented to prevent indirect impacts on such habitat and no individuals of this species are known to occur within the study area or directly adjacent, it is considered unlikely that the proposal would have a significant impacts on this specie or its habitat.

Leafless Tongue Orchid

Literature suggests that the Leafless Tongue Orchid occurs in swampy heath on sandy soils (Harden 1993). This species has also been recorded in grassy open areas of forest in the Vincentia area (GHD 2005). Similar vegetation structure to that of the Vincentia site occurs in small patches of the proposed gas fired power facility site in the north east and south. Given that this species flowers during summer there is potential for it to occur at the site. (Bishop 1996). The proposal would not result in the removal of habitat for this species but may have indirect impacts. Therefore provided management measures are implemented to prevent indirect impacts on this species it is considered unlikely that the proposal would constitute a significant impact or place the any local populations of this species at risk of extinction.

Ettrema Mallee

Ettrema Mallee has a very restricted occurrence on sandstone plateaus west and southwest of Nowra, with a few small patches nearby on the coastal plain (Brooker & Kleinig 1999). The small areas of heath vegetation adjacent to Flat Rock Creek support potential habitat for this species and there is potential for small areas of this vegetation not be removed for the proposal. However, this would only occur on the fringes and therefore would not constitute a significant impact on habitat for this species. In addition, given that this species was not recorded during this or any previous surveys it is considered unlikely that it occurs within the study area.

Deane's Melaleuca

Deane's Melaleuca occurs in heath vegetation communities on sandstone and is known from two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. Isolated populations are also known in the Blue Mountain, Central Coast and this species has been recorded at Yalwal in the Colymea State Recreation Area (DEC 2005). There is potential for this species to occur in the heath community adjacent to Flat Rock Creek and therefore areas of potential habitat for this species to be affected by the proposal. Given that the areas of heath are set back from the road it is likely that only very small areas, if any, of this vegetation would need to be removed from the margins for the proposal. Therefore given the small size of the potential area to be cleared and that this species is conspicuous but not recorded within the study area and therefore unlikely to occur, it is considered unlikely that the proposal would have a significant impact on this species or its habitat.

Brittle Midge Orchid

Brittle Midge Orchid occurs in sparse sclerophyll forest and moss gardens over sandstone from Nowra to Pittwater and potentially as far north as Port Stephens. Therefore this species would be close to the limits of its southern distribution if it occurred within the study area. Potential habitat for this species occurs in very small patches on the south side of Yalwal Road, in the heath community adjacent to Flat Rock Creek. Given that the areas of heath are set back from the road it is likely that only very small areas, if any, of this vegetation would need to be removed from the margins for the proposal. GHD surveyed the area with the aid of a local orchid expert with no records of this species. However, this species flowers in February to May (Bishop 1996) and therefore may be present on the site. Given that such a small area, if any, potential habitat would need to be removed as a consequence of the proposal and that potential habitat would remain, it is considered unlikely that the proposal would have a significant impact on this species.

Illawarra Greenhood

The habitat preferences of Illawarra Greenhood are difficult to identify due to variation in the species composition and vegetation types between the sites where they have been recorded. Illawarra Greenhood has been recorded in the Nowra area in Spotted Gum Open Forest, Grey Ironbark (*Eucalyptus paniculata*) and Cherry Ballart (NPWS, 2002). Targeted searches for the Illawarra Greenhood were undertaken with the aid of a local orchid expert but no plants recorded. It is considered unlikely that the Illawarra Greenhood will occur within the study area as it has different characteristics to areas where other populations of this species have been recorded (Alan Stephenson, pers. comm.).

Violet Nightshade

Violet Nightshade occurs in rainforest clearings and wet sclerophyll forest from Wollongong to just south of Nowra and west to Bungonia, with only one record found since 1960. Although it is unlikely that this species would occur, limited potential habitat for this species occurs north of Yalwal Road along Cabbage Tree Creek but would not be directly impacted by the proposal. However, there is the potential for the



proposal to have indirect impacts on this habitat from construction works if management measures are not implemented. However, given that stringent management measures would be implemented during construction to prevent impacts on adjacent vegetation it is considered unlikely that the proposal would have a significant impact on this species or its habitat.

Potential impacts of the proposal on current disturbance regimes

The proposal is not likely to significantly alter current disturbance regimes. A Bushfire Assessment (GHD 2005) prepared for the site does not propose any alteration in current fire hazard reduction burning regimes. Areas cleared as part of the Asset Protection Zones will be periodically slashed in order to reduce fuel loads, however this is unlikely to have a significant impact on any of the threatened flora species or their habitat.

Potential impacts on habitat connectivity

Given that the proposed clearing involves the removal of strips of vegetation along already existing easements and roadsides, as well as clearing an area of vegetation for the part of the proposed gas fired power facility adjacent to a previously cleared area (where the abattoir building and stockyards are located), impacts on habitat connectivity will be minimal.

Potential impacts on critical habitat

There are no areas identified as critical habitat present at the site.

4.2.2 Fauna

Woodland Birds and Owls

Small strips of potential nesting and foraging habitat would be removed for woodland birds and owls along the proposed and current transmission line easements and gas pipeline (approximately 5.6 ha) and a larger area within the proposed gas fired power facility site (approximately 7.2 ha).

It is unlikely that any hollow-bearing trees would need to be removed along the current transmission line easement as only 1 m either side of the easement needs to be cleared and most hollow-bearing trees occur further away from the boundaries within the vegetation. However, some hollow-bearing trees and stags supporting hollows of various sizes would be removed along Yalwal Road, the gas pipeline and at the proposed gas fired power facility site. Based on the result of the hollow-bearing tree counts it is unlikely that the number of hollow-bearing trees removed would be substantial. In addition, all of the areas adjacent to the study area support hollow-bearing trees and therefore potential roosting habitat for these species would remain within the locality and where possible construction would be undertaken to avoid hollow-bearing trees.

The proposed vegetation removal is unlikely to represent a significant area of potential habitat in terms of owl use as much of it occurs on the fringes of stands and the majority of large hollow-bearing trees would be avoided where possible. Furthermore,



owls have extremely large home ranges, e.g. Powerful Owl home range is around 500 to 1,000 ha, and are likely to forage extensively throughout the locality.

Given that the project is to be undertaken in two stages clearing and modification of native vegetation and fauna habitat would be gradual. Gradual removal of vegetation would provide the opportunity for some fauna to relocate to adjacent areas. Furthermore, in order to reduce the impact of vegetation removal on woodland birds it is recommended that hollows are checked and resident birds removed before clearing and where possible, removal undertaken outside the breeding season for key threatened birds species likely to occur in the area such as the Glossy Black Cockatoo and owls.

Given that these areas to be cleared are largely on the fringes of vegetation, extensive areas of potential foraging and roosting habitat would remain adjacent to the site and within the locality in Nature Reserves, State Forests and National Parks and that these species are highly mobile, it is considered unlikely that this vegetation removal would have a significant impact on any the lifecycle of any threatened woodland birds or their habitat or place any local populations at risk of extinction.

Furthermore, although a number of threatened woodland birds and owls are known to occur within or in close proximity to the study area, none are at the limits of their distribution in Shoalhaven.

The Glossy Black Cockatoo *Calyptorhynchus lathami lathami* occurs from southern Queensland to far-eastern Victoria and consequently the Shoalhaven is not at the edge of its range.

The Gang Gang Cockatoo is known from southern Victoria through to south eastern and central eastern NSW. In NSW this species inhabit areas from the Hunter Region to the south eastern coast. It is unlikely that this species is at the limits of its distribution within the study area.

The Square-tailed Kite occurs throughout NSW and Victoria, across northern Australia and the western third of western Australia (Pizzey & Knight 1999) and therefore the Shoalhaven is not at the edge of its range.

The Bush Stone-curlew occurs across northern Australia, extending down through the eastern two-thirds of NSW, across south western NSW to south-eastern South Australia. This species also occurs across in the western third of Western Australia (Pizzey & Knight 1999). The occurrence of this species in areas surrounding the site is not an edge of range record.

The Pink Robin occurs throughout Tasmania and on the south eastern part of the mainland from south of Sydney through to the south-eastern tip of South Australia (Pizzey & Knight 1999). The occurrence of this species in areas surrounding the site is not an edge of range record.

The Regent Honeyeater has had its range seriously reduced by habitat clearance and alteration. Currently it can be found in a strip west of the divide as far west as Dubbo from south-east Queensland to north-east Victoria, and over the divide on the central

coast on the far south coast (DEC 1999). Therefore this species is not at the limits of its distribution in the Shoalhaven.

The Barking Owl occurs on mainland Australia throughout the eastern states (excluding Tasmania), across northern Australia and throughout the western third of Western Australia (Pizzey & Knight 1999). The occurrence of this species in areas surrounding the site is not an edge of range record.

The Powerful Owl occurs along the eastern seaboard from Longreach (Qld) down to the south-eastern corner of South Australia, and up to 200 km inland (Pizzey & Knight 1999). This species is not at the limits of its distribution within the study area.

The Masked Owl has a stronghold in Tasmania, with rare occurrences along the eastern and northern seaboard of Australia and sometimes inland to the semi-arid edge. There are also populations in south western Western Australia and near the Western Australia – South Australia border (Pizzey & Knight 1999). The occurrence of this species in the Shoalhaven is not at the limits of its known distribution.

Arboreal Mammals

Potential foraging and nesting habitat for arboreal mammals is present throughout the study area and would be impacted by the proposal. However, impacts vary with each component of the proposal with the greatest impacts likely along Yalwal Road and at the proposed gas fired power facility site. Approximately 11.8 ha in total of potential habitat for arboreal mammals would be cleared for the proposal and includes the removal of some hollow-bearing trees. Hollow-bearing trees would be removed from vegetation adjacent to Yalwal Road, along the gas pipeline route and within the proposed gas fired power facility site. However a limited number, if any, hollow-bearing trees would need to be removed along the existing transmission line easement as only a strip of vegetation 1 m wide on either side of the easement is required. Although some hollow-bearing trees would be removed for the proposal, numerous hollow-bearing trees are known to occur in adjacent areas and are conserved in Bamarang National Park and Triplarina Nature reserve.

Vegetation clearance for the proposal is unlikely to have a significant impact on resources for arboreal mammals as it is on the fringes of current extensive stands of vegetation and would result in isolation of habitat or prevent dispersal for these species. Also, the proposal is to be undertaken in two stages clearing and modification of native vegetation and fauna habitat would be gradual. Gradual removal of vegetation would provide the opportunity for some fauna to disperse to adjacent areas.

Given that the proposal is unlikely to isolate or prevent dispersal or have a significant impact on foraging resources for arboreal mammals and that extensive areas of known habitat for these species occur adjacent to the study area and within the locality it is considered unlikely that the proposal would have a significant impact on any threatened arboreal mammals or their habitat.

Furthermore none are at their limits of their distribution within the study area.

The Yellow-bellied Glider is patchily distributed in wet sclerophyll forest from around Mackay in Queensland to near Melbourne with isolated populations in Otway Range



and far south-west Victoria (Menkhorst & Knight 2001) and on the Atherton Tablelands in far north Queensland. The occurrence of this species in areas surrounding the site is not an edge of range record.

The Koala is widespread in sclerophyll forest and woodland on foothills and plains on both side of the Great Dividing range from about Chillagoe in north Queensland to Mt Lofty Ranges in South Australia. Its range extends inland to desert uplands of central Queensland and along riverine forests in central NSW and north-central Victoria (Menkhorst & Knight 2001). The occurrence of this species in areas surrounding the site is not an edge of range record.

Ground-dwelling Mammals

The forest and heath vegetation across most of the study area provides potential habitat for ground-dwelling mammals. As consequence of the proposal approximately 11.8 ha of potential habitat would be removed. However, along Yalwal Road and the current transmission line easement clearance is to be along the margins of current large stands of vegetation. Edge clearance is also proposed at the gas fired power facility site but would be removed as a section of vegetation (approximately 6.6 ha including fire protection areas) rather than a strip. Given that this area was recently burnt and supports a relatively open understorey it is considered unlikely that many ground-dwelling mammals would currently inhabit the site. However, as the vegetation regenerates and the understorey becomes more dense the site is likely to provide higher quality habitat.

Vegetation clearance along a strip 10 m wide through the centre of currently intact vegetation is also proposed for the gas pipeline. Although this is unlikely to have a significant impact on foraging or nesting resources or dispersal of ground-dwelling mammals there is potential for increases in from non-native species such as the European Red Fox, which preferentially move along tracks, road and other cleared areas.

Given that the majority of the vegetation clearance for the proposal is along vegetation margins, the proposal would isolate habitat nor prevent dispersal of ground dwelling mammals and that extensive areas of potential habitat occur adjacent to the study area, it is considered unlikely that the proposal would have a significant impact on any threatened ground-dwelling mammals of their habitat. Furthermore, no local population would be placed a risk of extinction.

Only one of the ground-dwelling mammal, White-footed Dunnart, for which the study area provides potential habitat is at the limits of their distribution within the Shoalhaven.

The Eastern Pygmy Possum is sparse to locally common in a wide range of vegetation types on the Great Dividing Range, including western slopes, and coastal plains from south-eastern Queensland to south-eastern South Australia (Menkhorst & Knight 2001). This species is not at the limits of its distribution at the site.

Formerly widespread in south-east Australia, the Spotted-tailed Quoll now sparsely populates areas from Fraser Island in south-east Queensland to south-western

Victoria. It is widespread in Tasmania (Menkhorst & Knight 2001). Therefore this species is not at the edge of its range within the locality.

The Southern Brown Bandicoot is declining in inland parts of range but locally common in healthy forest, heath and coastal scrub from Sydney, NSW to the Eyre Peninsula, South Australia. This species also occurs in Tasmania, including Flinders Island (Menkhorst & Knight 2001). The occurrence of this species in areas surrounding the site is not an edge of range record.

The most southerly occurring of the Dunnarts, the White-footed Dunnart is patchily distributed in lowland heathy woodland and forest, coastal scrub, coastal dune grassland in South-eastern NSW and Victoria and throughout Tasmania (Menkhorst and Knight, 2001). The Shoalhaven would be at the northern edge of this species range.

The Long-nosed Potoroo is locally common in parts of Tasmania, with patchy occurrences on the mainland from coastal Victoria to south-eastern Queensland (Menkhorst Knight 2001). The occurrence of this species in areas surrounding the site is not an edge of range record.

Microchiropteran Bats

A number of threatened microbats have the potential to forage and roost within the study area and one was seen flying overhead and the proposed gas fired power facility site during the surveys. Potential roosting habitat in the form of hollows and potentially the disused abattoir for these species would be impacted by the proposal.

Establishment of the proposed transmission line easements are likely to result in the removal of small numbers of hollow-bearing trees suitable for bat roosting along Yalwal Road. In addition, hollow-bearing trees would be removed within the proposed gas fired power facility site and along the gas pipeline route. However, this removal is unlikely have a significant impact on any hollow dependent species as numerous hollow-bearing trees occur adjacent to the study area within Triplarina Nature Reserve and Bamarang National Park.

Potential roosting habitat for the Eastern Bent-wing Bat, Eastern Coast Freetail Bat, Fishing Bat and Large-eared Pied Bat occurs within the disused abattoir. A visual inspection of the interior of the abattoir failed to detect any bat colonies or bat guano which would indicate present and / or past usage by bats of this site for roosting.

The lights from the proposed gas fired power facility may affect bat foraging as the abundance of insects likely to be attracted to the lights may encourage bats to forage over the gas fired power facility.

The proposal would not prevent migration or dispersal of any threatened microchiropteran bats and extensive areas of potential foraging and roosting habitat for these species occurs adjacent to the study area and throughout the locality. Therefore it is considered unlikely that the proposal would have a significant impact on the lifecycle or habitat of any threatened bats.

The Large-eared Pied Bat occurs from South-eastern Queensland to NSW from the coast to the western slopes of the divide (Churchill 1998). The occurrence of this species in areas surrounding the site is not an edge of range record.

In Australia, the Eastern Bent-wing Bat occurs across the Kimberly region, and east of the Great Dividing Range from Cape York Peninsula to the south-east corner of South Australia (Churchill 1998). The occurrence of this species in areas surrounding the site is not an edge of range record.

The Eastern (East-coast) Freetail-bat occurs on the east coast of NSW from south of Sydney extending north into south-eastern Queensland near Brisbane (Churchill 1998). It is likely that this species is at the edge of its range in the Nowra area.

The Large-footed Myotis is primarily coastal (rarely extending further than 100 km inland) and ranges from the Kimberley region across the eastern seaboard to Victoria and South Australia. They occur farther inland along major rivers, including the Murray River (Churchill 1998). The occurrence of this species in areas surrounding the site is not an edge of range record.

Megachiropteran Bats

The Grey-headed Flying-fox is likely to forage over the study area and may roost within the locality. However, no camps were recorded within the study area. The Grey-headed Flying Fox occurs along the east coast of Australia from Rockhampton in Queensland to western Victoria (Churchill 1998) and is therefore not at the limits of its distribution in the Shoalhaven. Given that only small amounts of vegetation would be removed for the proposal, extensive areas of foraging habitat would remain within the locality and that this species is known to forage widely, it is considered unlikely that the proposal have a significant impact on this species or its habitat.

Amphibians

The drainage lines and adjacent vegetated areas provide potential habitat for the Giant Burrowing Frog. No direct impacts on the drainage lines are anticipated and potential indirect impacts would be mitigated against through protection of these areas from sedimentation and erosion. Vegetation within drainage lines along the transmission line easement would be slashed to a level of around 1 m and allowed to regenerate up to 3m in height. Furthermore, this species is not at the limits of its distribution in the Shoalhaven as it is known to occur on the Hawkesbury Sandstone in the Sydney region, extending south to Victoria (Barker *et al.* 1995). Therefore it is considered unlikely that the proposal would disrupt the lifecycle of or have a significant impact on this species or its habitat.

Reptiles

Rosenberg's Goanna occurs in coastal heaths, humid woodlands and both dry and wet sclerophyll forests in the far south of Western Australia and South Australia, with isolated occurrences in Victoria and coastal NSW (Cogger 1996). There is limited information on the location of the isolated NSW population.

The margins of potential foraging habitat for the Rosenberg's Goanna would be cleared for the proposal. However, extensive areas of potential foraging habitat adjoin the study area and would be retained. Furthermore, the proposed clearing would not result in isolation of habitat in terms of goanna use. Therefore it is considered unlikely that the proposal would have a significant impact on this species or its habitat.

Potential impacts of the proposal on current disturbance regimes

The proposal is unlikely to impact upon current fire regimes as fire prevention measures would be built into the equipment used within the gas fired power facility site and development is to be undertaken in accordance with the relevant provisions of *Planning for Bushfire Protection Guidelines* (PlanningNSW 2001). No prescribed burns and maintenance of APZs around the gas fired power facility have been recommended to prevent fires at the site and hence changes in the fire regime.

However, there is the potential for impacts on hydrology and drainage lines within the study area if mitigation measures are not implemented. Potential impacts from the proposal include:

- ▶ increases in the volume and intensity of storm water runoff at the proposed gas fired power facility site due to vegetation clearance and impervious surfaces
- ▶ increases in erosion associated with increased flows;
- ▶ limiting groundwater recharge by preventing rainwater from infiltrating through the ground;
- ▶ changes to the water table and soil moisture content;
- ▶ shifts in flora species composition;
- ▶ may create conditions more conducive to invasion by exotic species; and
- ▶ loss of fauna habitat.

Much of the proposed site of the gas fired power facility is currently hard stand areas due to the existing abattoir buildings so it is unlikely that significant changes from current disturbance levels would occur. However, management measures would also be implemented to prevent hydrological changes where possible or mitigate impacts.

Potential impacts on habitat connectivity

The only isolation to result as a consequence of the proposal would be where the gas pipeline would pass through currently intact vegetation. However, it would not result in isolation of habitat for any threatened fauna species such that it would prevent dispersal or movement of the species and is therefore considered unlikely to constitute a significant impact. Furthermore, many of the species are highly mobile and have large home ranges and therefore would not be impacted by this small opening in the vegetation. However, there is the potential for an increase in predation on ground-dwelling mammals as foxes are known to preferentially move along tracks, road and other cleared areas.

Potential impacts on critical habitat

There are no areas identified as critical habitat present within the study area.

4.3 Commonwealth Threatened Species Assessment

Nowra heath-myrtle was the only threatened species listed under the EPBC Act detected during the surveys but no individuals of this species would be removed for the proposal and only a very small area of potential habitat on the fringe of the bushland would be cleared for the proposal. However, a number have been recorded within the locality (DEC 2005) and the proposal has the potential to impact on small areas of potential habitat for these species including:

Flora

- ▶ Bynoe's Wattle;
- ▶ Leafless Tongue Orchid;
- ▶ White-flowered Wax Plant;
- ▶ Deane's Melaleuca;
- ▶ Illawarra Greenhood; and
- ▶ Nowra Heath-myrtle.

Fauna

- ▶ Large-eared Pied Bat;
- ▶ Giant Burrowing Frog;
- ▶ Southern Brown Bandicoot;
- ▶ Green and Golden Bell Frog;
- ▶ Eastern Bentwing-bat;
- ▶ Long-nosed Potoroo;
- ▶ Grey-headed Flying-fox; and
- ▶ Regent Honeyeater.

In line with the findings of the Part 3A assessment under the EP&A Act, it is considered that the proposal would be unlikely to have a significant impact on any threatened species listed under the EPBC Act or their habitat. Therefore, a Referral to the Department of Environment and Heritage (DEH) is not required.

5. Avoidance and Mitigation Recommendations

5.1 Avoidance

In order to avoid potential impacts on flora and fauna habitat at the site the following measures have been implemented:

- ▶ To reduce the amount of vegetation clearance required, the route for the proposed transmission line easement has been located so as to follow the existing route of current easements and tracks wherever possible;
- ▶ The transmission line is to be located on the southern side of Yalawal Road to prevent direct impacts on any Nowra Heath-myrtle individuals;
- ▶ The transmission line has been situated so as to avoid hollow-bearing trees where ever possible;
- ▶ Construction of stanchions power poles will be outside of drainage lines and riparian areas to avoid impacts of waterways; and
- ▶ The gas fired power facility has been situated within previously disturbed areas of the proposed site to reduce vegetation clearance.

5.2 Mitigation

A number of mitigation and management measures are recommended to prevent direct and indirect impacts of the proposal on flora and fauna and their habitat within the study area and locality. Recommended measures include:

- ▶ Fencing of proposed development areas to ensure construction works do not breach the boundaries and enter the adjacent vegetation and National Parks and Reserves;
- ▶ Installation of sediment detention basins, or similar, prior to construction to prevent untreated runoff and sediment entering drainage lines and creeks within the study area; and
- ▶ Implementation of 'best practice' stormwater treatment measures to maximise:
 - Onsite pollutant retention and removal; and
 - Infiltration and sub-surface discharge of stormwater (NPWS 1998);
- ▶ Placement of stockpiles away from vegetated areas;
- ▶ Piling of soil that may contain seed of exotic species away from adjacent vegetation or drainage lines where they could be spread during rainfall events.
- ▶ Monitoring and management of weed invasion along proposed gas pipeline route to ensure regeneration of native species takes place;
- ▶ Maintenance of a vegetated and managed buffer between any development and the adjacent Bamarang National Park;



- » Appropriate fire management measures and APZs to be implemented in accordance with the provisions outlined in the *Bushfire Risk Assessment* (GHD 2005) to prevent fires spreading from the site to adjacent areas;
- » Allowance for regeneration to maximum acceptable height along drainage lines supporting potential habitat for Nowra Heath-myrtle;
- » A more thorough inspection of the disused abattoir prior to demolition to verify the absence of the Eastern Bent-wing Bat;
- » Retention of mature, hollow-bearing trees within the study area (where possible) ; and
- » Where avoidance of hollow-bearing tree is not possible, hollow-bearing branches and trunks would be carefully removed and checked by an onsite ecologist for any fauna and then placed within the adjacent woodland area to provide habitat for other fauna species. Any fauna found within removed hollows would be captured and re-released at nightfall.

5.3 Potential Offsets

Delta acknowledges DEC's request for habitat offsets. Delta commits to commencing discussions with DEC on this issue.



6. Conclusion

The footprint of the gas fired power facility and associated easements have been designed to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to threatened species and endangered ecological communities. Consequently, it is considered that significant impacts on the biodiversity of the area are unlikely. Nonetheless, a number of mitigation measures have been recommended to ensure that the ecological values of the site are protected and offsets may be possible for those impacts that cannot be mitigated.

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Appendix A

Flora Species List



Table 9 Flora Species Recorded within the study area

Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair Fern						X
Adiantaceae	<i>Cheilanthes sieberi</i>		X	X	*			X
Asteraceae	<i>Cassinia aculeata</i>	Dolly Bush		X				
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed						X
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion						X
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine						X
Casuarinaceae	<i>Allocasuarina distyla</i>							*
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak	X	X	X	X		
Clusiaceae	<i>Hypericum gramineaum</i>	Small St John's wart		X				
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew						X
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed			X			
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	X					X
Cyperaceae	<i>Caustis flexuosa</i>	Curly Wig		X				
Cyperaceae	<i>Gahnia</i> sp.				X			



Family Name	Scientific Name	Common Name	Location				
			V1	V2	V3	V4	V5
Cyperaceae	<i>Lepidosperma filiforme</i>				X		
Cyperaceae	<i>Lepidosperma laterale</i>		X	X		X	
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Hard Bracken Fern	X	X	X	X	
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern	X	X			
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower	X				X
Dilleniaceae	<i>Hibbertia riparia</i>	Erect Guinea Flower				X	
Droseraceae	<i>Drosera peltata</i>		X		X		
Eleocarpaceae	<i>Tetralochea decora</i>						X
Ericaceae	<i>Epacris microphylla</i>						X
Ericaceae	<i>Epacris pulchella</i>	Wallum Heath		X			
Ericaceae	<i>Leucopogon lanceolatus</i>						X
Ericaceae	<i>Leucopogon</i> sp.						X
Euphorbiaceae	<i>Glochidion ferdandii</i>	Cheese Tree					X
Euphorbiaceae	<i>Phyllanthus hirtellus</i>						*
Euphorbiaceae	<i>Poranthera corymbosa</i>				X		
Fabaceae: faboideae	<i>Bossiaea heterophylla</i>	Variable Bossiaea					X



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Fabaceae: faboideae	<i>Bossiaea obcordata</i>	Spiny Bossiaea	X	X	X	X		
Fabaceae: faboideae	<i>Davesia ulicifolia</i>	Gorse Bitter Pea					X	
Fabaceae: faboideae	<i>Dillwynia retorta</i>		X	X	X			
Fabaceae: faboideae	<i>Glycine microphylla</i>	Small-leaf Glycine		X				
Fabaceae: faboideae	<i>Glycine</i> sp.			X	X	X		X
Fabaceae: faboideae	<i>Gompholobium grandiflorum</i>	Large Wedge Pea	X	X		X		
Fabaceae: faboideae	<i>Hardenbergia violacea</i>	False Sarsparilla	X	X	X	X		
Fabaceae: faboideae	<i>Hovea linearis</i>						X	
Fabaceae: faboideae	<i>Kennedia rubicunda</i>	Dusky Coral Pea	X		X			
Fabaceae: faboideae	<i>Platylobium formosum</i>		X	X	X			
Fabaceae: faboideae	<i>Pultenaea daphnoides</i>		X		X			
Fabaceae: mimosoideae	<i>Acacia brownii</i>	Heath Wattle	X	X		X		
Fabaceae: mimosoideae	<i>Acacia buxifolia</i>	Box-leaf Wattle	X	X	X	X		
Fabaceae: mimosoideae	<i>Acacia irrorata</i>	Green Wattle			X			
Fabaceae: mimosoideae	<i>Acacia longifolia</i>						X	
Fabaceae: mimosoideae	<i>Acacia terminalis</i> subsp. <i>angustifolia</i>	Sunshine Wattle		X				



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Geraniaceae	<i>Geranium</i> sp.				X			
Goodeniaceae	<i>Goodenia hederacea</i>	Forest Goodenia		X	X	X		
Haloragaceae	<i>Gonocarpus tetragynus</i>		X	X		X		
Iridaceae	<i>Patersonia sericea</i>	Silky Purple-flag	X	X		X		
Lauraceae	<i>Cassytha pubescens</i>		X	X	X			
Lauraceae	<i>Cassytha glabella</i>							X
Lindsaeaceae	<i>Lindsaea microphylla</i>	Lacy Wedge Fern		X				
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot				X	X	
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush		X				
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush						X
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush		X	X			
Lomandraceae	<i>Lomandra obliqua</i>		X	X				
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry						X
Luzuriagaceae	<i>Geitonoplesium cynosum</i>	Scrambling Lily						X
Myrtaceae	<i>Acmena smithii</i>	Lilly Pilly						X



Family Name	Scientific Name	Common Name	Location					Incidental
			V1	V2	V3	V4	V5	
Myrtaceae	<i>Baeckea diosmifolia</i>	Fringed Baeckea						X
Myrtaceae	<i>Calytrix tetragona</i>	Common Fringe-myrtle						X
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood	X	X	X	X		
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum						X
Myrtaceae	<i>Eucalyptus globoidea</i> - <i>eugenioides</i> intergrade							X
Myrtaceae	<i>Eucalyptus amplifolia</i>	Cabbage Gum						X
Myrtaceae	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark		X				
Myrtaceae	<i>Eucalyptus globoidea</i>	White Stringybark	X					
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt			X	X		
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum	X					
Myrtaceae	<i>Eucalyptus sclerophylla</i>	Hard-leaved Scribbly Gum						X
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum						X
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush				X	X	
Myrtaceae	<i>Leptospermum polygalifolium</i>	Lemon-scented Tea-				X		



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
		tree						
Myrtaceae	<i>Leptospermum rotundifolium</i>	Round Leaf Tea-tree						X
Myrtaceae	<i>Melaleuca armarillis</i>	Giant Honeymyrtle						
Myrtaceae	<i>Melaleuca decora</i>	White Feather Honeymyrtle						X
Myrtaceae	<i>Melaleuca hypericifoila</i>	Hillock Bush					X	
Myrtaceae	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark					X	
Myrtaceae	<i>Melaleuca squarrosa</i>	Scented Paperbark						X
Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea-tree					*	
Myrtaceae	<i>Triplarina nowraensis</i>	Nowra Heath-myrtle						X
Oleaceae	<i>Ligustrum sinense*</i>	Small-leaved Privet						X
Orchidaceae	<i>Acianthus</i> sp.			X				
Orchidaceae	<i>Corybas</i> sp.	A Helmet Orchid						X
Orchidaceae	<i>Cryptostylis erecta</i>	Bonnet Orchid						X
Orchidaceae	<i>Cryptostylis</i> sp.							X
Orchidaceae	<i>Cryptostylis subulata</i>	Large Tongue Orchid						X



Family Name	Scientific Name	Common Name	Location					Incidental
			V1	V2	V3	V4	V5	
Orchidaceae	<i>Cyanicula caerulea</i>	Blue Caladenia						X
Orchidaceae	<i>Cymbidium suave</i>	Snake Orchid						X
Orchidaceae	<i>Diuris maculata</i>	Spotted Doubletail						X
Orchidaceae	<i>Eriochilus</i> sp.							X
Orchidaceae	<i>Genoplesium</i> sp.							X
Orchidaceae	<i>Glossodia major</i>	Waxlip Orchid	X					
Orchidaceae	<i>Glossodia minor</i>	Small Waxlip Orchid						X
Orchidaceae	<i>Lyperanthus suaveolens</i>							X
Orchidaceae	<i>Microtis</i> sp.	A Onion Orchid						X
Orchidaceae	<i>Prasophyllum</i> sp.							X
Orchidaceae	<i>Pterostylis parviflora</i>	Tiny Greenhood						X
Orchidaceae	<i>Thelymitra ixioides</i>	Dotted Sun Orchid						X
Orchidaceae	<i>Thelymitra media</i>	Tall Sun Orchid						X
Oxalidaceae	<i>Oxalis</i> sp.						X	
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Blue Flax-lily		X	X	X		
Phormiaceae	<i>Dianella longifolia</i>	Blueberry Lily						X



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Pittosporaceae	<i>Billardiera scandens</i>	Hairy Apple Berry			X			
Pittosporaceae	<i>Bursaria spinosa</i>	Blackthorn						X
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum						X
Plantaginaceae	<i>Plantago lanceolata</i>	Lambs Tongues						X
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass						X
Poaceae	<i>Aristida</i> sp.		X	X				X
Poaceae	<i>Aristida vagans</i>	Threeawn Spreargrass						X
Poaceae	<i>Austrodanthonia</i> sp.	A Wallaby Grass					X	
Poaceae	<i>Briza minor</i> *	Quaking Grass						X
Poaceae	<i>Cymbopogon refractus</i>	Barbed-wire Grass						X
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass						X
Poaceae	<i>Entolasia marginata</i>				X			
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	X	X			X	
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass		X			X	
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass						X



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Poaceae	<i>Panicum simile</i>	Two-colour Panic		x	x	x		
Poaceae	<i>Paspalum dilatatum*</i>	Paspalum						x
Poaceae	<i>Pennisetum clandestinum*</i>	Kikuyu Grass						x
Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass						x
Poaceae	<i>Themeda australis</i>	Kangaroo Grass	x	x		x	x	
Proteaceae	<i>Banksia serrata</i>	Old-man Banksia		x				
Proteaceae	<i>Banksia spinulosa</i>	Hairpin Banksia	x	x				
Proteaceae	<i>Conosperma ericinum</i>	Matchheads						x.
Proteaceae	<i>Grevillea linearifolia</i> - <i>parviflora</i> intergrade		x					
Proteaceae	<i>Hakea sericea</i>	Needlebush	x					
Proteaceae	<i>Lambertia formosa</i>	Mountain Devil	x					
Proteaceae	<i>Persoonia levis</i>	Broad-leaved Geebung	x		x	x		
Proteaceae	<i>Petrophile pulchella</i>	Conesticks	x	x	x			
Proteaceae	<i>Telopea speciosissima</i>	Waratah			x	x		



Family Name	Scientific Name	Common Name	Location					
			V1	V2	V3	V4	V5	Incidental
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard						x
Restionaceae	<i>Baloskion tetraphyllum</i>			x				
Restionaceae	<i>Leptocarpus tenax</i>				x			
Rubiaceae	<i>Opercularia</i> sp.			x	x	x		
Rubiaceae	<i>Pomax umbellata</i>		x	x		x		
Santalaceae	<i>Exocarpos cupressiformis</i>	Cherry Ballart						x
Sapindaceae	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush						x
Smilacaceae	<i>Smilax glycyphylla</i>	Sweet Sarsaparilla		x	x			
Thymelaeaceae	<i>Pimelia linifolia</i>	Slender Rice Flower	x	x	x	x		
Urticaceae	<i>Urtisa incisa</i>	Scrub Nettle						x
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.	Grass Tree				x		
Zamiaceae	<i>Macrozamia communis</i>	Burrawang				x		

* = exotic species

Bold = threatened species



Appendix B

Fauna Species List



Table 10 Birds species recorded within the study area (GHD 2005)

Scientific Name	Common Name	Site			Incidental
		B1	B2	B3	
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	O	O		
<i>Anas superciliosa</i>	Pacific Black Duck		O		
<i>Anthochaera carunculata</i>	Red Wattlebird	O	O		
<i>Anthochaera chrysoptera</i>	Little Wattlebird	O			
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-cockatoo		O		
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo				O, W
<i>Chenonetta jubata</i>	Australian Wood Duck		O		
<i>Coracina tenuirostris</i>	Cicadabird		O		
<i>Cormobates leucophaea</i>	White-throated Treecreeper	O	W		
<i>Corvus coronoides</i>	Australian Raven			O	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra				W
<i>Gymnorhina tibicen</i>	Australian Magpie	O	W		
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		O	O	
<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater		O		
<i>Malurus cyaneus</i>	Superb Fairy-wren			O	
<i>Microeca leucophaea</i>	Jacky Winter	O		O	
<i>Pelecanus conspicillatus</i>	Australian Pelican		O		
<i>Pardalotus punctatus</i>	Spotted Pardalote	O	W		



Scientific Name	Common Name	Site			
		B1	B2	B3	Incidental
<i>Philemon corniculatus</i>	Noisy Friarbird	O			
<i>Platycercus elegans</i>	Crimson Rosella	O			
<i>Psophodes olivaceus</i>	Eastern Whipbird			W	
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		O		

O = observed, W = heard

Table 11 Mammals recorded within the study area (GHD 2005)

Scientific Name	Common Name	Site					
		S1	S2	S3	S4	S5	Incidental
<i>Macropus giganteus</i>	Eastern Grey Kangaroo						O, S
<i>Petauroides volans</i>	Greater Glider					O	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum					O	
	Microchiropteran Bat	O					

O = observed, W = heard



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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T. Haslehurst	A. Hunt		A. Hunt		12/9/05
1	T. Haslehurst	A. Hunt		A. Hunt		16/11/05
2	T. Haslehurst	A. Hunt		A. Hunt		10/4/06