

ENVIRONMENTAL ASSESSMENT

Volume 2 **Technical Papers**

MUNMORAH
GAS TURBINE FACILITY





Technical Papers (Volume 2)

Technical Paper No.1	Flora and Fauna Assessment
Technical Paper No.2	Heritage Assessment
Technical Paper No.3	Noise Assessment
Technical Paper No.4	Air Quality Impact Assessment
Technical Paper No 5	Photochemical Pollution Assessment
Technical Paper No 6	Preliminary Hazard Analysis

FLORA AND FAUNA ASSESSMENT

TECHNICAL PAPER

1

Technical Paper 1

Flora and Fauna Assessment of Munmorah Gas Turbine Facility

December 2005

Delta Electricity



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Acronyms and Abbreviations

EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
TSC Act	Threatened Species Conservation Act 1995
EIS	Environmental Impact Statement
DEC	NSW Department of Environment and Conservation
DEH	Commonwealth Department of Environment and Heritage
LGA	Local Government Area
LEP	Local Environment Plan
SEPP	State Environmental Planning Policy
ROTAP	Rare or Threatened Australian Plant

Executive Summary

Parsons Brinckerhoff was commissioned by Delta Electricity to carry out a flora and fauna assessment as part of an Environmental Impact Statement for the proposed gas turbine facility, gas connection pipeline and inlet facility at Munmorah in the Wyong local government area. The purpose of this assessment was to document the existing natural terrestrial biological environment and assess the potential impacts of the proposal on plants and animals of the area and in particular threatened species, populations, and communities listed under the Threatened Species Conservation Act 1995 (TSC Act) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Vegetation communities occurring within the site are Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Wyong Paperbark Swamp Forest, Swamp Mahogany-Paperbark Forest and Riparian Melaleuca Swamp Forest. These communities are in moderate to good condition.

Fauna habitats generally correspond to the structure, floristics and condition of the vegetation communities and are in good condition adjacent to the gas connection pipeline. More than fifty threatened fauna species listed under the TSC Act and EPBC Act have been recorded in the project locality, although the majority are unlikely to be affected by the proposal since important habitat features such hollow-bearing trees will not be modified or removed by the proposal.

The primary impact of the proposed gas connection pipeline route and inlet facility is the removal of vegetation within an existing high voltage transmission line easement. The gas connection pipeline would require approximately four hectares of native vegetation to be removed, but would not significantly affect the habitats of threatened flora and fauna likely to occur on the site or in the adjacent bushland.

Tests of significance of impact as required under the TSC Act 1995 and the EPBC Act 1999 were completed based on the likely presence of threatened species, populations and communities, the potential impacts of the proposal and the mitigation measures proposed in this report. Impact assessments were carried out for five threatened flora species and twelve threatened fauna species (eight species of microchiropteran bats were considered together as a group and two species of owl were considered together). The tests concluded that there was unlikely to be a significant impact on Threatened species, populations and communities as a result of the proposed gas connection pipeline routes, inlet facility and turbine facility.

Mitigation measures designed to minimise the potential for environmental impacts have been recommended in this report and would be required to be implemented during the proposed construction activities. By adopting the safeguards identified in this assessment there would be no significant impacts on the ecology of the area and therefore, no further survey or assessment is required.

1. Introduction

Parsons Brinckerhoff was commissioned by the Delta Electricity to prepare an assessment for the proposed open cycle gas turbine and gas connection pipeline at Munmorah, including an assessment of potential impacts of the project on terrestrial flora and fauna, which is the subject of this report.

The purpose of this assessment was to determine the existing natural environment and likely impacts of the proposed development on plants and animals of the area, and in particular, threatened species listed under *Threatened Species Conservation Act 1995 (TSC Act)* and *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

1.1 Project background

The existing Munmorah Power Station is a coal-fired electricity generating station that has been down-rated in terms of electricity generation and runs intermittently during the year. The development proposal involves modifying the existing coal-fired power station to incorporate a gas-fired turbine facility, with a gas connection pipeline to the existing Newcastle to Sydney gas supply network via an inlet facility.

The proposed gas-fired turbine and delivery facility would be located within land owned by Delta Electricity within close proximity to the Munmorah Power Station and would be constructed within an existing cleared area of approximately 1000 square metres. The Munmorah Power Station comprises an area of 940 hectares of undeveloped and 'buffer' lands separating the surrounding residential areas from the station.

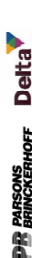

The proposed gas connection pipeline would run 7 kilometres west from the proposed gas turbine facility along an existing TransGrid easement, to connect with the main Sydney to Newcastle gas pipeline which is located adjacent to the Sydney to Newcastle Freeway (*Figure 1*).

The proposal for the underground pipeline would require a two metre wide by two metre deep trench, a 4WD road for access during and after construction as well as work compounds and areas for stockpiling. The footprint of the proposed pipeline would have a width of approximately 15 metres but would be restricted to the existing electricity easement which is 60 metres wide. Directional drilling would be used to cross under road and rail intersections and creeks such as Spring Creek and its tributaries.

A pressure-regulating inlet facility would be required at the western end of the pipeline to compress, filter and control the flow rate of gas from the gas trunk main. The facility would require an area of approximately one hectare to accommodate plant equipment and would be located within partially cleared private land adjacent to the transmission easement.

Following the completion of construction, rehabilitation works would be undertaken within the site.

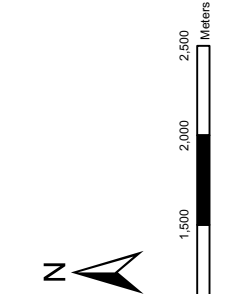















Datum: GDA94 \ MGA94_Z56 Scale: 1:30,000
 Drawn: SWD Date: 23 Jun, 05
 Designed: CO Date: 23 Jun, 05
 Checked: CO Date: 23 Jun, 05
 DWG No: 2116541B_2000c Fig No: 1

Proposed Natural Gas Pipeline Route
 Project: Functional Design - Munmorah Power Station Gas Turbine Facility
 Client: DELTA ELECTRICITY
 Proj. No. 2116541B Layout Size: A3
 GIS Proj: J:\AS3\ENVP\PROJ\2116541\2116541B_EIS\GIS\Maps\2116541B_2000c_Gas_Pipeline_Route.mxd

Title:



-  Proposed Pipeline Route
-  Newcastle to Sydney Gas Pipeline
-  Rail Line
-  Drainage
-  Land Owned by Delta Electricity
-  Swamp
-  SEPP14 - Wetland Area
-  Delivery Facility
-  Inlet Facility
-  OCGT Facility

PDF Address: J:\AS3\ENVP\PROJ\2116541\2116541B_EIS\GIS\Maps
 PDF File: 2116541B_2000c_Proposed_Natural_Gas_Pipeline_Route_A3.pdf

1.2 Study area

The study site and study area (see below for definitions) are located approximately 10 kilometres north-east of Wyong on the central coast of New South Wales (*Figure 1*). The study area is located within Wyong local government area, the Sydney Basin bioregion (Thackway & Cresswell 1995) and the Central Coast botanical subdivision (Anderson 1961, 1968).

For the purpose of the report and assessment the following definitions apply:

Subject Site: the specific area that is proposed for the turbine facility, delivery facility, gas connection pipeline and inlet facility. The gas connection pipeline would occur within the TransGrid electricity transmission easement.

Study area: the subject site and any additional areas that could potentially be affected by the proposal either directly or indirectly. The study area includes vegetation communities that are located adjacent to the electricity transmission easement.

Locality: the area within a 10 kilometre radius of the study area

Region: a bioregion defined in a national system of bioregionalisation. For this study this is the Sydney Basin bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).

1.3 Aims

The aims of this study are to assess the impacts of the proposed gas pipeline and associated facilities on terrestrial ecological values of the site. Specifically, this assessment aims to:

- determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats
- determine the occurrence, or likelihood of occurrence of Threatened species listed under the *Threatened Species Conservation Act 1995 (TSC Act)* and *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* occurring within the study area
- undertake significance assessments for threatened species, populations and communities that occur or have potential habitat within the study area
- propose further investigations and/or amelioration measures to mitigate impacts on the ecological values of the study area.

2. Legislation and policies

Commonwealth and State legislation and planning policies relevant to this project and protection of flora and fauna and biodiversity include:

- *Environmental Protection and Biodiversity Act 1999 (EPBC Act)*
- *Threatened Species Conservation Act 1995 (TSC Act)*
- *Environmental Planning and Assessment Act 1979 (EP&A Act);*

The environmental impact of the proposed activity must be assessed under Part 3A of the. Although the relevant approval provisions of the Acts and Policies do not apply for developments assessed under Part 3A of the *EP&A Act*, their intent has been considered:

- *Water Management Act 2000*
- *Rivers and Foreshores Improvement Act 1948*
- *National Parks and Wildlife Act 1974*
- State Environmental Planning Policy 44 – Koala Habitat Protection
- Hunter Regional Environmental Plan 1989
- Wyong Local Environmental Plan 1991.

3. Methods

3.1 Personnel

Names and qualifications of team members undertaking the field studies and preparing the report are shown in *Table 3-1*. Short CVs are included in *Appendix B*.

Table 3.1 Personnel involved in the field studies and report preparation

Name	Qualifications	Years Experience	Role
Selga Harrington	BSc (Hons)	6	Ecologist / Botanist
Alex Fraser	BSc(Hons)	2	Ecologist/ Zoologist
Nick Corkish	B For Sc	9	Ecologist/ Botanist

All work was carried out under NSW Department of Environment and Conservation Scientific Licence number S10445 and a NSW Department of Agriculture Animal Research Authority (AW01/1380).

3.2 Nomenclature

Names of plants used in this document follow Harden (1992; 1993; 2000; 2002) with updates from PlantNet (Royal Botanic Gardens 2005). Names of vertebrates follow the Census of Australian Vertebrates (CAVS) data maintained by Department of Environment and Heritage (Department of Environment and Heritage 2005).

3.3 Database searches and literature reviews

Relevant and available documents were reviewed for information on surrounding land uses and the presence of vegetation communities and flora and fauna.

Records of threatened species of plant and animal were obtained from the Department of Environment and Conservation Atlas of NSW Wildlife for the project locality, using the Gosford and Lake Macquarie 1:100 000 map sheets (accessed 10 February 2005). Records for threatened species, populations and communities and migratory species listed pursuant to the *EPBC Act* that could potentially occur in the project locality were obtained from the Department of the Environment and Heritage Protected Matters Search Tool (<http://epbcweb.ea.gov.au>, accessed 10 February 2005). Details of the accuracy of each database are shown in *Appendix B*

Other sources of information considered in the preparation of this report include aerial photographs, vegetation mapping (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b) and a previous flora and fauna survey of the Munmorah Power Station and the nearby Colongra Wetlands (Payne 2002a).

3.4 Survey

Fauna and flora surveys were conducted between 7 and 11 March 2005. During this time the weather was warm and dry with maximum daily temperatures ranging between 26 and 32 degrees Celsius. Given the known occurrence nearby and the likely presence of suitable habitat, targeted surveys for *Tetratheca juncea* were undertaken between 30 and 31 August and between 12 and 13 December to coincide with the flowering time of this species. The December surveys also coincided with the flowering period of *Cryptostylis hunteriana*.

3.4.1 Flora

Species of plants on site were assessed and recorded using the random meander technique (Cropper 1993), in where the recorder walks in a random manner throughout the site, recording all species seen. The time spent in each vegetation community is generally proportional to the size of the community and its species richness.

The quality of vegetation was assessed using parameters such as intactness, diversity, history of disturbance, weed invasion and health. Three categories were used to describe the condition of vegetation communities:

Good: Vegetation still retains the species complement and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time and displays resilience to weed invasion due to intact ground cover, shrub and canopy layers.

Moderate: Vegetation generally still retains its structural integrity but has been highly disturbed and has lost some component of its original species complement. Weed invasion can be significant in such remnants.

Poor: Vegetation that has lost most of its species and is significantly modified structurally. Often such areas now have a discontinuous canopy of the original tree cover, very few shrubs and exotic species, such as introduced pasture grasses or weeds, replacing much of the indigenous ground cover. Environmental weeds are often co-dominant with the original indigenous species. It can often be difficult to assign a vegetation type to such remnants as they are so species poor.

3.4.1.1 Targeted surveys

Targeted surveys were undertaken on 30 and 31 August to coincide with the flowering time of *Tetratheca juncea*. A second targeted survey was undertaken on 12 and 13 December to coincide with the flowering of both *Tetratheca juncea* and *Cryptostylis hunteriana*. Four transects approximately five metres apart were walked along the proposed pipeline route. Areas containing rare or threatened species were recorded using a GPS (Geographic Positioning System).

3.4.2 Fauna

Fauna surveys included both general habitat based surveys and targeted surveys for threatened species of animal conducted in accordance with the NPWS guidelines on the preparation of Eight Part Tests (NSW National Parks and Wildlife Service 1996b). While recording threatened species within survey results can confirm their presence in a study area, the lack of threatened species records cannot necessarily be used to argue for the absence of the species from the site when suitable habitat is present: by the very nature of their rarity, threatened species are often difficult to detect. Suitable habitat is therefore the most important factor to consider when determining the potential presence of Threatened Species.

The condition of fauna habitats were assessed by examining characteristics such as native vegetation, ground and litter layers, breeding, nesting, feeding and roosting resources and evidence of fauna presence. The following categories were used to describe the condition of fauna habitats:

Good: A full range of fauna habitat components are usually all present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.

Moderate: Some fauna habitat components are often missing (for example, old-growth trees, fallen timber), although linkages with other remnant habitats in the landscape are usually intact, although sometimes degraded.

Poor: Many fauna habitat elements in low quality remnants have been lost, including old-growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive past clearing.

3.4.2.1 Targeted surveys

Targeted surveys were used to supplement the habitat-based assessment and these are detailed below. Survey locations are shown in *Figure 2*.

Call playback surveys

Call playback was used to survey for a range of nocturnal fauna using the methods of Kavanagh and Peake (1993) and Debus (1995). An initial listening period of 10 to 15 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity. The calls of the target species were then played intermittently for 5 minutes followed by a 10 minute listening period. After the calls were played, another 10 minutes of spotlighting and listening was conducted in the vicinity to check for birds attracted by the calls but not vocalising. Calls played during the survey included Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*).

Elliott trapping

Elliott trapping followed the Department of Primary Industries Director-General's Policy of Cage Trapping and the Animal Research Review Panel's 'Animal Care Guidelines for Wildlife Surveys'. Small ground-dwelling mammals were targeted using Elliott traps (Type A), positioned on the ground near the base of trees, within understorey vegetation and dead wood. Tree-mounted Elliott traps (Type B) were placed on wooden platforms approximately two to three metres above the ground on large trees. A plastic bag was placed over the closed end of all traps in order to keep any captured animals dry and warm. Each trap was baited with a mixture of rolled oats, peanut butter and honey. A mixture of honey and water was sprayed onto the trunk of the tree above the tree-mounted Elliott traps.

A total of 75 ground traps (Elliott Type A) and 25 tree-mounted traps (Elliott Type B) was placed along three transect lines within the site. The ground traps were placed approximately 10 metres apart and the tree-mounted traps approximately 30 metres apart, except in areas where there was an absence of suitable large trees. Fifty ground traps and ten tree traps remained open for four nights, while the remaining 25 ground traps and 15 tree traps were open for the three nights. All traps were checked each morning at sunrise and captured animals were identified to species, sexed and released at the site of capture.

Spotlighting

Spotlighting for arboreal and ground-dwelling mammals and amphibians was undertaken on three consecutive nights at sites throughout the study area on foot using two handheld 100 watt spotlights with light adjusting dimmer switches. The speed of survey was approximately one kilometre per hour. Any sighted animal was identified to the species level.

Anabat recordings

Anabat detection was used to record and identify the echolocation calls of microchiropteran bats and detectors were placed at eight different sites. The detector was attached to a time delay switch allowing bats to be identified throughout the night, with the recording starting at dusk. Recorded calls were analysed by Ray Williams of Ecotone Pty Ltd.

Harp trapping

Harp trapping was used to physically capture microchiropteran bats within flight pathways through vegetated areas which at two different sites locations within the study area (*Figure 2*). Traps were set up at dusk and were checked each morning and captured bats were weighed, measured, sexed and identified to species level. Bats were released the following night.

Incidental sightings

Species of animal present in the study area were recorded through observation methods including incidental sightings, bird surveys, identification of bird and frog calls, searches for ground-dwelling reptile species under logs and leaf litter and by sighting indirect evidence of species presence such as scats, feathers, tracks and hair.

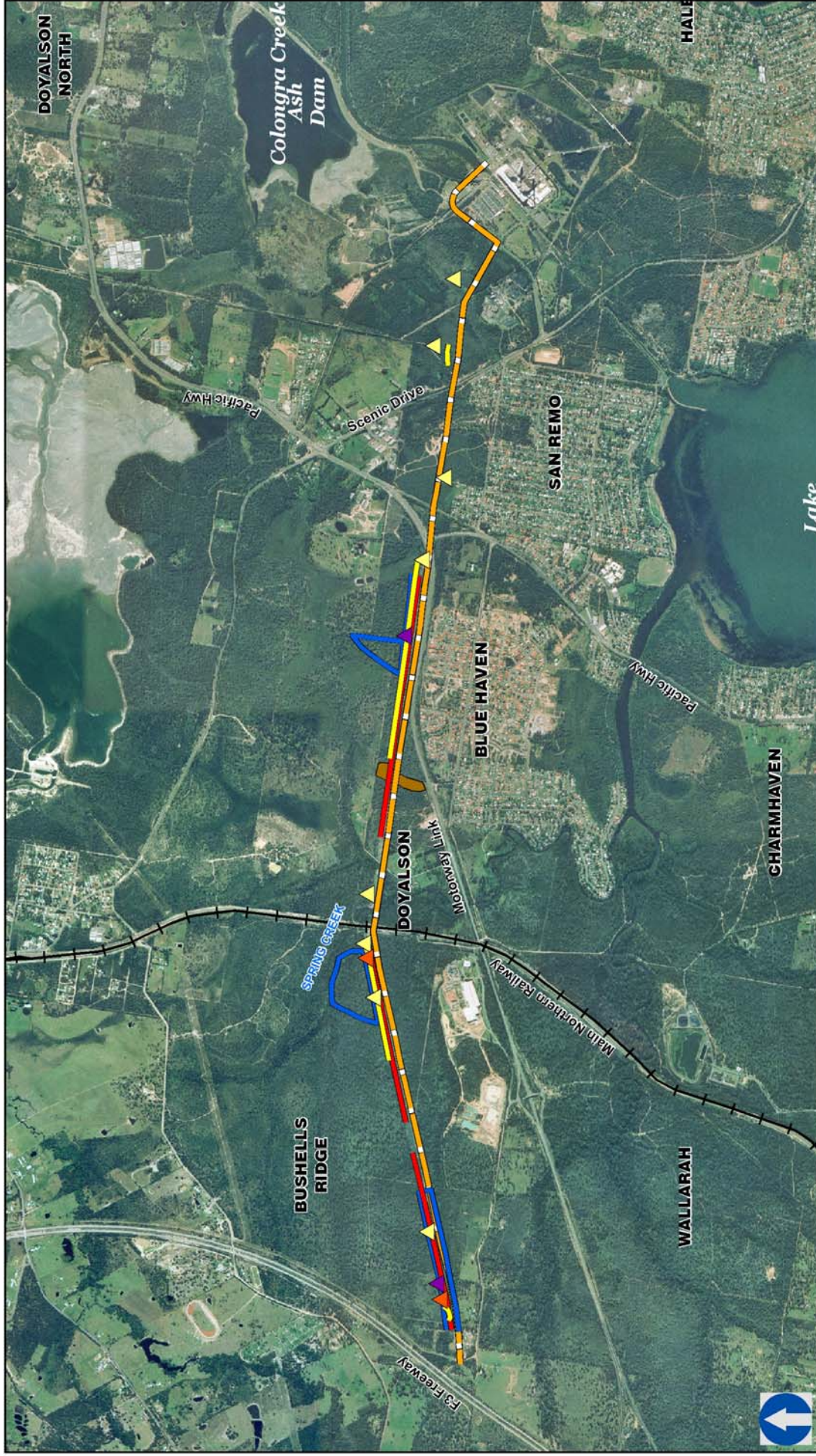


Figure 2 - Fauna Survey Locations

3.4.3 Survey effort

The location of survey effort is described in *Figure 2* and below in *Table 3.2*.

Table 3.2 Survey effort and location of targeted survey methods

Date(s)	Survey Method	Effort (Number or Time)	Easting (WGS 84)	Northing (WGS 84)
7/3/05- 11/3/05	Elliot Type A (ground traps)	100 trap nights	Start: 356493 End: 357685	Start: 6325012 End: 6324757
7/3/05- 11/3/05	Elliot Type A (ground traps)	100 trap nights	Start: 357856 End: 359050	Start: 6325069 End: 6325399
8/3/05- 11/3/05	Elliot Type A (ground traps)	75 trap nights	Start: 359745 End: 361471	Start: 6325223 End: 6324971
7/3/05- 11/3/05	Elliot Type B (tree mounted traps)	40 trap nights	Start: 360264 End: 631562	Start: 6325162 End: 6324973
8/3/05- 11/3/05	Elliot Type B (tree mounted traps)	25	Start: 358269 End: 354043	Start: 6325171 End: 6325344
8/3/05- 11/3/05	Elliot Type B (tree mounted traps)	15	Start: 356556 End: 356649	Start: 6324772 End: 6324804
8/3/05	Spotlighting (2 x 100w Spotlight)	4 person hours	Start: 356497 End: 357402	Start: 6324783 End: 6324967
9/3/05	Spotlighting (2 x 100w Spotlight)	4 person hours	Start: 358526 End: 358953	Start: 6325236 End: 6325487
10/3/05	Spotlighting (2 x 100w Spotlight)	4 person hours	Start: 360826 End: 3614831	Start: 6325093 End: 6325016
	Anabat ¹	1 night	363433	6324743
	Anabat	1 night	362993	6324876
	Anabat	1 night	362124	6324802
	Anabat	1 night	361579	6324949
	Anabat	1 night	359374	6325313
	Anabat	1 night	359048	6325334
	Anabat	1 night	358693	6325269
	Anabat	1 night	357148	6324917
7/3/05- 11/3/05	Harp Trap	1 night	356806	6324852
7/3/05- 11/3/05	Harp Trap	1 night	361079	6325066
8/3/05	Call Playback	1 night	356699	6324832
9/3/05	Call Playback	1 night	358952	6325320
7/3/05- 11/3/05	Fauna habitat	30 person hours	-	-
7/3/05- 11/3/05	Flora habitat surveys	30 person hours	-	-
30/8/05- 31/8/05	Targeted flora survey	25 person hours	-	-
12/12/05- 13/12/05	Targeted surveys	flora 5 person hours	-	-

Notes: 1 – Anabat bat detectors were set with a delay switch and had the potential to record throughout the entire night if bats were present.

3.5 Conservation significance

Assessment of the conservation significance of native flora and fauna is done according to the hierarchy:

- national
- state
- regional
- local.

Meaningful comparisons of significance or value at a variety of scales rely on widely accepted criteria (for example, International Union for the Conservation of Nature 2001). The following criteria were used to assign the site to an appropriate conservation significance category:

National: Remnant ecosystems containing populations of plant or animal species considered nationally vulnerable or endangered and listed under the *EPBC Act*. This category also includes:

- plants listed as threatened and rare in *Rare or Threatened Australian Plants* (Briggs & Leigh 1996)
- species listed as endangered, vulnerable or rare in Australia in an Action Plan published by the Department of Environment and Heritage.

State: Remnant ecosystems containing populations of plant or animal species, or vegetation or animal communities considered threatened in New South Wales, including species and communities listed under the *TSC Act*. This category also includes plants listed as poorly known in Australia in *Rare or Threatened Australian Plants* (Briggs & Leigh 1996).

Regional: There are no widely accepted criteria for regional significance in New South Wales. The state is divided into bioregions (Thackway & Cresswell 1995) and much of the listing of Endangered Ecological Communities under *TSC Act* and the *EPBC Act* are based around these regions. The New South Wales Government has set up Catchment Management Authorities that will direct natural resource management within thirteen general catchments. These authorities will incorporate earlier Regional Vegetation Management Plans that were required under the *Native Vegetation Conservation Act 1999*. In addition, numerous published studies and vegetation mapping projects have indicated the importance of vegetation and species at various spatial scales (e.g. *Native Vegetation of the Cumberland Plain*, NSW National Parks and Wildlife Service 2002c).

Local: All remnant native vegetation and fauna habitat that does not fall into the categories above is considered to be of at least local significance as most such areas have been reduced in extent since European settlement. The overall significance of the site on a local scale can take into consideration factors such as the size of remnants, degree of intactness and connectivity.

Potentially Significant: Often, time constraints, the limitations of field methods or seasonal factors make it impossible to confirm the presence of a significant plant and animal species or populations. However, the habitat of an area being investigated may closely match that used by the significant species in areas nearby where it is known to occur. In these circumstances, the level of significance that would otherwise apply is qualified by “potential”. In addition, some species or communities may possess characteristics that make them eligible for listing as threatened at either the State or National levels, although the listing has not taken place. Again, the level of significance for these species and communities is qualified by the term “potential”.

3.6 Impact assessment

The impact assessments follow the definitions given in *Section 1.2*.

Subject species for which tests of significance were completed were determined based on the following criteria.

- species recorded in the study area and for which important microhabitat elements will be removed or modified
- species recorded in the locality that have potential to occur within the study area and for which important microhabitat elements will be removed or modified.

For species, populations and communities listed under the *TSC Act*, significance assessments (Eight Part Tests) were carried out as required under Section 94 of the *TSC Act* and Section 5A of the *Environmental Planning and Assessment Act 1979* and followed the methods suggested by the New South Wales Department of Environment and Conservation Information Circular on Threatened Species Assessment (NSW National Parks and Wildlife Service 1996b).

For species and communities listed under the *EPBC Act*, significance assessments followed the administrative guidelines of the Department of the Environment and Heritage (Environment Australia 2000).

3.7 Limitations

On all sites, varying degrees of non-uniformity of flora and fauna habitats are encountered. Hence no sampling technique can totally eliminate the possibility that a species is present on site (e.g. species of plant present in the seed bank). The conclusions are based upon data acquired for the site and the environmental field surveys and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of threatened species, can change with time.

4. Results

4.1.1 Vegetation communities

The pipeline route is along an existing electricity easement which is maintained through periodic slashing and selective clearing of canopy species. Due to this ongoing maintenance, vegetation within the easement lacks a canopy and contains only shrub and ground layers. Although the canopy species are generally absent and the easement is maintained as a grassland, sedgeland or heathland, the general species composition is consistent with the adjacent vegetation.

Some intact woodland vegetation would be cleared as part of the construction of the inlet facility and the access track required for construction of the Open Cycle Gas Turbine Facility near the existing Munmorah power plant.

Five vegetation communities occur within the site (*Figure 3*):

- Coastal Plains Smooth-barked Apple Woodland
- Coastal Plains Scribbly Gum Woodland
- Wyong Paperbark Swamp Forest
- Swamp Mahogany- Paperbark Forest¹
- Riparian Melaleuca Swamp Forest¹ (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b).

1: Part of Endangered Ecological Community (EEC) Swamp Sclerophyll Forest on Coastal Floodplain under the *TSC Act*.

Coastal Plains Smooth-barked Apple Woodland

Coastal Plains Smooth-barked Apple Woodland (Map Unit 30, (Department of Environment and Conservation 2005b; Lower Hunter and Central Coast Regional Environmental Management Strategy 2003a) occurs on low undulating coastal plains. This community covers the majority of the pipeline route as well as the inlet facility.

The community is characterised by a low open canopy (to 20 metres tall and 35 per cent cover) consisting of *Angophora costata*, *Corymbia gummifera* and *Eucalyptus capitellata*. The understorey contains a shrub layer typically consisting of *Banksia spinulosa*, *Acacia myrtifolia*, *Allocasuarina littoralis*. The ground cover is dominated by grasses including *Entolasia stricta*, *Themeda australis* and herbs such as *Lomandra obliqua*, *Phyllanthus hirtellus*, *Pimelea linifolia* and *Pteridium esculentum* (NSW National Parks and Wildlife Service 2000b).

This community contains potential habitat for *Tetratheca juncea* and *Angophora inopina* (NSW National Parks and Wildlife Service 2000b).

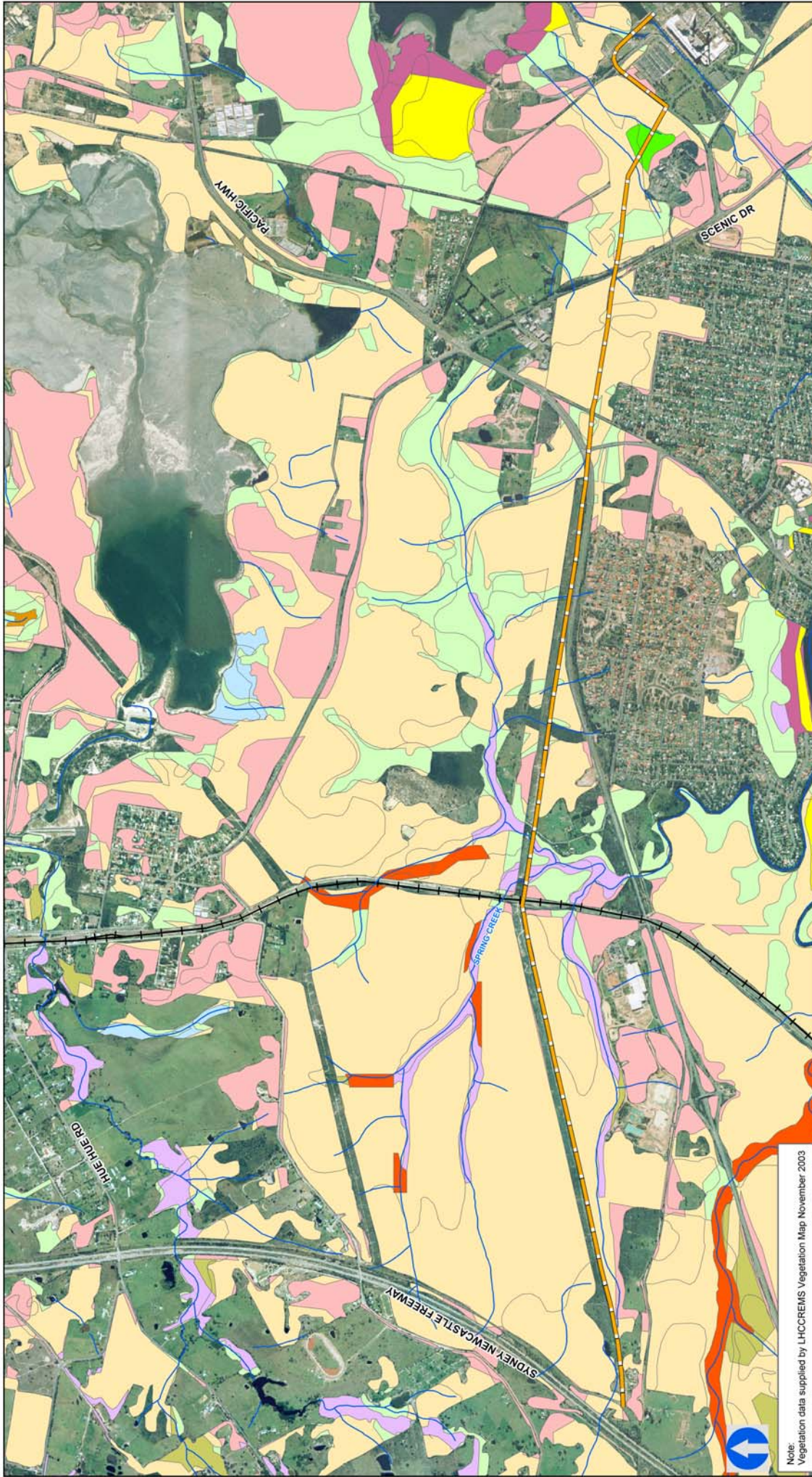


Figure 3 Vegetation Communities Within the Study Area

Within the easement, this community is generally a grassland with scattered shrubs consisting of the species listed above. Canopy species are generally absent although some regenerating eucalypt saplings were evident.

Within the site, this vegetation generally has a high diversity of native species, and weed invasion is restricted largely to areas immediately adjacent to roads and the railway corridor. The community is generally in good condition.

Coastal Plains Scribbly Gum Woodland

Coastal Plains Scribbly Gum Woodland (Map Unit 31, (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b) occurs on crests and flats of the coastal plain and typically occurs on acidic, infertile soils with poor drainage. Within the site, this community occurs as two patches in the vicinity of the Great Northern railway line. This community also occurs in the vicinity of the proposed access track. This community intergrades with and is similar to the Coastal Plains Smooth-barked Apple Woodland (described above).

Coastal Plains Scribbly Gum Woodland is characterised by a low open canopy (to 25 metres and 30 per cent cover) consisting of *Eucalyptus haemastoma*, *Corymbia gummifera* and *Eucalyptus capitellata*. The understorey contains a shrub layer to eight metres including *Leptospermum trinervium*, *Hakea dactyloides*, *Lambertia formosa* and *Banksia oblongifolia*. The ground cover consists of a dense cover of grasses, herbs and sedges including *Themeda australis*, *Entolasia stricta*, *Anisopogon avenaceus*, *Ptilothrix deusta*, *Epacris pulchella*, *Pimelea linifolia* and *Panicum simile* (NSW National Parks and Wildlife Service 2000b).

This community contains potential habitat for *Tetratheca juncea*, *Cryptostylis hunteriana*, *Acacia bynoeana* and *Angophora inopina* (NSW National Parks and Wildlife Service 2000b).

Within the easement, this community is generally a grassland with scattered shrubs consisting of the species listed above. Canopy species are generally absent although some regenerating eucalypt saplings were evident.

Within the site, this vegetation generally has a high diversity of native species and weed invasion is largely restricted to areas immediately adjacent to roads and the railway. The community is generally in good condition.

Wyong Paperbark Swamp Forest

Wyong Paperbark Swamp Forest (map unit 43, (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b) occur on swampy floodplains on coastal floodplain near Wyong. Within the site, this community occurs on the floodplain of Spring Creek, to the east of the railway.

This community is characterised by a dense thicket of *Melaleuca* species (10 metres tall) including *Melaleuca nodosa*, *M. sieberi* and *M. linariifolia*. The ground cover is dominated by grasses and herbs including native species such as *Gahnia clarkei*, *Entolasia marginata*, *Centella asiatica* and introduced species such as *Paspalum dilatatum* and *Ageratina adenophora* (NSW National Parks and Wildlife Service 2000b).

Outside the easement this community also includes scattered emergent eucalypts including *Eucalyptus robusta* and *Eucalyptus capitellata*.

This community has a moderate level of weed invasion and is in moderate condition.

Swamp Mahogany-Paperbark Forest

Swamp Mahogany-Paperbark Forest (map unit 37, (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b) occurs in areas of impeded drainage near coastal swamps and along drainage lines and alluvial flats. This community occurs as a small patch in the eastern section of the pipeline route near the Munmorah Power Station.

This community is characterised by a canopy (to 35 metres and 50 per cent cover) consisting of *Eucalyptus robusta*, *Melaleuca quinquenervia* and *Casuarina glauca*. The understorey consists of a dense cover of sedges, herbs and grasses including *Gahnia clarkei*, *Baumea acuta*, *Persicaria* spp., *Juncus* spp. and *Entolasia marginata* (NSW National Parks and Wildlife Service 2000b).

This community is a sub-unit of Swamp Sclerophyll Forest on Coastal Floodplain which is listed as an endangered ecological community under the *TSC Act* (NSW Scientific Committee 2004). This community also provides potential habitat for threatened flora including *Tetratheca juncea* (NSW National Parks and Wildlife Service 2000b).

Within the easement, this community occurs as a wet sedgeland with scattered shrubs and regenerating canopy species consisting of the species listed above.

This community has a moderate level of weed invasion and is in moderate condition.

Riparian Melaleuca Swamp Woodland

Riparian Melaleuca Swamp Woodland (Map Unit 42, (Lower Hunter and Central Coast Regional Environmental Management Strategy 2003b)) occurs on floodplains, alluvial flats and drainage lines on the central coast lowlands.

This community is characterised by a canopy (to 25 metres and 35 per cent cover) of *Eucalyptus robusta* and other canopy species integrating from adjacent communities including *Angophora costata* and *Eucalyptus haemastoma*. The understorey contains a shrub layer (to 10 metres) consisting of *Melaleuca sieberi*, *Leptospermum juniperinum*, *Banksia oblongifolia* and *Callistemon rigidus* and *Leptospermum polygalifolium*. The ground cover is dense with sedges including *Lepyrodia scariosa*, *Empodima minus*, *Schoenus brevifolius*, *Baumea rubiginosa* and herbs such as *Melaleuca thymifolia*, *Pultenaea villosa*, *Comespermum ericinum* and *Pimelea linifolia* (NSW National Parks and Wildlife Service 2000b).

This community is a sub-unit of Swamp Sclerophyll Forest on Coastal Floodplain which is listed as an endangered ecological community under the *TSC Act* (NSW Scientific Committee 2004). This community also provides potential habitat for threatened flora including *Angophora inopina* (NSW National Parks and Wildlife Service 2000b).

Within the easement, this community occurs as a dense wet sedgeland with scattered shrubs and regenerating canopy species consisting of the species listed above.

Within the subject site, this vegetation community generally has a low level of weed invasion and is in good condition.

4.1.2 Species of plant

A total of 147 species of plant were recorded on site (*Appendix C*). The majority of species (85 per cent) are native. No noxious weeds were recorded on site.

Angophora inopina, listed as vulnerable under both *EPBC Act* and the *TSC Act*, was recorded during within the easement near Charmhaven and also in the western section of the site (*Figure 4*).

4.1.3 Fauna habitats

The suitability, size and configuration of fauna habitats correlate broadly with the structure, floristics, connectivity and quality of the local vegetation communities as described above. The fauna habitats for the Coastal Plains Scribbly Gum Woodland and the Coastal Plains Smooth-barked Apple Woodland have been collectively described, as the two communities share similar fauna habitat features and because of the nature in which they intergrade with each other. The fauna habitats of the heathland occurs in an undisturbed state and as a regenerating shrub layer within some unmaintained areas of the electricity transmission easement.

Finer scale habitat features in and near the study area include foraging resources including nectar, pollen and fruit, tree hollows, hollow logs and riparian habitats including creeks, waterbodies and ephemeral drainage lines. These habitats and species associations are discussed below.

Transmission Easement Areas

There are limited habitat features associated with the cleared grassland within the existing electricity easement due to ongoing maintenance activities (*Photograph 1 and 2*). However, there are areas of regrowth vegetation including young tree saplings, acacia shrubs and grasses that have not been maintained at the edges of the easement and are in the early stages of heathland formation. Sedgeland habitats including a dense two metre high regenerating shrub/ riparian shrub layer are present in a tributary of Spring Creek, occurring in the central area of the proposed route on the eastern side of the railway line. A semi-permanent inundated sedgeland is also present within Delta land near the power station in the eastern extent of the site.

The grasslands of the easement areas provide a marginal foraging area for macropods including the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*), and insectivorous microchiropteran bats use the ecotone between the easements and adjacent to the woodland and heathland for foraging. The various stages of the regenerating shrub layer provides habitat for small ground-dwelling mammals including the Bush Rat (*Rattus fuscipes*) and the Brown Antechinus (*Antechinus stuartii*). The suitability of water holding sedgeland and drainage line for amphibian diversity is likely to be seasonally dependant or ephemeral in nature and species present at Spring Creek include Leseur's Frog (*Litoria lesueuri*) and Striped Marsh Frog (*Limnodynastes peronii*).

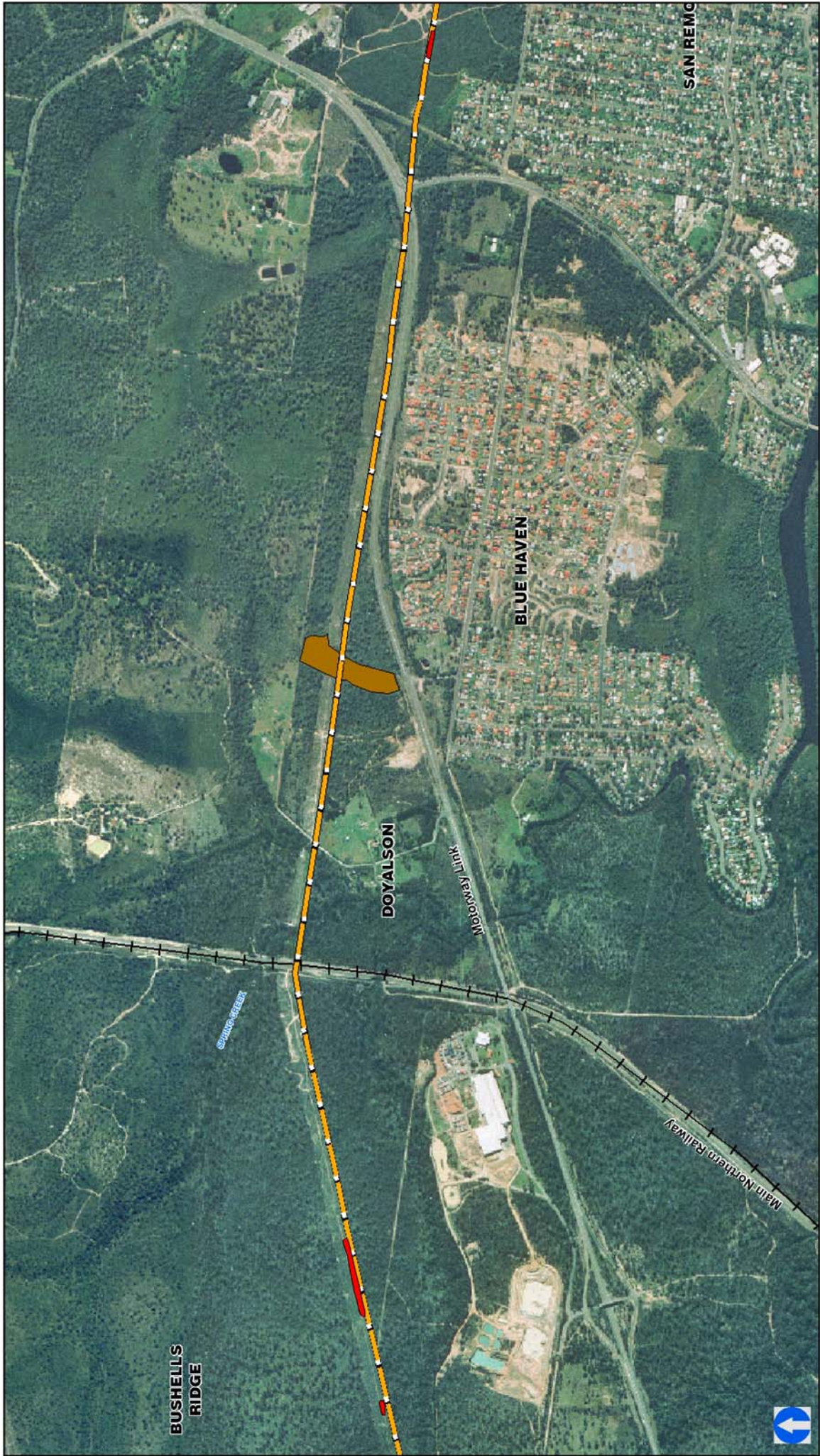






Figure 4 Location of Angophora inopina in study area

-  Proposed Pipeline Route
-  Rail Line
-  Angophora inopina within easement
-  Swamp



Photograph 1: Maintained easement



Photograph 2: Low sedges and shrubs within easement

The fauna habitats in transmission easements are generally disturbed and are in poor condition.

Coastal Plains Open Woodland

The Coastal Plains Scribbly Gum Woodland and the Coastal Plains Smooth-barked Apple Woodland vegetation communities are the most abundant throughout the study area and form part of a wider area of bushland.

The open woodland in both the southern and northern areas of the site is generally dominated by a moderately dense upper canopy of tall eucalypt trees, although some areas contain sparse distribution of tall trees and shrub layers. Understorey species include winter-flowering species such as *Banksia spinulosa* and *Acacia* sp. In association with summer flowering eucalypts, these species in the overstorey provide important food resources for a variety of birds and arboreal marsupials throughout the year. There are a moderate number of tree that have developed medium to large sized

tree hollows, mostly within the core of the woodland area. The two to three metre tall shrubby understorey and the groundcover layers are moderately dense in areas away from the margins of the transmission easement, and tend to be sparser closer to the easement. There is a moderate amount of leaf litter and fallen dead timber throughout most of the open woodland that provides refuge, shelter and foraging resources for a variety of native fauna.

The groundcover vegetation including *Lomandra* grasses and fallen dead timber and logs provide habitat for small ground-dwelling mammals including the Bush Rat and the Brown Antechinus as well as small reptiles including *Lampropholis* spp. The Eastern Grey Kangaroo and Swamp Wallaby forage throughout the woodland and into adjacent cleared areas of the easement. Native species of birds including fairy wrens and scrub wrens forage amongst the shrub layer, while honeyeaters and coastal woodland birds forage amongst the canopies of taller *Angophora* and eucalypt trees. Trees in varying stages of hollow formation are used by microchiropteran species of bat for roosting and by arboreal marsupials. Some areas of the open woodland contain a disturbed understorey from grazing by goats and access tracks throughout the site, although some of the tracks are likely to be used by microchiropteran bats as flight pathways for foraging.

The Threatened Squirrel Glider (*Petaurus norfolcensis*) is also likely to use the foraging and breeding habitats available in the denser areas of woodland within the central and eastern areas of the study area.

Fauna habitats in the Open Woodlands are generally in moderate to good condition.

4.1.4 Species of animal

A total of 52 vertebrate species of animal were recorded on site (*Appendix D*), comprising four species of amphibian, five species of reptile, 32 species of bird, seven species of native mammals and four introduced species.

No threatened species of animal was recorded on site.

4.1.5 Corridors and connectivity

Wildlife corridors can be defined as “retained and/or restored systems of (linear) habitat which, at a minimum enhances connectivity of wildlife populations and may help them overcome the main consequences of habitat fragmentation” (Wilson and Lindenmayer 1995). Corridors can provide ecological functions at a variety of spatial and temporal scales from daily foraging movements of individuals, to broad-scale genetic gradients across biogeographical regions.

Corridors serve a number of different functions in terms of conservation including:

- providing increased foraging area for wide-ranging species
- providing cover for movement between habitat patches, and enhancing the movement of animals through sub-optimal habitats
- reducing genetic isolation

- facilitating access to a mix of habitats and successional stages to those species which require them for different activities (for example, foraging or breeding)
- providing refuge from disturbances such as fire
- providing habitat in itself
- linking wildlife populations and maintaining immigration and recolonisation between otherwise isolated patches. This in turn may help reduce the risk of population extinction (Wilson and Lindenmayer 1995).

The site is connected with broader areas of open sclerophyll woodland extending from the site. The importance of the bushland in the areas adjacent to the existing transmission easement is increased due to the overall the disturbance to bush land areas in the coastal areas of the project locality. The proposed development would take place within the existing transmission easement or cleared areas and does not require the removal of significant amounts of vegetation. The nature of the proposed clearing would not fragment populations and communities or their habitats.

4.2 Species, populations and communities of conservation concern

4.2.1 Threatened ecological communities

Endangered Ecological Communities are listed under Schedule 1, Part 3 of *TSC Act*, while threatened ecological communities (Critically Endangered, Endangered and Vulnerable) are listed under the *EPBC Act*. Two vegetation communities within the site (Swamp Mahogany- Paperbark Forest and Riparian Melaleuca Swamp Forest) form part of Swamp Sclerophyll Forest on Coastal Floodplain which is listed as an endangered ecological community under the *TSC Act* (refer *Figure 3*).

4.2.2 Endangered populations

Endangered Populations are listed under Schedule 1 Part 2 of the *TSC Act*. One species is listed as an Endangered Population within the Wyong Local Government Area: *Eucalyptus parramattensis* subsp. *parramattensis*. This species was not recorded during the current survey, however, potential habitat for this species occurs within the woodland adjacent to the easement and the proposed pipeline route.

4.2.3 Threatened flora species

A total of 13 species of threatened flora listed under the *TSC Act* (*Figure 4*) and/or the *EPBC Act* are known to occur in the local area and are considered in this study (*Appendix E*).

Angophora inopina, listed as vulnerable under both *EPBC Act* and the *TSC Act*, was recorded within the easement near Charmhaven and also in the western section of the site. Only immature individuals were recorded (less than two metres tall).

Based on habitat assessment and the known distribution of Threatened species in the Sydney Basin Bioregion, a further four species were assessed as having the potential within the site (*Appendix E*): *Acacia bynoeana*, *Cryptostylis hunteriana*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea*. However, *Tetratheca juncea* was not recorded within the site despite two targeted surveys (undertaken in August and December) during its flowering period. Targeted surveys undertaken for *Cryptostylis hunteriana* in December to coincide with its flowering period failed to detect this species within the site.

Impact assessments as required under the *TSC Act* and/or the *EPBC Act* have been completed for the threatened species recorded or with potential habitat within the site (*Appendix F*).

4.2.4 Threatened fauna species

A total of 58 Threatened species of vertebrate fauna has been recorded or has the potential to occur within the project locality, including five species of amphibian, 37 species of birds (a majority being marine nomadic species), 16 species of mammal and one species of reptile (*Appendix G*). All species are listed under the *TSC Act* and twelve are listed under the *EPBC Act* (*Appendix F*).

It is, however, highly unlikely that all these species occur at or near the proposed development site on a regular basis, and even fewer species would be affected by the proposal.

Despite the occurrence of local records or predicted habitat, 48 Threatened species are considered unlikely to be significantly affected by the proposal for one or more of the following reasons:

- core habitats were not recorded in the study area
- the species has a large home-range, significantly larger than the area of proposed development and as such are unlikely to be dependent on resources within the development areas
- the area is outside the normal range of the species and records are likely to be of vagrants
- the species is considered locally extinct.

Full details of species requirements are shown in *Appendix F*. Impact assessments as required under the *TSC Act* and/or the *EPBC Act* have been completed for the remaining species which include microchiropteran bats, nocturnal birds, Squirrel Glider and Wallum Froglet (*Appendix F*).

4.2.5 Migratory species

A total of 25 migratory species has been predicted to occur within 10 kilometres of the study area based on the Department of the Environment and Heritage Protected Matters Search Tool (*Appendix F*). A majority of migratory species are coastal marine birds and no migratory species listed on the *EPBC Act* were recorded on site. While terrestrial migratory species of bird may potentially use the area, the site is not classed as an

'important habitat' as defined under the administrative significance guidelines of the *EPBC Act* in that the site does not contain:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat utilised by a migratory species which is at the limit of the species range
- habitat within an area where the species is declining.

As such there is unlikely to be an impact on migratory species and this group is not considered further.

4.2.6 Key threatening processes

Key threatening processes are listed under Schedule 3 of the *TSC Act* and also under the *EPBC Act*. Clearing of native vegetation is listed as a key threatening process under the *TSC Act* and land clearance is listed under the *EPBC Act*. Removal of dead wood, dead trees and logs is listed as a key threatening process under the *TSC Act*.

The proposed action involves both the clearing of native vegetation (approximately 10.5 hectares) and the removal of dead wood, dead trees and logs. However, this is unlikely to further threaten any listed species.

4.2.7 Critical habitat

Critical Habitat is listed under both the *TSC Act* and *EPBC Act* and both the State and Federal Director Generals maintain a register of this habitat. Critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community (NSW National Parks and Wildlife Service 1996b).

There is no listed critical habitat within the site or study area and none is likely to be affected by the proposed development.

4.2.8 SEPP 44 – Koala Habitat Protection

The site is located in the Wyong Shire Council which is listed under Schedule 1 of State Environmental Planning Policy - 44 Koala Habitat Protection (SEPP-44). The study area contains two preferred Koala feed tree species listed in Schedule 2 of the policy, namely the *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum).

The study area is within the Central Coast Koala Management Unit area identified in the Draft Koala Recovery Plan which includes *E. tereticornis* (Forest Red Gum) as a primary feed tree and *E. capitellata* (Brown Stringybark) as a supplementary feed tree species (NSW National Parks and Wildlife Service 2002b).

A colony of Koala was once known from the Wyong local government area (Payne 2002b), however records are scattered and the nearest record of a Koala is two kilometres to the south of the site (Department of Environment and Conservation 2005a).

Habitats connecting the location of the record and the study area are fragmented by urban development.

Outside the existing powerline easement the Wyong Paperbark Swamp Forest community contains scattered emergent eucalypts including *Eucalyptus robusta* and *Eucalyptus capitellata* on the floodplain of Spring Creek, to the east of the railway. The density of feed trees in these areas does not meet the SEPP-44 definition of potential Koala habitat.

4.3 Conservation significance

Although modified, the site is generally in good condition and has high species diversity. *Angophora inopina*, listed as vulnerable under both *EPBC Act* and the *TSC Act*, was recorded during the field survey along the proposed pipeline route. As such, the site is of national conservation significance.

5. Impact and amelioration

5.1 Impacts of the proposal

5.1.1 Vegetation clearing

The primary impact of the proposal is the removal of vegetation within the transmission easement. It involves a maximum removal of 15 metre wide strip within the seven kilometre easement (approximately 10.5 hectares).

The proposed inlet facility would require an area of approximately 0.3 hectares to accommodate plant equipment. It would be located within partially cleared land adjacent to the transmission easement but is likely to also require some additional clearing.

Widening of an access track would be required during construction of the Open Cycle Gas Turbine (OCGT) facility. The proposed access track would follow an existing vehicle track which traverses bushland within Delta Electricity property, and would require clearing at some points to widen the existing track. Following the completion of construction, rehabilitation works would be undertaken in this area.

The proposed OCGT plant and delivery facility are to be located within existing cleared areas of the power station site. No additional clearing is expected as a result of this infrastructure.

Vegetation clearing also has the potential for seed dispersal of weed species, however, few weeds were recorded in the site (refer to *Section 4.1.2*).

An insignificant number of tree hollows were recorded, and the amount of vegetation to be removed would not significantly affect the habitats of threatened animals that are likely to occur in the adjacent bushland. Although removal of vegetation has a negative impact in terms of habitat values, mulching and its reapplication may have some positive impacts in terms of nutrient cycling.

5.1.2 Fragmentation and edge effects

The major impact of habitat fragmentation is the reduction of population sizes and the dispersal and quality of remaining habitats. Edge effects may occur when a new boundary is established within an existing habitat producing a change in the remaining habitat (Goldingay & Whelan 1997), and may also increase the invasion of noxious weeds and the vulnerability of native animals to predation by feral cats, dogs and the European Red Fox.

The proposed pipeline is within an existing electricity easement. Existing access, maintenance and motorcycle tracks traverse the easement and surrounding bushland. Clearing for the proposed pipeline and access tracks would be linear and restricted to already cleared or disturbed areas. The proposed inlet facility would be located within partially cleared areas adjacent to the transmission easement. As such, there is unlikely to be an increase in the extent of fragmentation and associated edge effects.

5.1.3 Erosion

Trenching for the pipelines and construction of the inlet facility will produce exposed soils that have the potential to enter surrounding areas of vegetation and Spring Creek (near the railway crossing) if not properly managed.

5.1.4 Noise

During construction of the pipeline and other facilities there will be increased noise in the local area for a short period of time. This may cause disturbance for fauna in the area, although given the proximity of the pipeline to existing roads and infrastructure, it is expected that the impact of this would be minor. Access for maintenance vehicles may cause intermittent disturbance, however, the impacts are likely to be minor.

5.2 Impact assessments

5.2.1 Flora

Angophora inopina, listed as vulnerable under both *EPBC Act* and the *TSC Act*, was recorded in two areas along the proposed gas pipeline. The vegetation within the easement is regularly maintained through slashing and selective removal of tall vegetation. Only immature individuals were recorded (less than two metres tall) and the site is unlikely to contain a significant seedbank as seeds are short-lived and seed dispersal is limited (Tierney 2004). Only individuals greater than two metres have been observed to set seed and it has been estimated that a minimum of 15 years is required for reproductive maturity (Tierney 2004). Due to regular maintenance, the easement is unlikely to contain a viable population of this species. Impact assessments for concluded that the proposal is unlikely to have a significant impact on this species (*Appendix G*).

Although not recorded, the site provides potential habitat for a further four species of threatened plant: *Acacia bynoeana*, *Cryptostylis hunteriana*, *Grevillea parviflora* ssp. *parviflora* and *Tetradlea juncea*.

Two of these species, *Cryptostylis hunteriana* and *Tetradlea juncea*, are highly cryptic and difficult to detect when not flowering. Targeted surveys were undertaken on 30 and 31 August 2005 to coincide with the beginning of the flowering season of *Tetradlea juncea* with a second targeted survey undertaken on 12 and 13 December to coincide with the flowering period of both *Tetradlea juncea* and *Cryptostylis hunteriana*. These species have not been recorded and due to ongoing maintenance activities and other disturbances are considered unlikely to occur within the site.

Impact assessments were conducted for these species and concluded that the proposal is unlikely to have a significant impact (*Appendix G*).

5.2.2 Fauna

No threatened species of animal was recorded on site during targeted surveys. A field assessment of fauna habitats and the NSW Department of Environment and Conservation Atlas of Wildlife database searches determined that the Squirrel Glider

and Wallum Froglet may use habitats in the Coastal Plains Scribbly Gum Woodland located in the central area of pipeline route. It is likely that eight species of microchiropteran bat (East Coast Freetail Bat, Common Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Large-footed Myotis and the Large-eared Pied Bat) and two species of nocturnal bird (Masked Owl and Powerful Owl), use the site as a marginal foraging area.

Impact assessments for the threatened species under the *TSC Act* and *EPBC Act* significance assessment guidelines concluded that the proposal would not have a significant impact on threatened animal species (*Appendix G*).

5.3 Impact amelioration

A general principle of environmental management is to, in order of preference;

- **Avoid** environmental impacts
- **Minimise** impacts
- **Mitigate** the impacts
- as a last resort once the above options have been investigated, **compensate** for the residual impacts.

Impacts on local flora and fauna have been minimised by utilising already disturbed areas including a maintained electricity easement and existing access tracks. However, some native woodland vegetation would be cleared for the inlet facility and to widen the access track to the Open Cycle Gas Turbine Facility.

In order to further minimise and mitigate impacts on ecological values of the site, the following will be undertaken:

- access for workers, their equipment and vehicles is restricted to the powerline easement and designated access tracks. No access be allowed within bushland surrounding the site
- clearing and soil disturbance should be minimised, particularly in the vicinity of Threatened species *Angophora inopina* (*Figure 4*).
- except for trenching, vegetation clearing involve only the removal of above ground plant parts with root systems and soil profile left undisturbed
- colour tape or 'parawebbing' be used to delineate the maximum work area permitted. This should be implemented prior to any work commencing on site. If any tape is disturbed then it should immediately be replaced along the appropriate alignment;
- soil disturbance should be limited and sediment control devices should be installed prior to clearing vegetation to ensure no impacts on surrounding vegetation or creeks
- topsoil removed during trenching stockpiled nearby within the easement and replaced once the pipe has been laid. Care should be taken not to transfer top soil between areas

- vegetative material removed along the easements should be retained in the area it is removed from to maintain the nutrient balance. The material can be chipped and spread around the towers to assist in the prevention of regrowth unless otherwise requested or agreed by the Department of Environment and Conservation. Weeds should not be mulched, but rather bagged and removed from the site
- vehicles and other equipment (including boots) are thoroughly cleaned of soil, seeds and plant material before entering or leaving a site. This will help to prevent the further spread of weed species or pathogens within the site or into the surrounding bushland
- a clearing management plan should be prepared and implemented for areas containing native woodlands including the inlet facility and access track. The management plan should include tree clearing protocols such as:
 - ▶ shaking the tree using a bulldozer
 - ▶ slowly pushing the tree to the ground so that it largely remains intact
 - ▶ leaving the tree in place once felled for at least one day/night before removing to allow animals to relocate to nearby vegetation
 - ▶ all contractors having the contact numbers of wildlife rescue groups should animals be injured during clearing
 - ▶ undertaking vegetation clearing during September/October or in March/May to avoid summer breeding seasons and the winter hibernation for hollow dependent species.
- cover up trenches when work is finished for the day to prevent animals being accidentally trapped
- any dead logs within the development footprint should be moved to an adjacent area which is outside the footprint thus minimizing the loss of habitat
- do not park, stockpile or store construction equipment and materials under trees. This will avoid compaction within the root zone.

6. Summary and conclusions

The proposed OCGT plant and delivery facility will be located in existing and cleared areas within the power station site and will therefore not result in any vegetation clearing.

The proposed pipeline is within an existing electricity easement which is maintained through periodic slashing and selective clearing of canopy species. Due to this ongoing maintenance, vegetation within the easement lacks a canopy and contains only shrub and ground layers. Although the canopy species are generally absent and the easement is maintained as a grassland, sedgeland or heathland, the species composition is consistent with the adjacent vegetation. This vegetation generally has a high diversity of native species, low weed invasion and is in moderate to good condition. Vegetation communities recorded in the study area (i.e pipeline in adjoining lands) include:

- Coastal Plains Smooth-barked Apple Woodland
- Coastal Plains Scribbly Gum Woodland
- Wyong Paperbark Swamp Forest
- Swamp Mahogany- Paperbark Forest
- Riparian Melaleuca Swamp Forest.

The associated fauna habitats were in moderate to good condition within the Coastal Plains Woodland vegetation communities, and no significant fauna habitats were recorded within the transmission easement.

The primary impact of the proposed gas pipeline and associated facilities is the removal of approximately 10.5 hectares of native vegetation. The majority of this vegetation is within an existing electricity easement and is highly modified. Its removal would not significantly affect the habitats of threatened flora and fauna that are likely to occur in the adjacent bushland.

One Threatened species of plant (*Angophora inopina*) was recorded within the existing electricity easement. Impact assessments were completed for this species and concluded that due to ongoing disturbance to this species and its habitat through easement maintenance, the site is unlikely to support a viable population and as such the proposal was unlikely to significantly impact this species.

Although not recorded on site during preliminary inspections or two targeted surveys, the site provides potential habitat for a further four threatened species (*Acacia bynoeana*, *Cryptostylis hunteriana*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea*). Impact assessments were completed for these species and concluded that the proposal would not have a significant impact on their recovery due to the proposal being located almost entirely within already cleared areas or maintained easement. No significant fauna habitats were recorded within the existing transmission easements and impact assessments conducted for threatened animals that are likely to occur in the study area concluded that the proposal would not have a significant impact on threatened species or populations.

Mitigation measures designed to minimise the potential for environmental impacts have been recommended in this report and would be required to be implemented during the proposed construction activities. It is concluded that by adopting these mitigation measures there would be no significant environmental impacts from the proposed works and therefore, that no further assessment should be required.

7. References

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Appendix A

Curricula vitae of project team

Appendix A: Curricula Vitae of project team

This appendix details the qualifications and experience of team members involved in the current project.

SELGA HARRINGTON

Ecologist

Years of Experience

6 (1 with PB, 5 with others)

Education

Bachelor of Science (Hons) University of Sydney 2000

Planning for Bushfire Prone Areas, University of Technology Sydney 2005

Key Qualifications

Selga has over six years experience in ecological surveys, ecological and systematic research, herbarium curation and bush regeneration. Her field experience covers a range of habitats from eastern Australia to arid regions of Queensland, New South Wales and South Australia. This work has encompassed a variety of habitats including rainforest, heath, sclerophyll forest, mallee, swamps, wetlands and coastal dunes. Selga is experienced in the assessment of vegetation communities, flora habitat, conservation significance, long-term monitoring, impacts and mitigation. Selga is skilled in the application of Federal and State environmental legislation including the Environment Protection and Biodiversity Conservation Act 1999, the *Threatened Species Conservation Act 1995* and the *Environmental Planning and Assessment Act 1979*.

Key Experience

- Preliminary Environmental Assessment of Two Stabling Yard Sites on the Central Coast NSW, Rail Corporation New South Wales. Ecologist. Outlined the options and constraints of two proposed rail stabling yards on the central coast. One of the proposed sites contained the Threatened *Melaleuca biconvexa*.
- Flora and Fauna Assessment of John Hunter Hospital, NSW, Bovis Lend Lease Pty Ltd. Botanist. Undertook an ecological assessment to support a proposed rezoning application for John Hunter Hospital.
- Flora and Fauna Constraints Assessment of Proposed Electricity Transmission Route Options, Riverstone, Integral. Botanist. Undertook a route selection study and environment impact assessment including a comparison of potential ecological impacts along nine electricity transmission line route options in the suburbs of Riverstone, Vineyard and Schofields.
- Preliminary flora and fauna constraints assessment of the Wyong Gas Project, NSW, Sydney Gas. Ecologist. Assessed the ecological options and constraints of the construction of gas extraction wells, connective pipeline system and gas processing station in Wyong Shire.
- Bulahdelah Pacific Highway Upgrade Addendum to the Biological Impact Assessment, Roads and Traffic Authority. Botanist. Undertook an assessment of freshwater wetlands which had recently been listed as an endangered ecological community under the Threatened Species Conservation Act 1995. Provided mitigation measures to minimise impacts to this community.
- Assessment of the existing ecological condition of the Windale/Gateshead Wastewater System, NSW, Hunter Water. Botanist. Assessed the existing ecological condition of the vegetation in the vicinity of the Windale/ Gateshead Wastewater System and the condition of Jewells Swamp and its catchment due to overflows.
- Targeted surveys for *Tetratheca glandulosa* within Stage 2 Hornsby Sand Mine, Hornsby NSW, P.F. Formations. Project Manager/Ecologist. Undertook targeted surveys within the site for *Tetratheca glandulosa*, a threatened species listed on both the Threatened Species Conservation Act 1995 and Environment Protection and Biodiversity Conservation Act 1999. Estimated the size and distribution of this species within the site. Outlined the options and constraints for future mining within the area.

ALEX FRASER

Zoologist

Years of Experience

2 (Professional)

Education

Bachelor of Applied Science (Hons) Southern Cross University 2002

Key Qualifications

Alex has two years professional work experience in practicing terrestrial wildlife ecology for both the Department of Environment and Conservation and State Forests of NSW, and a private consulting firm. He also has five years of volunteer work experience involved in biodiversity surveys all throughout NSW and Queensland, ranging from terrestrial fauna surveys, to marine mammal research and bush regeneration programs. His field experience covers a range of habitats in eastern Australia, to southern Queensland, as well as research work in the Republic of Vanuatu and Japan. Alex's experience covers all vertebrates and aspects of terrestrial ecology, but he is particularly interested in habitat and corridor design and ornithology. Previous research and consultancies have included contributions to the draft conservation plan to Vanuatu's National Conservation Strategy, weed and pest management plans, surveys for Species Impact Statements, Environmental Impact Assessments for local council and private developments and field research for government agencies.

Key Experience

- Flora and fauna assessment of routes options for electricity transmission easements at Riverstone, Liverpool and Schofields, Blacktown City Council. Integral Energy. Zoologist. Determined future options and constraints associated with the transmission easement options throughout bushland areas within close locality to Cumberland Plain Woodland and rural residential areas. Described existing fauna habitat conditions and potential impacts on threatened species.
- Preliminary ecological assessment for the proposed Bamarang gas turbine facilities at Nowra, South Coast. Delta Electricity. Zoologist. Conducted desktop studies and compared route options for the proposed gas connection pipeline and the turbine facility. Field investigations were conducted for inspection of potential fauna habitats for threatened species along an existing electricity transmission easement and surrounds.
- Flora and Fauna Assessment of Maroota sandmine, Baulkham Hills. PF Formations. Ecologist. Described existing fauna habitat conditions and conducted targeted surveys for threatened species within proposed mining areas.
- Flora and fauna assessment for proposed train support facilities at Thornton, Maitland. Queensland Rail. Zoologist. Determined the impacts of proposed train support facility to fauna habitats within an Endangered Ecological Community. Also conducted targeted surveys for threatened plants.
- Preliminary Flora and Fauna Assessment of Windale/Gateshead Wastewater Upgrade Management Plan; Lake Macquarie. Hunter Water. Zoologist. Determined options and constraints associated with terrestrial flora and fauna of a proposed upgrade of wastewater discharge system.
- Wingecaribee Weed Management Program. Ecologist. Sydney Catchment Authority. Conducted targeted surveys for the threatened Australasian Bittern, Giant Dragonfly and threatened species of plants.

- Flora and fauna assessment of the upgrade of naval training facilities at the RANSSSS HMAS Cresswell, Jervis Bay. Department of Defence. Zoologist. Determined future options and constraints associated with upgrading facilities, described fauna habitat conditions and impact assessments for the Eastern Bristlebird and the Green and Golden Bell Frog.

NICHOLAS CORKISH

Ecologist

Years of Experience

9 (6 months with PB, 9 years with others)

Education

Bachelor of Forest Science, University of Melbourne; Graduate Diploma in Science (Biological Science), University of Wollongong (currently enrolled)

Key Qualifications

Nick has the equivalent over nine fulltime years practical experience in biodiversity, soil and water conservation and management. Nick's experience covers a number of aspects of native vegetation resource use and conservation issues, especially of native forests, and he has particular knowledge of biodiversity survey and conservation management for threatened species.

A considerable portion of Nick's work has engaged him in assisting, conducting and managing a number of general or targeted surveys for both vegetation and vertebrate fauna. His field experience covers a range of habitats, primarily forests and woodlands, from coastal and tablelands areas of New South Wales and Victoria. Nick maintains particular interests in botany, plant ecology and fire ecology. Nick is experienced in the assessment and mitigation of impacts, especially from timber harvesting, clearing, roads, infrastructure development, prescribed burning and wildfires. He has comprehensive theoretical and practical understanding of the conservation significance of threatened flora, fauna and of wildlife habitat and is knowledgeable in application of Federal and State environmental legislation including the *Environment Protection and Biodiversity Conservation Act 1999*, the *Threatened Species Conservation Act 1995* and the *Environmental Planning and Assessment Act 1979*.

Key Experience

- Environmental Impact Statement for Augmentation of the North-west Sector Electricity Transmission Network, Riverstone (NW Sydney), NSW, Integral Energy. Assessed potential impacts of a number of route options on terrestrial flora and fauna and habitats, including endangered ecological communities of the Cumberland Plain. Survey for threatened flora and fauna and assessment of impacts of infrastructure proposed on preferred option.
- Environmental Impact Statement for Pacific Highway Upgrade, Bulahdelah Bypass, NSW, Roads and Traffic Authority. Assessed terrestrial flora and possible endangered ecological communities on floodplain and contributed to report on the likely impacts of the Pacific Highway Upgrade on terrestrial flora and fauna.
- Environmental Impact Statement for Waste Resource Recovery and Recycling Facility, Rutherford (Maitland), NSW, Transpacific Industries. Assessed the terrestrial flora and fauna and habitats and impacts of the proposed facilities on endangered ecological communities.
- Terrestrial Flora and Fauna Assessment of Proposed Gas Main Pipeline, Erskine Park (Western Sydney), NSW, Agility. Surveyed for threatened flora and fauna and assessed potential impacts on terrestrial flora and fauna and habitats, including endangered ecological communities of the Cumberland Plain.
- Terrestrial Flora and Fauna Assessment and Species Impact Statement of Proposed Bickham Coal Mine, Upper Hunter Valley, NSW, Bickham Coal Pty Ltd. Undertook and reported desktop studies, flora survey, vegetation community mapping (including definition and mapping of an endangered ecological community) and targeted terrestrial fauna surveys.

Appendix B

Accuracy of searched databases

Appendix B: Accuracy of searched databases

This appendix details the types of data obtained from the Department of Environment and Conservation Atlas of NSW Wildlife and the EPBC Protected Matter Search Tool and the accuracy of both datasets.

Atlas of NSW Wildlife

The Atlas of NSW Wildlife is based on records of specific sightings. Each point is entered on a one kilometre grid and hence location is only accurate to within one kilometre. The Atlas of NSW Wildlife is not based on systematic surveys across New South Wales and the number of records is generally biased towards coastal sites and areas where people commonly visit, such as National Parks. It is also biased towards particular species, reserves and roads.

Department of the Environment and Heritage Protected Matters Search Tool

The Department of the Environment and Heritage Protected Matters Search Tool is based on predicted distributions compiled from a number of sources at various resolutions. Generally, where distributions are well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and detailed habitat studies. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps. For species whose distributions are less well known, point locations are collated from various sources and bioclimatic distribution models generated and then validated by experts. In some cases, distribution maps are based solely on expert knowledge.

The following species and ecological communities have not been mapped and do not appear in reports produced from the EPBC database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- cetaceans which are not listed as threatened
- some terrestrial species that overfly the Commonwealth marine area;
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent.

Appendix C

Plants recorded on site

Appendix C: Plants recorded on site

This appendix details the plants recorded on site during the current surveys

Family	Scientific Name	Common Name	Native ¹
Anthericaceae	<i>Thysanotus tuberosus</i>	Common Fringe-lily	Y
Apiaceae	<i>Actinotus minor</i>	Lesser Flannel Flower	Y
	<i>Hydrocotyle bonariensis</i>		N
	<i>Hydrocotyle peduncularis</i>		Y
	<i>Platysace linearifolia</i>		Y
	<i>Trachymene incisa</i>		Y
	<i>Xanthosia tridentata</i>		Y
Asclepiadaceae	<i>Tylophora barbata</i>	Bearded Tylophora	Y
Asparagaceae	<i>Asparagus asparagoides</i>		N
Asphodelaceae	<i>Bulbine bulbosa</i>	Bulbine Lily	Y
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed	N
	<i>Bidens pilosa</i>	Cobbler's Pegs	N
	<i>Chrysanthemoides monilifera</i>		N
	<i>Conyza albida</i>	Tall Fleabane	N
	<i>Hypochaeris radicata</i>	Catsear	N
	<i>Senecio madagascariensis</i>	Fireweed	N
	<i>Tagetes minuta</i>	Stinking Roger	N
	<i>Taraxacum officinale</i>	Dandelion	N
Campanulaceae	<i>Wahlenbergia gracilentia</i>	Annual Bluebell	Y
Caryophyllaceae	<i>Stellaria graminea</i>		N
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black Sheoak	Y
Convolvulaceae	<i>Ipomoea cairica</i>		N
Cyperaceae	<i>Chorizandra cymbaria</i>		Y
	<i>Gahnia erythrocarpa</i>		Y
	<i>Lepidosperma laterale</i>		Y
	<i>Ptilothrix deusta</i>		Y
	<i>Schoenus brevifolius</i>		Y
	<i>Tetraria capillaris</i>		Y
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken	Y
Dilleniaceae	<i>Hibbertia aspera</i>		Y
Epacridaceae	<i>Epacris microphylla</i>		Y
	<i>Epacris pulchella</i>	NSW Coral Heath	Y
	<i>Leucopogon microphyllus</i>		Y
	<i>Styphelia triflora</i>		Y
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge	Y
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>		Y

Family	Scientific Name	Common Name	Native ¹
	<i>Dillwynia retorta</i>		Y
	<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea	Y
	<i>Hardenbergia violacea</i>	False Sarsaparilla	Y
	<i>Mirbelia rubifolia</i>		Y
	<i>Mirbelia speciosa</i>		Y
	<i>Pultenaea elliptica</i>		Y
	<i>Pultenaea villosa</i>		Y
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>	Sydney Golden Wattle	Y
	<i>Acacia myrtifolia</i>	Red-stemmed Wattle	Y
	<i>Acacia parramattensis</i>	Parramatta Wattle	Y
	<i>Acacia suaveolens</i>	Sweet Wattle	Y
	<i>Acacia terminalis</i>	Sunshine Wattle	Y
Goodeniaceae	<i>Dampiera stricta</i>		Y
	<i>Goodenia hederacea</i>		Y
	<i>Scaevola ramosissima</i>		Y
Haemodoraceae	<i>Haemodorum planifolium</i>		Y
Haloragaceae	<i>Gonocarpus teucrioides</i>		Y
Iridaceae	<i>Patersonia glabrata</i>		Y
	<i>Patersonia sericea</i>		Y
Juncaceae	<i>Juncus acutus</i>		N
Lauraceae	<i>Cassytha glabella</i>		Y
	<i>Cassytha pubescens</i>		Y
Lindsaeaceae	<i>Lindsaea linearis</i>	Screw Fern	Y
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot	Y
Lomandraceae	<i>Lomandra filiformis</i>		Y
	<i>Lomandra glauca</i>	Pale Mat-rush	Y
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Y
	<i>Lomandra obliqua</i>		Y
Loranthaceae	<i>Amyema sp.</i>		Y
Malvaceae	<i>Hibiscus sp.</i>		Y
Myrtaceae	<i>Angophora bakeri</i>	Narrow-leaved Apple	Y
	<i>Angophora costata</i>	Sydney Red/Rusty Gum	Y
	<i>Angophora floribunda</i>	Rough-barked Apple	Y
	<i>Angophora inopina</i>		Y
	<i>Baeckea linearis</i>		Y
	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush	Y
	<i>Callistemon rigidus</i>	Stiff Bottlebrush	Y
	<i>Callistemon salignus</i>	Willow Bottlebrush	Y
	<i>Corymbia gummifera</i>	Red Bloodwood	Y
	<i>Eucalyptus capitellata</i>	Brown Stringybark	Y
	<i>Eucalyptus haemastoma</i>	Broad-leaved Scribbly Gum	Y
	<i>Eucalyptus racemosa</i>	Narrow-leaved Scribbly Gum	Y
	<i>Eucalyptus umbra</i>		Y
	<i>Kunzea ambigua</i>	Tick Bush	Y

Family	Scientific Name	Common Name	Native ¹
	<i>Leptospermum juniperinum</i>		Y
	<i>Leptospermum polygalifolium</i>		Y
	<i>Leptospermum trinervium</i>		Y
	<i>Melaleuca nodosa</i>		Y
	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Y
	<i>Melaleuca sieberi</i>		Y
	<i>Melaleuca thymifolia</i>		Y
Philydraceae	<i>Philydrum lanuginosum</i>	Frogsmouth	Y
Phormiaceae	<i>Dianella caerulea</i>		Y
	<i>Dianella caerulea var. producta</i>		Y
	<i>Dianella revoluta</i>		Y
Pittosporaceae	<i>Billardiera scandens</i>	Appleberry	Y
	<i>Pittosporum undulatum</i>	Sweet Pittosporum	Y
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass	Y
	<i>Aristida warburgii</i>		Y
	<i>Austrodanthonia tenuior</i>		Y
	<i>Chloris virgata</i>	Feathertop Rhodes Grass	N
	<i>Cortaderia selloana</i>	Pampas Grass	N
	<i>Cynodon dactylon</i>	Common Couch	Y
	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass	Y
	<i>Entolasia stricta</i>	Wiry Panic	Y
	<i>Eragrostis curvula</i>	African Lovegrass	N
	<i>Imperata cylindrica</i>		Y
	<i>Microlaena stipoides</i>		Y
	<i>Panicum simile</i>	Two-colour Panic	Y
	<i>Paspalum distichum</i>	Water Couch	Y
	<i>Pennisetum clandestinum</i>	Kikuyu Grass	N
	<i>Phragmites australis</i>	Common Reed	Y
	<i>Setaria gracilis</i>	Slender Pigeon Grass	N
	<i>Stipa pubescens</i>		Y
	<i>Themeda australis</i>	Kangaroo Grass	Y
Polygalaceae	<i>Comesperma ericinum</i>		Y
	<i>Comesperma sphaerocarpum</i>		Y
Proteaceae	<i>Banksia oblongifolia</i>		Y
	<i>Banksia robur</i>		Y
	<i>Banksia serrata</i>		Y
	<i>Banksia spinulosa</i>		Y
	<i>Grevillea sericea</i>		Y
	<i>Hakea dactyloides</i>	Broad-leaved Hakea	Y
	<i>Hakea sericea</i>		Y
	<i>Hakea teretifolia</i>	Dagger Hakea	Y
	<i>Isopogon anemonifolius</i>		Y
	<i>Lambertia formosa</i>	Mountain Devil	Y
	<i>Persoonia lanceolata</i>		Y
	<i>Persoonia levis</i>	Broad-leaved Geebung	Y
	<i>Persoonia oblongata</i>		Y
	<i>Persoonia pinifolia</i>	Pine-leaved Geebung	Y
	<i>Petrophile pulchella</i>		Y
Ranunculaceae	<i>Ranunculus sp.</i>		Y

Family	Scientific Name	Common Name	Native ¹
Restionaceae	<i>Empodisma minus</i>		Y
	<i>Lepyrodia scariosa</i>		Y
	<i>Restio gracilis</i>		Y
Sapindaceae	<i>Dodonaea triquetra</i>		Y
Selaginellaceae	<i>Selaginella uliginosa</i>		Y
Stylidiaceae	<i>Stylidium graminifolium</i>	Grass Triggerplant	Y
Thymelaeaceae	<i>Pimelea linifolia</i>		Y
Typhaceae	<i>Typha domingensis</i>	Narrow-leaved Cumbungi	Y
Urticaceae	<i>Urtica incisa</i>	Stinging Nettle	Y
Verbenaceae	<i>Lantana camara</i>	Lantana	N
	<i>Verbena bonariensis</i>	Purpletop	N
	<i>Verbena rigida</i>	Veined Verbena	N
Violaceae	<i>Hybanthus monopetalus</i>	Slender Violet-bush	Y
Xanthorrhoeaceae	<i>Xanthorrhoea latifolia ssp. latifolia</i>		Y
Xyridaceae	<i>Xyris gracilis</i>		Y
	<i>Xyris sp.</i>		Y

Key: 1) N= No (introduced); Y= Yes (native)

Appendix D

Animals recorded on site

Appendix D: Animals recorded on site

This appendix details the animals recorded on site during the current and previous surveys.

Common Name	Scientific Name	Observation Type
Amphibians		
Lesueur's Frog	<i>Litoria lesueuri</i>	W
Striped Marsh Frog	<i>Limnodynastes peronii</i>	O
Eastern Banjo Frog	<i>Limnodynastes dumerillii</i>	W
Smooth Toadlet	<i>Uperoleia laevigata</i>	W
Reptiles		
Jacky Lizard	<i>Amphibolurus muricatus</i>	O
Robust Ctenotus	<i>Ctenotus robustus</i>	O
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	O
Garden Skink	<i>Lampropholis guichenoti</i>	O
Grass Skink	<i>Lampropholis delicata</i>	O
Native Birds		
Galah	<i>Cacatua roseicapilla</i>	O
Magpie Lark	<i>Grallina cyanoleuca</i>	O
Long-billed Corella	<i>Cacatua tenuirostris</i>	O
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	O
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	O
Dollarbird	<i>Eurystomus orientalis</i>	O
Australian Raven	<i>Corvus coronoides</i>	O
Willie Wagtail	<i>Rhipidura leucophrys</i>	O
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	O
Black-faced Cuckoo Shrike	<i>Coracina novaehollandiae</i>	O
Welcome Swallow	<i>Hirundo neoxena</i>	O
Superb Fairy-wren	<i>Malurus cyaneus</i>	O
Variiegated Fairy Wren	<i>Malurus lamberti</i>	O
Lewin's Honeyeater	<i>Meliphaga lewinii</i>	O
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>	O
White-browed Scrubwren	<i>Sericornis frontalis</i>	O
Yellow-throated Scrubwren	<i>Sericornis citreogularis</i>	O
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	O
Silvereye	<i>Zosterops lateralis</i>	O
Red-browed Finch	<i>Neochmia temporalis</i>	O
Little Wattlebird	<i>Anthochaera chrysoptera</i>	O
Brown thornbill	<i>Acanthiza pusilla</i>	O
Noisy Miner	<i>Manorina melanocephala</i>	O
Red Wattlebird	<i>Anthochaera carunculata</i>	O
Spotted Pardalote	<i>Pardalotus punctatus</i>	W
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	O
Eurasian Coot	<i>Fulica atra</i>	O
Purple Swamphen	<i>Porphyrio porphyrio</i>	O
Australian White Ibis	<i>Threskiornis molucca</i>	O
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	O
Wedge-tailed Eagle	<i>Aquila audax</i>	O
Australian Pelican	<i>Pelecanus conspicillatus</i>	O

Common Name	Scientific Name	Observation Type
Native Mammals		
Brown Antechinus	<i>Antechinus stuartii</i>	O
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O
Red-necked Wallaby	<i>Macropus rufogriseus</i>	O
Swamp Wallaby	<i>Wallabia bicolor</i>	O
Swamp Rat	<i>Rattus lutreolus</i>	O
Bush Rat	<i>Rattus fuscipes</i>	O
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	O
Introduced Mammals		
Goat (feral)	<i>Capra hircus</i>	P
Fox	<i>Vulpes vulpes</i>	O
Brown Hare	<i>Lepus capensis</i>	O
Rabbit	<i>Oryctolagus cuniculus</i>	O

Notes:

- O = Observed, P = Indirect Evidence, L = Literature, W= Heard call.

Appendix E

Threatened species of plant in the
local area

Appendix E: Threatened plants in the local area

This appendix details the threatened species of plant that have either been recorded in the local area, or that have the potential to occur, based on the NPWS Atlas of NSW Wildlife and the EPBC Protected Matters Search Tool.

Scientific Name (Common name)	TSC Act ¹	EPBC Act ²	ROTAP ³	Habitat	Potential habitat
<i>Acacia bynoeana</i> (Bynoe's Wattle)	E1	V	3V	Occurs south of Dora Creek-Morriset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (Harden 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with <i>Corymbia gummifera</i> , <i>Eucalyptus haemastoma</i> , <i>E. gummifera</i> , <i>E. parramattensis</i> , <i>E. sclerophylla</i> , <i>Banksia serrata</i> and <i>Angophora bakeri</i> (NSW National Parks and Wildlife Service 1999h).	Yes, but not recorded despite two targeted surveys
<i>Angophora inopina</i>	V	V		Restricted to the Charmhaven - Wyee area where it grows in open dry sclerophyll woodland of <i>Eucalyptus haemastoma</i> and <i>Corymbia gummifera</i> with a dense shrub understorey. Occurs on deep white sandy soils over sandstone, often with some gravelly laterite (Harden 2002; NSW Scientific Committee 1998c).	Yes, recorded
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	E1	V	3V	Occurs south of Swansea where it grows on clay loam or sandy soils (Harden 1993). Prefers low open forest with a heathy or sometimes grassy understorey (Bishop 2000).	No
<i>Callistemon linearifolius</i>	V		2Ri	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies (Fairley & Moore 2002; Harden 2002; Robinson 1994).	No
<i>Chamaesyce psammogeton</i>	E1			Occurs in coastal regions of NSW where it grows on sand dunes near the sea (Harden 2000).	No
<i>Cryptostylis hunteriana</i>	V	V	3V	Occurs mostly in coastal districts south of the Gibraltar Range where it grows in swamp-heath on sandy soils (Harden 1993).	Yes, but not recorded despite a targeted survey during its flowering period
<i>Diuris praecox</i>	V	V	2V	Occurs in coastal and near-coastal districts from Ourimbah to Nelson Bay where it grows in sclerophyll forest (Harden 1993) often on hilltops or slopes (Bishop 2000).	No
<i>Eucalyptus camfieldii</i> (Heart-leaved Stringybark)	V	V	2Vi	Occurs from Tomago to the Royal National Park where it grows in coastal shrub heath in sandy soils on sandstone (Harden 2002).	No
<i>Grevillea parviflora</i> <i>ssp. parviflora</i>	V	V		Mainly for the Prospect area (now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam area with a disjunct population near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998a).	Yes, but not recorded despite two targeted surveys
<i>Eucalyptus parramattensis</i> <i>ssp. parramattensis</i>	E2			Occurs from the upper Goulburn Valley to Hill Top where it grows in dry sclerophyll woodland on sandy soils (Harden 2002).	No. Easement slashed eucalypts selectively removed
<i>Melaleuca biconvexa</i>	V	V		Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area (NSW Scientific Committee 1998b). Grows in damp places, often near streams (Harden 2002).	No

Scientific Name (Common name)	TSC Act ¹	EPBC Act ²	ROTAP ³	Habitat	Potential habitat
<i>Syzygium paniculatum</i>	V	V	3Ri	Occurs between Buladelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002).	No
<i>Tetratheca juncea</i>	V	V	3Vi	Occurs in coastal districts from Buladelah to Port Macquarie where it grows in sandy, occasionally swampy heath and in dry sclerophyll forest (Harden 1992).	Yes, but not recorded despite two targeted surveys during its flowering period

1. V= Vulnerable, E1 = Endangered; E2= Endangered Population, E4 = Extinct (Threatened Species Conservation Act 1995);
2. V = Vulnerable, E = Endangered (Environment Protection and Biodiversity, X = Extinct Conservation Act 1999)
3. ROTAP (Rare or Threatened Australian Plants, Briggs and Leigh 1996) is a conservation rating for Australian plants.
Codes are:
 - 1 Species only known from one collection
 - 2 Species with a geographic range of less than 100km in Australia
 - 3 Species with a geographic range of more than 100km in Australia
 - X Species presumed extinct; no new collections for at least 50 years
 - E Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
 - V Vulnerable species at risk of long-term disappearance through continued depletion.
 - R Rare, but not currently considered to be endangered.
 - K Poorly known species that are suspected to be threatened.
 - C Known to be represented within a conserved area.
 - a At least 1,000 plants are known to occur within a conservation reserve(s).
 - i Less than 1,000 plants are known to occur within a conservation reserve(s).
 - The reserved population size is unknown.
 - t The total known population is reserved.
 - + The species has a natural occurrence overseas.

Appendix F

Threatened species of animal in the local area

Appendix F: Threatened species of animal in the local area

This appendix details the threatened and migratory species of animal that have either been recorded in the local area or that have the potential to occur based on the NSW Atlas of NSW Wildlife and the EPBC Protected Matters Search Tool.

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Amphibians						
Wallum Froglet	<i>Crinia tinnula</i>	V		Occurs along coast from south-eastern Queensland to Sydney. Mostly associated with swamps, dams and flooded roadside ditches, usually in heathland, where it is confined to acid, paperbark swamps of the 'wallum' country. Males call anytime of year. Breed in late winter (Anstis 2002).	Yes. Habitat is present within the Coastal Plains Scribbly Gum Woodland in the northern part of the study area.	Yes. Refer to Appendix G.
Green and Golden Bell Frog	<i>Litoria aurea</i>	E1	V	The Green and Golden Bell Frog inhabits marshes, dams and stream sides, particularly those containing bullrushes <i>Typha</i> spp. or spikerushes <i>Eleocharis</i> spp. Optimum habitat includes water bodies which are unshaded, free of predatory fish <i>Gambusia holbrooki</i> , have a grassy area nearby and diurnal sheltering sites available such as vegetation and/or rocks (NSW National Parks and Wildlife Service 1999g).	No suitable habitat for this species occurs in the study area.	No
Green Thighed Frog	<i>Litoria brevipalmata</i>	V		The species inhabits coastal forest and bushland from south-east QLD to Ourimbah NSW and breeding takes place only after heavy summer rains when calling males gather around temporary or semi-permanent ponds and flooded ditches. Egg masses are often laid in temporary ponds and their survival may depend on subsequent rains around grassy semi-permanent ponds in late spring and summer (Cogger 2000).	No suitable habitat for this species occurs in the study area.	No
Heath Frog	<i>Litoria littlejohni</i>	V	V	Distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern Victoria. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats (NSW Scientific Committee 2000).	No suitable habitat for this species occurs in the study area.	No
Giant Barred Frog	<i>Mixophyes iteratus</i>	E1	E	Terrestrial species which occurs in rainforests, antarctic beech or wet sclerophyll forests. Feeds on insects and smaller frogs (Cogger 2000). The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas (NSW Scientific Committee 1999b).	The species has not been recorded in the locality, and suitable habitat is not present in the study area.	No
Native Birds						

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Australasian Bittern	<i>Botaurus poeciloptilus</i>	V		Occurs in shallow, vegetated freshwater or brackish swamps. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Great Knot	<i>Calidris tenuirostris</i>	V	M	Generally a coastal species found on tidal mudflats and sandy ocean shores. A migratory species visiting Australian waters between September and March (Pizzey & Knight 1997).	No suitable habitat for this species occurs in the study area.	No
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V		Occurs in eucalypt woodland and forest with Casuarina/Allocasuarina spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key Allocasuarina species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garrett & Crowley 2000; NSW National Parks and Wildlife Service 1999i).	Yes. Although this species may occasionally use the Casuarina feed trees for foraging, the proposal would not significantly impact on foraging or nesting resources.	No
Lesser Sand Plover	<i>Charadrius mongolus</i>	V	M	Migratory bird that migrates from the northern hemisphere to coastal areas of northern and east coast of Australia (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Amsterdam Albatross	<i>Diomedea amsterdamensis</i>		EM	Breeds on Amsterdam Island and foraging mainly in the surrounding Indian Ocean, but possibly occurring as far a field as Tasmania and New Zealand. Breed biennially in colonies among grass tussocks (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Antipodean Albatross	<i>Diomedea antipodensis</i>	V	VM	A nomadic marine species that occasionally breeds off the coast of New South Wales (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Shy Albatross	<i>Diomedea cauta</i>	V	VM	An oceanic species that has been recorded off the coast of New South Wales (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Tristan Albatross	<i>Diomedea dabbona</i>		EM	Breeding range now restricted to Inaccessible and Gough Island., having been eliminated from the main island of Tristan de Cunha by 1907. Current global population estimated to contain about 1,000 breeding pairs. There is only one record from Australian waters. Breed biennially in colonies among grass tussocks on isolated subantarctic islands and feed pelagically on squid, fish and crustaceans (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
Wandering Albatross	<i>Diomedea exulans</i>	E1	VM	Nomadic marine species, that breeds in small loose colonies among grass tussocks, using a large mud nets, sometimes off the coast of NSW (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Gibson's Albatross	<i>Diomedea gibsoni</i>	V	VM	A nomadic marine species that forages off the coast of New South Wales (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E1		Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	V		Found on rocky shorelines where it forages on intertidal flats (Garrett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Pied Oystercatcher	<i>Haematopus longirostris</i>	V		Occurs in undisturbed beaches, sandpits, sandbars, tidal mudflats, estuaries and coastal islands. Occasionally found on rocky reefs, shores, rock stacks, brackish or saline wetlands and also in grassy paddocks, golf courses or parks near coast. Eggs are laid in shallow scrape in sand on open beach or among low growth behind beach (Pizzey & Knight 1997).	No suitable habitat for this species occurs in the study area.	No
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>		M	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 1997).	No. Habitat within the local areas would not be considered 'important habitat' as defined under the EPBC Act.	No
White-throated Needletail	<i>Hirundapus caudacutus</i>		M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 1997).	No. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
Black Bittern	<i>Ixobrychus flavicollis</i>	V		Occurs in vegetated wetlands and feeds on aquatic fauna along streams, in estuaries and beside billabongs and pools. It nests in trees (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Swift Parrot	<i>Lathamus discolor</i>	E1	EM	Occur in eucalypt forests and woodlands, particularly in box-ironbark forests. Prefer sites with flowering <i>Acacia pycnantha</i> or highly fertile soils where large trees have high nectar production (including drainage lines and isolated trees in rural or urban landscapes). Breeding occurs in Tasmania (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	V	M	A migratory species that breeds in the northern hemisphere between June and August. Individuals feed both on exposed mudflats and while wading in water (NSW National Parks and Wildlife Service 1999f).	No suitable habitat for this species occurs in the study area.	No
Black-tailed Godwit	<i>Limosa limosa</i>	V	M	A coastal species found on tidal mudflats, swamps, shallow river margins and sewage farms. Also found inland on larger shallow fresh or brackish waters. A migratory species visiting Australia between September and May (Pizzey & Knight 1997).	No suitable habitat for this species occurs in the study area.	No
Southern Giant-Petrel	<i>Macronectes giganteus</i>	E1	EM	A partly nomadic marine species that forages off the coast of New South Wales (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Northern Giant-Petrel	<i>Macronectes halli</i>	V	VM	Nomadic marine species, that nest as dispersed pairs, often amidst tussocks in dense vegetation. Forages in inshore waters of southern Australia and occasionally visits the coast of NSW (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Powerful Owl	<i>Ninox strenua</i>	V		A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	Yes- the species may use the habitats as a foraging area.	Yes. Refer to Appendix G.
Osprey	<i>Pandion haliaetus</i>	V	M	A coastal species it occurs in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers and far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey & Knight 1997).	No suitable habitat for this species occurs in the study area.	No
Gould's Petrel	<i>Pterodroma leucoptera</i>	E1	EM	A marine species, it nests on islands among rocks and debris of Cabbage Tree Palms. It feeds on fish, cephalopods and other marine animals (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Kermadec Petrel	<i>Pterodroma neglecta</i>	V	V	An oceanic species that forages in the tropical and subtropical pacific ocean (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V		Occurs in rainforests and fringes, scrubs, mangroves and wooded stream-margins, lantana thickets, isolated figs, pittosporums, lilly pillies and blackberries (Pizzey & Knight 1997).	No suitable habitat for this species occurs in the study area.	No
Painted Snipe	<i>Rostratula benghalensis</i>	E1	VM	Occurs in shallow, vegetated, temporary or infrequently filled wetlands. Sometimes found where there are Eucalyptus camaldulensis (River Red Gum), E. populnea (Poplar Box) or Muehlenbeckia florulenta (Lignum). Feeds at the water's edge and on mudflats on seeds and invertebrates such as insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Diamond Firetail	<i>Stagonopleura guttata</i>	V		Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Little Tern	<i>Sterna albifrons</i>	E1	M	A coastal species found along the coast of New South Wales. They nest between the high tide mark and shore vegetation on undisturbed and unvegetated sites near estuaries and adjacent freshwater lakes. They feed on fish taken from inshore waters (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Buller's Albatross	<i>Thalassarche bulleri</i>		VM	An oceanic species that has been recorded off the coast of New South Wales (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Cambells Albatross	<i>Thalassarche impavida</i>		VM	An oceanic species that has been recorded off the coast of New South Wales (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
Black-browed Albatross	<i>Thalassarche melanorhphs</i>		M	Nomadic marine species that breeds on subantartic island outside Australian waters, but moves northwards in non-breeding seasons. The waters off southern Australia between Brisbane and Perth are the principal feeding area of birds (Garnett & Crowley 2000).	No. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
Salvin's Albatross	<i>Thalassarche salvini</i>		VM	An oceanic species that has been recorded off the coast of New South Wales (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
White-capped Albatross	<i>Thalassarche steadi</i>		VM	An oceanic species that has been recorded off the coast of New South Wales (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.	No
Masked Owl	<i>Tyto novaehollandiae</i>	V		Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	Yes- the species may use the habitats as a foraging area.	Yes. Refer to Appendix G
Regent Honeyeater	<i>Xanthomyza phrygia</i>	E1	EM	Occur mostly in box-ironbark forests and woodland and prefer the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with <i>Casuarina cunninghamiana</i> and <i>Amyema cambagei</i> are important for feeding and breeding. Important food trees include <i>Eucalyptus sideroxylon</i> (Mugga Ironbark), <i>E. albens</i> (White Box), <i>E. melliodora</i> (Yellow Box) and <i>E. leucoxylon</i> (Yellow Gum). This species usually lays 2-3 eggs in cup nests (Garnett & Crowley 2000).	No suitable habitat for this species occurs in the study area.	No
Native Mammals						
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	No suitable habitat for this species occurs in the study area.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	Occurs in sclerophyll forests and rainforests. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999c).	No suitable habitat for this species occurs in the study area.	No
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V		Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings (Churchill 1998).	No suitable habitat for this species occurs in the study area.	No
Southern Brown Bandicoot	<i>Isoodon obesulus</i>	E1	E	Occurs in a variety of habitats in south-eastern Australia, including heathland, shrubland, dry sclerophyll forest with heathy understorey, sedgeland and woodland. Many of the habitats are prone to fire (NSW National Parks and Wildlife Service 1999e).	No suitable habitat for this species occurs in the study area.	No
Little Bent-wing Bat	<i>Miniopterus australis</i>	V		Feeds on small insects beneath the canopy of well timbered habitats including rainforest, Melaleuca swamps and dry sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan 1995).	The species may use the habitats in the study area for marginal foraging, however important roosting and nursery sites are not present in the study area.	Yes. Refer to Appendix G
Eastern Bent-wing Bat	<i>Miniopterus schreibersii</i>	V	C	Usually found in well timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 1998).	Yes, the species may use the habitats in the study area for foraging and roosting.	No
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V		Thought to live in sclerophyll forest and woodland. Small colonies have been found in tree hollows or under loose bark. It feeds on insects above the forest canopy or in clearings at the forest edge (Churchill 1998).	Yes, the species may use the habitats in the study area for foraging and roosting.	No
Large-footed Myotis	<i>Myotis adversus</i>	V		Colonies occur in caves, mines, tunnels, under bridges and buildings. Colonies always occur close to bodies of water where this species feeds on aquatic insects (Churchill 1998).	The species may use the habitats in the study area for marginal foraging, however important roosting habitats are not present in the study area.	No
Yellow-bellied Glider	<i>Petaurus australis</i>	V		Restricted to tall, mature eucalypt forest in high rainfall areas of temperate to sub-tropical eastern Australia. Feeds on nectar, pollen, the sap of eucalypts and sometimes insects. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round food resources are available from a mixture of eucalypt species (NSW National Parks and Wildlife Service 1999d, 2003a).	No suitable habitat for this species occurs in the study area.	No
Squirrel Glider	<i>Petaurus norfolcensis</i>	V		Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999a).	Yes- within Coastal Plains Scribbly Gum Woodland. Refer to Appendix G.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	E1	V	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or 'colonies' each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003b).	No suitable habitat for this species occurs in the study area.	No
Koala	<i>Phascolarctos cinereus</i>	V		Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum <i>Eucalyptus tereticornis</i> , Grey Gum <i>E. punctata</i> , Monkey Gum <i>E. cypellocarpa</i> and Ribbon Gum <i>E. viminalis</i> . In coastal areas, Tallowwood <i>E. microcorys</i> and Swamp Mahogany <i>E. robusta</i> are important food species, while in inland areas White Box <i>E. albens</i> , Bimble Box <i>E. populnea</i> and River Red Gum <i>E. camaldulensis</i> are favoured (NSW National Parks and Wildlife Service 1999b, 2003c).	No suitable habitat including feed trees are abundant in the study area.	No- SEPP 44 Koala Habitat Protection has been addressed in Section 4.2.8
Common Planigale	<i>Planigale maculata</i>	V		Occurs in a range of habitats from rainforest, sclerophyll forest, grasslands, marshlands and rocky areas, usually where there is ground cover and close to water (NSW National Parks and Wildlife Service 2002a). Builds small saucer-shaped nests of grass and bark (Strahan 1995)	No suitable habitat for this species occurs in the study area.	No
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V	V	It occurs within coastal heath and sclerophyll forests generally in areas with rainfall greater than 760 millimetres. Relatively thick ground cover is a major habitat requirement and it seems to prefer areas with light sandy soils. Feeds at dusk on roots, tubers, fungi, insects and their larvae and other soft bodied animals in the soil (Johnston 1995).	No suitable habitat for this species occurs in the study area.	No
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 1998; NSW National Parks and Wildlife Service 2001).	The species may use the habitats for marginal foraging, however, there no camps in the study area.	No
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	V		Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 1998).	Yes, the species may use the habitats in the study area for foraging and roosting.	No

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat	Potential habitat	Impact Assessment Required
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V		The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 1998).	Yes, the species may use the habitats in the study area for foraging and roosting.	No
Eastern Chestnut Mouse	<i>Pseudomys gracilicaudatus</i>	V		The species is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again (Strahan 1995).	No suitable habitat for this species occurs in the study area.	No
Reptiles						
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	E1	V	A nocturnal species that occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb, J.K. & Shine 1994; Webb, J.K & Shine 1998).	No suitable habitat for this species occurs in the study area.	No

Notes:

1. V= Vulnerable, E1 = Endangered (*Threatened Species Conservation Act 1995*)
2. V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (*Environment Protection and Biodiversity Conservation Act 1999*).
3. Actual is taken to be when the species is recorded on site. Likely is when there is a real chance or probability of the species occurring based on the habitat present.

Appendix G

Impact significance assessments

Appendix G: Impact assessments

This appendix details the significance assessments carried out for threatened and migratory species, populations and communities with potential habitat on site as required under the *TSC Act* (Eight Part Tests) or under the significance administrative guidelines of the *EPBC Act*.

Swamp Sclerophyll Forest on Coastal Floodplains

Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an Endangered Ecological Community under the *TSC Act*.

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

Not applicable

b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable

c) In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Within New South Wales it is estimated that there is less than 30 percent of the original extent of coastal floodplain wetlands (which includes swamp sclerophyll forest) remaining. Within the lower hunter and central coast region, less than 7000 hectares was estimated to be remaining (NSW National Parks and Wildlife Service 2000a). The proposal would require approximately 0.2 hectares of Swamp Sclerophyll Forest to be cleared. However, the proposal is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. The removal of 0.2 hectares of highly modified Swamp Sclerophyll Forest is not considered to be significant area.

d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Approximately 0.2 hectares of highly modified Swamp Sclerophyll Forest will be cleared. However, the proposed development is restricted to the existing electricity easement and would not result in further isolation of this community.

e) Whether critical habitat will be affected

Critical habitat is listed under the *TSC Act* and the Director General of the New South Wales Department of Environment and Conservation maintains a register of such habitat. Critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the

survival of the species, population or ecological community (NSW National Parks and Wildlife Service 1996a).

Critical habitat has not been listed for swamp sclerophyll forest and the site is unlikely to be critical for the survival of the community.

f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Small areas of Swamp Sclerophyll Forest occur within conservation reserves including: Bungawalbin, Tuckean and Moonee Beach Nature Reserves and Hat Head, Crowdy Bay, Willingat, Myall Lakes and Garigal National Parks. However, these conservation reserves are unevenly scattered across the range of the community and are unlikely to represent the full diversity of the community. This community is unlikely to be adequately represented within conservation reserves.

g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Key Threatening Process are listed in Schedule 3 of the *TSC Act*. Swamp sclerophyll forest is subject to a number of key threatening processes as well as other threats (*Table G 1*).

The proposed development would include clearing of native vegetation which is listed as a key threatening process under the *TSC Act*. Approximately 0.2 hectares of highly modified Swamp Sclerophyll Forest would be cleared from a maintained electricity easement.

Table G 1: Recognised threats for Swamp Sclerophyll Forest

Threat to community	Key Threatening Process	Threat likely to increase as a result of the proposal
Clearing of Native Vegetation	Yes	Yes
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	Yes	No
Weed invasion, particularly by exotic perennial grasses	Yes	No, mitigation measures provided
Predation, habitat destruction, competition and disease transmission by feral pigs	Yes	No
Anthropogenic climate change	Yes	No
High frequency fire	Yes	No
Removal of dead wood and dead trees	Yes	No
Fragmentation and degradation	No	No
Landfilling and earthworks associated with urban and industrial developments	No	No
Pollution from urban and agricultural runoff	No	No
Trampling and other soil disturbance by domestic livestock and feral animals including pigs	No	No
Increasing acid sulfate content of soils	No	No
Rubbish dumping	No	No
Hydrological changes in patterns of flooding and drainage following flood mitigation and drainage works, particularly the construction of drains, levees and flood gates	No	No

h) Whether any threatened species, population or ecological community is at the limit of its known distribution

Swamp Sclerophyll Forest is found along the New South Wales coast within the NSW North Coast, Sydney Basin and South East Corner Bioregions. The site is not at the limits of its distribution.

Conclusion

The proposed development will require the clearing of approximately 0.2 hectares of poor condition vegetation. The proposed development is unlikely to have a significant impact on this community.

Acacia bynoeana- Bynoe's Wattle

Acacia bynoeana is listed as endangered on the *TSC Act* and as vulnerable on the *EPBC Act*. This species was not recorded within the site but potential habitat for this species occurs within Coastal Plains Scribbly Gum Woodland and adjacent easements.

Acacia bynoeana is a small shrub to one meter high which produces golden yellow flowers from September until March.

Threatened Species Conservation Act 1995

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

Acacia bynoeana was not recorded within the site. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Habitat disturbance including easement maintenance activities is a recognised threat for this species (NSW National Parks and Wildlife Service 1999h) and as such the easement is unlikely to support a viable population.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Acacia bynoeana is listed as an endangered species and as such cannot be listed as an endangered population under the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Acacia bynoeana occurs in heath and dry sclerophyll forest including Sydney Sandstone Ridgetop Woodlands, Castlereagh Woodlands (particularly Castlereagh Scribbly Gum Woodlands) (James 1997), Exposed Hawkesbury Woodland and Coastal Plains Scribbly Gum Woodland (NSW National Parks and Wildlife Service 1999h). Potential habitat for this species is extensive within the region.

Acacia bynoeana was not recorded within the site. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Habitat disturbance including easement maintenance activities is a recognised threat for

this species (NSW National Parks and Wildlife Service 1999h) and as such this area provides only limited potential habitat for this species. The proposed development would not modify a significant area of habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed development is restricted to an existing maintained electricity easement and existing access track or immediately adjacent vegetation and would not result in isolation of currently interconnecting or proximate areas of habitat for this species.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. No critical habitat has been listed for *Acacia bynoeana*.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

This species occurs in Sydney Basin and South Eastern Highlands Bioregions. It is known from approximately 30 locations, only a few of these occur within conservation reserves including Marramarra National Park, Castlereagh Nature Reserve, Lake Macquarie State Recreation Area, Blue Mountains National Park (NSW Scientific Committee 1999a), Royal National Park and Tarlo River National Park (Department of Environment and Heritage 2004). This species is unlikely to be adequately represented in conservation reserves within the region.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key Threatening Processes are listed under the *TSC Act*. The proposal will include clearing of native vegetation (a key threatening process) and other recognised threats such as increased weed invasion and habitat disturbance.

Table G 2: Threats to *Acacia bynoeana*

Threat ¹	Key Threatening Process ²	Development likely to increase threat
Habitat disturbance (including road, trail and powerline maintenance; recreational vehicle use)	No	Yes
Native vegetation clearing	Yes	Yes
Weed invasion	No	Yes
Too frequent fire	Yes	No
Fragmentation	No	No
Small population size	No	Unlikely
Proximity of urbanisation	No	No

1) Department of Environment and Heritage, 2004 #391; NSW National Parks and Wildlife Service, 1999 #61}

2) listed on the *TSC Act* as a key threatening process

Whether any threatened species, population or ecological community is at the limit of its known distribution

Acacia bynoeana occurs in Sydney Basin and South Eastern Highlands Bioregions from Kurri Kurri to Nowra and west to Lithgow. The site is not at the limit of distribution of *Acacia bynoeana*.

Environment Protection and Biodiversity Conservation Act 1999

Important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity
- at or near the limit of the species range.

Acacia bynoeana was not recorded within the site. If the site contained a population of *Acacia bynoeana*, this population would be unlikely to be an important population due to the regular disturbance of habitat within the site through easement maintenance activities including slashing and mowing.

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

The site is unlikely to support an important population.

Is the action likely to reduce the area of occupancy of an important population?

The site is unlikely to support an important population.

Is the action likely to fragment an existing important population into two or more populations?

The site is unlikely to support an important population.

Is the action likely to adversely affect habitat critical to the survival of a species?

Acacia bynoeana was not recorded within the site and the proposed development is restricted to an existing electricity easement which is subject to ongoing disturbance due to maintenance activities. This area is unlikely to be critical to the survival of *Acacia bynoeana*.

Is the action likely to disrupt the breeding cycle of an important population?

The site is unlikely to support an important population.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Acacia bynoeana was not recorded and the site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal would include the disturbance of limited habitat but this is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The development is proposed for an area, which although regularly disturbed, currently has a very low incidence of weeds. Mitigation measures have been provided to minimise the spread of weeds during construction.

Is the action likely to interfere substantially with the recovery of the species?

Acacia bynoeana was not recorded and the site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal is unlikely to substantially interfere with the recovery of *Acacia bynoeana*.

Conclusion

Acacia bynoeana was not recorded within the site. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Habitat disturbance including easement maintenance activities is a recognised threat for this species and as such the easement is unlikely to support a viable population. The proposed development is unlikely to significantly impact *Acacia bynoeana* or interfere with its recovery.

Angophora inopina

Angophora inopina is listed as vulnerable on the *TSC Act* and the *EPBC Act*. This species was recorded at three locations within the easement. Within the easement plants were less than two metres tall with the majority less than one metre. Mature individuals were also observed in the woodlands to the south of the easement.

Angophora inopina is a small tree to eight metres tall. This species has a restricted distribution and occurs within the Wallarah catchment between Charmhaven and Wyee where it grows on deep white sandy soils over sandstone in open dry sclerophyll woodland of *Eucalyptus haemastoma* and *Corymbia gummifera*.

Threatened Species Conservation Act 1995**In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction**

Angophora inopina was recorded within the easement near Charmhaven and also in the western section of the site. The vegetation within the easement is regularly maintained through slashing and selective removal of tall vegetation. Only immature individuals were recorded (less than two metres tall) and the site is unlikely to contain a significant seedbank as seeds are short-lived and seed dispersal is limited (Tierney 2004). Only individuals greater than two metres have been observed to set seed and it has been estimated that a minimum of 15 years is required for reproductive maturity (Tierney 2004). Due to regular maintenance, the easement is unlikely to contain a viable population of this species.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No population of *Angophora inopina* is listed as Vulnerable under the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Angophora inopina is restricted to the Sydney Basin bioregion (central coast botanical district) where it occurs within the Wallarah catchment between Charmhaven and Wyee where it grows on deep white sandy soils over sandstone in open dry sclerophyll woodland of *Eucalyptus haemastoma* and *Corymbia gummifera* (NSW Scientific Committee 1998c).

The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing and as such this area provides only limited potential habitat for this species. There is estimated to be approximately 40,120 hectares of habitat within the region (Bell 2004). The proposed development would include the disturbance of 10.5 hectares of modified habitat and this is not a significant area of habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed development is restricted to an existing maintained electricity easement and existing access track or immediately adjacent vegetation and would not result in isolation of currently interconnecting or proximate areas of habitat for this species.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. No critical habitat has been listed for *Angophora inopina*.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

This species has been recorded within Karuah Nature Reserve, Lake Macquarie State Conservation Area (NSW Scientific Committee 1998c) and Wallaroo Nature Reserve (Bell 2004). However population numbers within these reserves are not known. This species has also been recorded within Wallaroo and Medowie State Forests however, the future management of these area is not known (NSW Scientific Committee 1998c). Only 1655 hectares out of a total of 40120 hectares of habitat (or 4per cent) occurs within conservation reserves (Bell 2004). *Angophora inopina* is unlikely to be adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key Threatening Processes are listed under the *TSC Act*.

Table G 3: Threats to *Angophora inopina*

Threat ¹	Key Threatening Process ²	Development likely to increase threat
Development	No	Yes
Native vegetation clearing	Yes	Yes
Weed invasion, particularly by exotic perennial grasses	Yes	No, mitigation measures provided
Too frequent fire	Yes	No
Habitat loss and fragmentation particularly from residential and industrial developments	No	No
Direct impacts on plants and habitat degradation from grazing and trampling by animals, illegal waste disposal and grassy weeds such as <i>Andropogon virginicus</i>	No	No
Changes to watertable and hydrological processes, due to residential and industrial developments and mining subsidence	Yes	No

1) (Bell 2004; NSW Scientific Committee 1998c; Tierney 2004)

2) listed on the *TSC Act* as a key threatening process

The proposed development will include the clearing of native vegetation which is listed as a Key Threatening Processes under the *TSC Act*.

Whether any threatened species, population or ecological community is at the limit of its known distribution

Angophora inopina is endemic to NSW where it is restricted to the Central Coast botanical subdivisions where it occurs in the Charmhaven to Wyee region (NSW Scientific Committee 1998c). The site is near the southern limit of distribution of this species.

Environment Protection and Biodiversity Conservation Act 1999

Important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity
- at or near the limit of the species range.

Angophora inopina was recorded within the site within a maintained easement. This population would be unlikely to be an important population due to the regular disturbance of habitat within the site through easement maintenance activities including slashing and mowing.

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

The site is unlikely to support an important population.

Is the action likely to reduce the area of occupancy of an important population?

The site is unlikely to support an important population.

Is the action likely to fragment an existing important population into two or more populations?

The site is unlikely to support an important population.

Is the action likely to adversely affect habitat critical to the survival of a species?

The proposed development is restricted to an existing electricity easement which is subject to ongoing disturbance due to maintenance activities. This area is unlikely to support a viable population of this species and is therefore unlikely to be critical to the survival of *Angophora inopina*.

Is the action likely to disrupt the breeding cycle of an important population?

The site is unlikely to support an important population.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal would include the disturbance of limited habitat but this is unlikely to result in a significant decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The development is proposed for an area, which although regularly disturbed, currently has a very low incidence of weeds. Mitigation measures have been provided to minimise the spread of weeds during construction.

Is the action likely to interfere substantially with the recovery of the species?

The site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal is unlikely to substantially interfere with the recovery of *Angophora inopina*.

Conclusion

The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing and this area would not support a viable population of this species. The proposed development is unlikely to significantly impact *Angophora inopina* or interfere with its recovery.

Cryptostylis hunteriana

Potential habitat occurs within the study site for *Cryptostylis hunteriana*, listed as Vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995*.

Cryptostylis hunteriana is a leafless terrestrial orchid that flowers from December to February when it produces an erect inflorescence (15-45 centimetres tall) with 5 to 10 maroon, black and green flowers. It occurs mostly in coastal districts south of the Gibraltar Range where it grows in swamp-heath on sandy soils (Bishop 2000, Harden 1993).

Targeted surveys, undertaken in December, during its flowering period failed to detect this species.

Threatened Species Conservation Act 1995

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

Cryptostylis hunteriana has not been recorded within the easement. The vegetation within the easement is regularly maintained through slashing, mowing and is also subject to disturbance through grazing and track creation. Due to this ongoing maintenance and disturbance the easement is unlikely to contain a viable population of this species.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No population of *Cryptostylis hunteriana* is listed as Vulnerable under the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Cryptostylis hunteriana occurs mostly in coastal districts south of the Gibraltar Range where it grows in swamp-heath on sandy soils (Harden 1993). In the central coast region it is also known to occur within scribbly gum woodland and smooth-barked apple woodland (Bell 2001).

The proposed development is largely restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing and as such this area provides only limited potential habitat for this species. Approximately 37,000 hectares of potential habitat is estimated to occur within lower Hunter Valley and central coast area (approximately 10 per cent of the extant vegetation) (Bell 2001). The proposed development would include the disturbance of approximately 10.5 hectares of marginal habitat and this is unlikely to be a significant area of habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed development is restricted to an existing maintained electricity easement and existing access track or immediately adjacent vegetation and would not result in isolation of currently interconnecting or proximate areas of habitat for this species.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. No critical habitat has been listed for *Cryptostylis hunteriana*.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Only one population of unknown size has ever been recorded in a conservation reserve, in 1954 from Ku-Ring-Gai National Park (Bell 2001). This species is unlikely to be adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key Threatening Processes are listed under the *TSC Act*.

A number of threats have been identified for this species (*Table G 4*). The proposed development will include the clearing of native vegetation which is listed as a Key Threatening Processes under the *TSC Act*.

Table G 4: Threats to *Cryptostylis hunteriana*

Threat ¹	Key Threatening Process ²	Development likely to increase threat
Drainage of swamps	No	No
Native vegetation clearing	Yes	Yes
Weed invasion	Yes	No, mitigation measures provided
Altered fire regime	Yes	No
Unscrupulous collection	No	No
Loss of habitat for its pollinator (a native wasp)	No	No

1) (Bell 2001) }

2) listed on the *TSC Act* as a key threatening process

Whether any threatened species, population or ecological community is at the limit of its known distribution

Cryptostylis hunteriana occurs in NSW and Victoria in coastal districts south of the Gibraltar Range. The site is not near the limit of distribution of this species.

Environment Protection and Biodiversity Conservation Act 1999

A population of *Cryptostylis hunteriana* that may occur within the development footprint would not be considered an important population because:

- it is unlikely to be key source populations either for breeding or dispersal
- it is unlikely to be necessary for maintaining genetic diversity
- the study site is not at or near the limit of the species range.

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

If present within the study area then a population of *Cryptostylis hunteriana* would not be considered an important population.

Is the action likely to reduce the area of occupancy of an important population?

If present within the study area then a population of *Cryptostylis hunteriana* would not be considered an important population.

Is the action likely to fragment an existing important population into two or more populations?

If present within the study area then a population of *Cryptostylis hunteriana* would not be considered an important population.

Is the action likely to adversely affect habitat critical to the survival of a species?

The Department of the Environment and Heritage and the Department of Environment and Conservation maintain registers of Critical this habitat. Critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community. No critical habitat has been listed for this species.

Is the action likely to disrupt the breeding cycle of an important population?

The study site is not considered to contain an important population of *Cryptostylis hunteriana*.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The development footprint is small and is largely restricted to cleared areas, maintained easement and existing access tracks. *Cryptostylis hunteriana* is unlikely to occur within the previously cleared areas and the electricity easement would provide only marginal habitat for this species. The proposed development is unlikely to decrease the availability or quality of the habitat to the extent that the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

Weed invasion within the site is very low and is largely restricted to areas that have been previously cleared. No weeds were recorded within intact vegetation. The proposed development will be

largely restricted to areas that have already been previously cleared or highly modified and are likely to remove some of the existing weeds within these areas. Due to the resilience of the intact vegetation, the proposed development is unlikely to result in the establishment of weeds.

Is the action likely to interfere substantially with the recovery of the species?

The development footprint is small and is largely restricted to previously cleared and highly modified areas. *Cryptostylis hunteriana* is considered unlikely to occur within the previously cleared areas and the electricity easement would provide only marginal habitat for this species. The proposed development is unlikely to remove any individuals of this species or have a significant impact on potential habitat for this species.

Conclusion

Based on the above assessment, *Cryptostylis hunteriana* is unlikely to be significantly impacted by the development activity.

Grevillea parviflora* ssp. *parviflora

Grevillea parviflora ssp. *parviflora* is listed as a vulnerable species under the *TSC Act* and the *EPBC Act*. This species was not recorded, however, the site provides potential habitat for this species. Impact assessments are provided below as a precaution.

Threatened Species Conservation Act 1995

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

Grevillea parviflora ssp. *parviflora* has not been recorded within the site and it is considered unlikely that this species would have remained undetected if a viable population were present within the footprint.

The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Maintenance of easement s is a recognised threat for this species (NSW National Parks and Wildlife Service 2002d) and as such the easement is unlikely to support a viable population.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No population of *Grevillea parviflora* ssp. *parviflora* is listed as Endangered under Schedule 1, Part 2 of the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Grevillea parviflora ssp. *parviflora* occurs in the Sydney Basin bioregion (north coast and central coast botanical subdivisions) from the Lower Hunter to Appin. It grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998a). Habitat for this species includes a range of communities including endangered ecological communities such as Shale Sandstone Transition Forest; Kurri Sand Swamp Woodland and Castlereagh Ironbark Woodland; as well as common communities such as Sydney Sandstone Ridgetop Woodland (NSW National Parks and Wildlife Service 2002d). Habitat for this species is likely to be well represented in conservation reserves.

The site is unlikely to support a viable population due to ongoing maintenance activities. The disturbance of 10.5 hectares of marginal habitat is not considered to be a significant area.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed development is restricted to an existing maintained electricity easement and existing access track or immediately adjacent vegetation and would not result in isolation of currently interconnecting or proximate areas of habitat for this species.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. No critical habitat has been listed for *Grevillea parviflora* ssp. *parviflora*.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Grevillea parviflora ssp. *parviflora* is only known from Werakata National Park in the Lower Hunter (NSW National Parks and Wildlife Service 2002d). This species is unlikely to be adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key Threatening Processes are listed under the *TSC Act*.

A number of threats have been identified for this species (*Table G 5*). The proposed development will include the clearing of native vegetation which is listed as a Key Threatening Processes under the *TSC Act*. The proposed development may also involve other threats including easement maintenance works and road widening.

Table G 5: Threats to *Grevillea parviflora* ssp. *parviflora*

Threat ¹	Key Threatening Process ²	Development likely to increase threat
Clearing of native vegetation	Yes	Yes
Fragmentation	No	No
Direct loss of plants	No	No
Road widening and maintenance works	No	Yes
Maintenance of transmission line and gas pipeline easements	No	No
Alteration in fire regime	Yes	No
Rubbish dumping	No	No
Recreational activities, particularly trail bikes	No	No
Weed invasion	No	No, Mitigation measures provided
Dense growth (particularly of <i>Kunzea ambigua</i> or <i>Imperata cylindrica</i>)	No	No

1) (NSW National Parks and Wildlife Service 2002d)

2) listed on the *TSC Act* as a key threatening process

Whether any threatened species, population or ecological community is at the limit of its known distribution

Grevillea parviflora ssp. *parviflora* is endemic to NSW and has a widespread but sporadic distribution. Its main occurrence is in the Appin, Wedderburn, Picton, Bargo districts where it is associated within the Nepean and Georges Rivers. It also occurs as disjunct population in the Lower Hunter Valley where it occurs in the Kurri Kurri- Heddon Greta region as well as on the western shores of Lake Macquarie with the northern limit of distribution at Karuah (NSW National Parks and Wildlife Service 2002d). The site is not at the limit of distribution of this species.

Environment Protection and Biodiversity Conservation Act 1999

Important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity
- at or near the limit of the species range.

Grevillea parviflora ssp. *parviflora* was not recorded within the site. If the site contained a population of *Grevillea parviflora* ssp. *parviflora*, this population would be unlikely to be an important population due to the regular disturbance of habitat within the site through easement maintenance activities including slashing and mowing.

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

The site is unlikely to support an important population.

Is the action likely to reduce the area of occupancy of an important population?

The site is unlikely to support an important population.

Is the action likely to fragment an existing important population into two or more populations?

The site is unlikely to support an important population.

Is the action likely to adversely affect habitat critical to the survival of a species?

Grevillea parviflora ssp. *parviflora* was not recorded within the site and the proposed development is restricted to an existing electricity easement which is subject to ongoing disturbance due to maintenance activities. This area is unlikely to be critical to the survival of *Grevillea parviflora* ssp. *parviflora*.

Is the action likely to disrupt the breeding cycle of an important population?

The site is unlikely to support an important population.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Grevillea parviflora ssp. *parviflora* was not recorded and the site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal would include the disturbance of limited habitat but this is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The development is proposed for an area, which although regularly disturbed, currently has a very low incidence of weeds. Mitigation measures have been provided to minimise the spread of weeds during construction.

Is the action likely to interfere substantially with the recovery of the species?

Grevillea parviflora ssp. *parviflora* was not recorded and the site is unlikely to support a viable population due to regular habitat disturbance due to easement maintenance activities. The proposal is unlikely to substantially interfere with the recovery of *Grevillea parviflora* ssp. *parviflora*.

Conclusion

Grevillea parviflora ssp. *parviflora* was not recorded within the site. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Habitat disturbance including easement maintenance activities is a recognised threat for this species and as such the easement is unlikely to support a viable population. The proposed development is unlikely to significantly impact *Grevillea parviflora* ssp. *parviflora* or interfere with its recovery.

Tetratheca juncea

Tetratheca juncea is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species is also listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* and has a conservation rating of 3Vi (Briggs & Leigh 1996).

Tetratheca juncea was not recorded within the site despite two targeted surveys during its flowering period undertaken in August and December 2005. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Destruction of overstorey species resulting in an increase light penetration and changed growing conditions is a recognised threat for this species (NSW National Parks and Wildlife Service 2000d). The site is therefore unlikely to support a viable population.

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

Tetratheca juncea has not been recorded within the site despite a targeted survey during its flowering period. Destruction of overstorey species resulting in an increase light penetration and changed growing conditions is a recognised threat for this species (NSW National Parks and Wildlife Service 2000d). The site is therefore unlikely to support a viable population. The proposal is unlikely to disrupt the lifecycle of a viable population of this species such that the species is placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

An endangered population is defined under the *Threatened Species Conservation Act 1995* as 'a population specified in Part 2 of Schedule 1'. At the present time, there are no endangered populations of this species listed under the Act.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Tetratheca juncea has not been recorded within the site despite a targeted survey during its flowering period. The proposed development is largely restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. As such this area provides only limited potential habitat for this species. Approximately 37,000 hectares of potential habitat is estimated to occur within lower Hunter Valley and central coast area (approximately 10 per cent of the extant vegetation) (NSW National Parks and Wildlife Service 2000b). The proposed development would include the disturbance of approximately 10.5 hectares of habitat and this is not a significant area of habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed development is restricted to an existing maintained electricity easement and existing access track or immediately adjacent vegetation and would not result in isolation of currently interconnecting or proximate areas of habitat for this species.

Whether critical habitat will be affected.

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Tetratheca juncea is known from Awabakal Nature Reserve, Glenrock State Recreation Area, Lake Macquarie Recreation Area, and Munmorah State Recreation Area. These reserves are concentrated along the eastern edge of the species' current range (NSW National Parks and Wildlife Service 2000d). This species is unlikely to be adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key Threatening Processes are listed under the *TSC Act*.

A number of threats have been identified for this species (*Table G 6*). The proposed development will include the clearing of native vegetation which is listed as a Key Threatening Processes under the *TSC Act*.

Table G 6: Threats to *Tetratheca juncea*

Threat ¹	Key Threatening Process ²	Development likely to increase threat
Clearing of native vegetation	Yes	Yes
Frequent fire which promote a dense understorey of <i>Imperata cylindrica</i> and <i>Pteridium esculentum</i> that exclude <i>T. juncea</i>	Yes	No
Slow cool fires are also known to destroy roots and kill individuals	Yes	No
Weed invasion near urban development	No	No
Destruction of overstorey species resulting in an increase light penetration, promotion of weed growth and changed growing conditions	No	No

1) (NSW National Parks and Wildlife Service 2000d, 2000c)

2) listed on the *TSC Act* as a key threatening process

Whether any threatened species, population or ecological community is at the limit of its known distribution.

Tetratheca juncea is endemic to NSW where it is restricted to the northern portion of the Sydney Basin Bioregion and the southern portion of the north coast Bioregion. It is known to occur in Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock Local Government Areas.

The site is not at the limit of distribution of this species.

Environment Protection and Biodiversity Conservation Act 1999

Important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity
- at or near the limit of the species range.

Tetratheca juncea was not recorded within the site despite two targeted surveys during its flowering period (in . . .). If the site contained a population of *Tetratheca juncea*, this population would be unlikely to be an important population due to the regular disturbance of habitat within the site through easement maintenance activities including slashing and mowing. Furthermore the site is not at the limit of distribution of this species.

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

The site is unlikely to support an important population.

Is the action likely to reduce the area of occupancy of an important population?

The site is unlikely to support an important population.

Is the action likely to fragment an existing important population into two or more populations?

The site is unlikely to support an important population.

Is the action likely to adversely affect habitat critical to the survival of a species?

Tetratheca juncea was not recorded within the site despite two targeted surveys during its flowering period. The proposed development is largely restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. As such this area provides only limited potential habitat for this species and is unlikely to be critical to the survival of *Tetratheca juncea*.

Is the action likely to disrupt the breeding cycle of an important population?

The site is unlikely to support an important population.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Tetratheca juncea has not been recorded within the site despite two targeted survey during its flowering period and the site is unlikely to support a viable population. The proposal would include the disturbance of limited habitat but this is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The development is proposed for an area, which although regularly disturbed, currently has a very low incidence of weeds. Mitigation measures have been provided to minimise the spread of weeds during construction.

Is the action likely to interfere substantially with the recovery of the species?

Tetratheca juncea has not been recorded within the site despite two targeted survey during its flowering period. The site is unlikely to support a viable population and the proposal is unlikely to substantially interfere with the recovery of this species.

Conclusion

Tetratheca juncea was not recorded within the site despite two targeted surveys during its flowering period. The proposed development is restricted to an existing electricity easement which is regularly maintained through slashing, mowing and selective clearing. Destruction of overstorey species resulting in an increase light penetration and changed growing conditions is a recognised threat for this species (NSW National Parks and Wildlife Service 2000d). The site is therefore unlikely to support a viable population and the proposed development is unlikely to significantly impact *Tetratheca juncea* or interfere with its recovery.

Microchiropteran Bats (TSC Act Assessment)

A total of seven Threatened species of microchiropteran bat are likely to use the site as marginal foraging area, although they were not recorded during field surveys (Figure 4). These species include the East Coast Freetail Bat (*Mormopterus norfolkiensis*), Common Bent-wing Bat (*Miniopterus schreibersii oceansis*), Little Bent-wing Bat (*Miniopterus australis*), Southern Myotis (*Myotis adversus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*). All species have been listed as Vulnerable under Schedule 2 of the TSC Act. The habitat requirements, distribution and threats of each species are described in Table G 7.

Despite the large ranges of each species, there is a general lack of detailed ecological knowledge (Churchill 1995). No communal roosting or nursery sites were recorded in the study area. Hollow-utilising bats use tree hollows as diurnal roost sites, places for torpor and sites to rear their young, with some species utilising multiple roost sites (Gibbons & Lindenmayer 2000). It is likely that microchiropteran bats roost in dead and living trees which occur in the study area, however, these habitats are generally lacking in areas adjacent to the transmission easements.

The species of microchiropteran bat listed above have been assessed as a group due to their similarity in habitat requirements and the impacts associated with the proposal.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

A majority of the seven species of microchiropteran bat occupy similar habitat types which are mostly dry sclerophyll forests and woodlands. The Eastern False Pipistrelle and the Little Bent-wing Bat have been recorded to roost in rainforest and melaleuca swamps which are not present in the site. The Large-footed Myotis and the Greater Broad-nosed Bat forage along waterbodies and tree lined creeks which make up a relatively small area of the site. All of the seven species of microchiropteran bat are likely to use the site as a marginal foraging area, however, habitats that are considered important for the lifecycle of a viable population such as maternity caves, derelict mine shafts or communal roosting sites are not present in the site or study area.

Although the removal of foraging habitat may temporarily disrupt the local population, there would not be disturbance to diurnal roosting sites. The loss of foraging habitat would not disrupt important lifecycle components of each species, and is unlikely to place the populations at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No population of microchiropteran bat is currently listed as Endangered under Schedule 1, Part 2 of the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The proposed clearing of a maximum removal of 10.5hectares of Coastal Plains Scribbly Gum/ Smooth-barked Apple Woodland for the gas pipeline and the inlet facility is considered to be relatively small in terms of its size and does not contain significant habitat features including communal roosting or nursery sites. The vegetation communities to be removed/ modified widely occur in local bushland, National Parks and State Forest which are within the range for each species.

Although the proposal may temporarily affect the dynamics of the local population, the proposed development will not remove a significant area of known foraging, roosting and breeding habitat for the seven species of bat.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The nature of the clearing will not fragment habitat and the microchiropteran bat species' high mobility allows the exploitation of other offsite habitat resources that are within their relatively large ranges.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. The habitat within the site is not listed as a critical habitat for any microchiropteran species of bat assessed.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

All of the seven species considered in the assessment use a wide variety of habitats for foraging, including disturbed areas. The Department of Environment and Conservation Atlas of NSW wildlife records show have been recorded in a number of coastal conservation reserves throughout the Sydney Basin bioregion (Department of Environment and Conservation 2004) and the species' foraging habitat is considered to be adequately reserved in the region.

There is limited knowledge in regards to the abundance, ecological requirements or distribution of most microbat species (Duncan, Baker & Montgomery 1999). The roost site characteristics for some species are specific and, therefore, are not adequately conserved in the Sydney Basin bioregion. For example, nursery caves are considered to be particularly important for the Common Bent-wing Bat where young bats are nursed and reared at densities of up to 3,000 individuals per square metre in locations such as Yesabah Caves near Kempsey (Churchill 1998). Maternity sites for the other seven species are not well recorded within conservation reserves (Duncan, Baker & Montgomery 1999; Hoye & Dwyer 1998; Richards 1998a).

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Schedule 3 of the *TSC Act* currently recognises 26 actions classified as Key Threatening Processes. Only two are relevant to the proposed action and the seven microchiropteran bat species:

- clearing of native vegetation
- removal of dead wood and dead trees.

The proposed action will remove native vegetation that includes relatively small number of hollow bearing timber and dead tree stags that provide roosting resources.

Whether any threatened species, population or ecological community is at the limit of its known distribution

All seven species are found over most of New South Wales and the site is not within the distributional limit for any of the species of microchiropteran bat.

Conclusion

The proposal will disturb a small amount of foraging habitat and roosting resources for the seven species. It will temporarily disrupt the local populations, however, important maternity sites and significant roosting resources will not be disturbed. The removed/modified foraging habitats are

available in the local and regional area within each of the species foraging range. As such it is unlikely that the proposed development will have a significant impact on the species.

Table G 7: Details of Threatened species of microchiropteran bat

Common name (Scientific name)	Threats	Habitat and distribution	TSC Act¹
East Coast Freetail Bat (<i>Mormopterus norfolkiensis</i>)	Vulnerable to loss of tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. Its population is suspected to have been reduced. It is an ecological specialist and depends on particular types of diet or habitat (Churchill 1998).	Thought to live in sclerophyll forest and woodland. Small colonies have been found in tree hollows or under loose bark. It feeds on insects above the forest canopy or in clearings at the forest edge (Churchill 1998).	V
Common Bent-wing Bat (<i>Miniopterus schreibersii</i>)	Loss of habitat, feral predators such as cats and foxes, disturbances of winter roosts, relies on very few nursery caves at high density (Dwyer 1998).	Distributed across the east coast of Australia, Rests in caves, old mines, stormwater channels and comparable structures including occasional buildings (Dwyer 1998). Typically found in well-timbered valleys where it forages, above tree canopy on small insects (Churchill 1998).	V
Little Bent-wing Bat (<i>Miniopterus australis</i>)	The species is an ecological specialist (it depends on particular types of diet or habitat) and it concentrates (individuals within populations of the species congregate or aggregate at specific locations).	Feeds on small insects beneath the canopy of well timbered habitats including rainforest, Melaleuca swamps and dry schlerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan 1995).	
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	Its population and distribution are suspected to be reduced It faces severe threatening processes It is an ecological specialist (it depends on particular types of diet or habitat)	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings (Churchill 1998).	V
Large-footed Myotis (<i>Myotis adversus</i>)	Not certain. Is likely to be susceptible to changes in water quality, which may result from vegetation clearing and logging (sedimentation), sewage and fertilizer run-off (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology). Where populations concentrate in roosts which are susceptible to disturbance, human activities such as recreational use of caves and removal of old wooden bridges would also be a threat (Duncan, Baker & Montgomery 1999). The species may have been subject of over-collection in the past (Richards 1998b).	Found in roosting caves, tunnels, tree hollows and possibly dense vegetation (Churchill 1998). Roosts have been located in hanging trees, buildings and underneath bridges have also been listed as roost sites for the species. The species is always associated with permanent, usually slow-flowing water bodies. Forages over small creeks, coastal rivers, estuaries lakes and inland rivers. Records come from a wide range of vegetation communities associated with water (Richards 1998b).	V
Yellow-bellied Sheathtail Bat (<i>Saccolaimus flaviventris</i>)	Vulnerable to loss of tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. Its population is suspected to have been reduced. It is an ecological specialist (it depends on particular types of diet or habitat) (Churchill 1998).	Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 1998).	V

Common name (Scientific name)	Threats	Habitat and distribution	TSC Act¹
Greater Broad-nosed Bat <i>(Scoteanax rueppellii)</i>	Its population is suspected to have been reduced It is an ecological specialist (it depends on particular types of diet or habitat)	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 1998). The species has been previously recorded in Abercrombie River National Park	V

1: V= Vulnerable, E1 = Endangered (TSC Act)

Nocturnal Birds - Masked Owl and Powerful Owl. (TSC Act assessment)

The Masked Owl and Powerful Owl are both listed as Vulnerable under the *TSC Act*. Although the species were not recorded during call playback surveys (see section 3.6) the species has been previously recorded in the study area (Figure 4). It is likely that the site and forms part of marginal foraging area for the owls. The details of the threats, habitat distribution and ecology of both species is described later in Table G 8. Both species occupy similar ecological niches and habitat requirements and therefore, they have been assessed together.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

The Masked Owl and Powerful Owl occupy similar habitat types, including wet and dry sclerophyll forests and woodlands. It is likely that the birds use the Coastal Plains Scribbly Gum/ Smooth-barked Apple Woodland in the study area as a marginal foraging area due to the presence of prey animals (arboreal marsupials) and roosting resources available in larger trees. However, the site contains few suitable hollows that would be used for nesting and none were recorded in the area for the proposed inlet facility and areas adjacent to the proposal.

It is unlikely that the loss of habitat would disrupt important lifecycle components of these species, because they do not rely on specialised habitat resources (such as large hollows for nesting) in the site and have a large range allowing them to forage in the wider area. It is unlikely that the proposal would place populations at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No population of threatened nocturnal birds are currently listed as Endangered under Schedule 1, Part 2 of the *TSC Act*.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Both species have relatively large home ranges and suitably sized tree hollows for nesting do not exist in the area to be affected by the proposal. The proposed removal of 10.5 hectares of Coastal Plains Scribbly Gum/ Smooth-barked Apple Woodland for the gas pipeline is considered insignificant compared to the distribution of similar foraging habitats available in the local and wider area of the Sydney Basin bioregion.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The home range for a pair of Powerful Owl is estimated to reach 1,000 hectares and varies according to habitat quality (Gibbons & Lindenmayer 2000).

Pairs of masked owl have been estimated to occupy a home range of 500 to 1,000 hectares in well forested environments and in other areas the home range is approximately 200 hectares per pair (Kavanagh 1996).

The nature of the clearing will not fragment an area of important habitat or a known breeding population. The species' high mobility allows the exploitation of other offsite habitat resources that are widely available within their relatively large range.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. The habitat within the site is not listed as a critical habitat for any threatened nocturnal species of bird assessed.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

The Department of Environment and Conservation Atlas of NSW wildlife records show that both species of owl have been recorded in a number of coastal conservation reserves throughout the Sydney Basin bioregion (Department of Environment and Conservation 2004) and suitable habitat for the owls is also well represented throughout the region. However, the owls are ecological specialists that are associated with older growth forests that have been significantly reduced to relatively small areas in comparison to their original size (Gibbons & Lindenmayer 2000). Given the apparent rarity of the owls and their relatively large home range, it seems unlikely that populations are adequately represented in regional conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Schedule 3 of the *TSC Act* currently recognises 26 actions classified as Key Threatening Processes. It is considered that of these, five are relevant to the proposed action and the two nocturnal bird species:

- clearing of native vegetation
- removal of dead wood and dead trees
- increased predation by feral cats
- increased predation by the European red fox
- inappropriate fire regimes.

Other known threats include:

- historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl
- inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat
- disturbance to nest sites, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success
- high frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability
- road kills
- secondary poisoning.

The removal of 10.5 hectares of marginal foraging habitat would not interfere with the recovery of the species and the proposal will not remove suitable hollow bearing trees or significant amounts of dead tree stags. Predation by feral cats and the European Red Fox is also considered a threat to the species survival due to the vulnerability of fledglings to predation by the introduced carnivores (Garnett & Crowley 2000). However, it is unlikely that predation would be increased by the proposed removal of habitat.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The known distribution for the Masked Owl and Powerful Owl range from coastal southern Victoria to South-eastern Queensland. The site is not within the distributional limit for any of the species.

Conclusion

It is unlikely that the construction and operation impacts resulting from the proposed development will interfere with the overall recovery of the Masked Owl and Powerful Owl.

Table G 8: Details of the Masked Owl and Powerful Owl

Common name (Scientific name)	Threats	Habitat, distribution and ecology	TSC Act¹
Masked Owl (<i>Tyto novaehollandiae</i>)	Clearance of agriculture is the principal listing for the species. Although food does not appear to be limiting on the east coast (Kavanagh 1996), the decline may be due to that of 50 and 200 grams. The availability of nest trees and vigorous regrowth from logging makes the habitat less suitable for foraging (Gibbons & Lindenmayer 2000).	<p>The Masked Owl inhabits forests, woodlands, timbered waterways and open country on the fringe of these areas. The main requirements are tall trees with suitable hollows for nesting and roosting and adjacent areas for foraging. Generally found in sub-coastal habitats. But also inland along watercourses (Garnett & Crowley 2000).</p> <p>The owl may have a preference for forest types with a dry and open understorey and a mosaic of dense and sparse groundcover. Most recorded nest sites have been in live Eucalypts, however the species has also been observed nesting dead trees. Nest trees are often an isolated stem or emergent above the canopy (Gibbons & Lindenmayer 2000).</p> <p>Pairs of masked owl have been estimated to occupy a home range of 500 to 1000 hectares in well forested environments and in other areas the home range is approximately 200 hectares per pair (Kavanagh 1996).</p>	V
Powerful Owl (<i>Ninox strenua</i>)	<p>The population size has declined as a result of widespread clearance for agriculture and pastoralism. Main threats include the removal of old growth forest which reduces the availability of suitable nest hollows and den site for prey (Debus & Chafer 1994).</p> <p>The species It is an ecological specialist (it depends on particular types of diet or habitat) Intense local wildfire can result in local loss. Poisoning, disturbance and predation by foxes on fledglings may cause nest failure and some deaths (NSW National Parks and Wildlife Service 1998).</p>	<p>Typically wet and hilly sclerophyll forest with dense gullies and understorey adjacent to more open forest. Will also occur in smaller, drier forest, provided that there are some large tree hollows and an adequate supply of prey. Generally confined to the forests of the Great Dividing Range and through to the coast. Tree hollows are important because a large proportion of the diet is comprised of hollow-dependent arboreal marsupials (James 1980, Kavanagh 1988, Pavey 1992, Debus & Chafer 1994). Birds, insects and some terrestrial mammals are also taken opportunistically, with some prey species being characteristic of open country, indicating that they may forage on forest margins (Garnett & Crowley 2000).</p> <p>The species is described as a generalist associated with a wide variety of habitats although it is commonly recorded in open forest, closed forest and woodland communities within gullies with a relatively dense understorey (Kavanagh 1996). The home range for a pair of Powerful Owl is estimated to reach 1000 hectares and varies according to habitat quality.</p> <p>Nesting hollows are often located in the trunk of the broken top of large eucalypts. Tree hollows are also important for the species because a large proportion of its diet is comprised of hollow-dependent arboreal marsupials (Gibbons & Lindenmayer 2000).</p>	V

1: V= Vulnerable, E1 = Endangered (Threatened Species Conservation Act 1995)

2: V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (Environment Protection and Biodiversity Conservation Act 1999).

Squirrel Glider- *Petaurus norfolcensis* (TSC Act Assessment)

The Squirrel Glider (*Petaurus norfolcensis*) is an arboreal mammal that is listed as Vulnerable under the *TSC Act* and inhabits dry sclerophyll forest and woodland in south-eastern Australia. The nocturnal Squirrel Glider shelters and nests in tree hollows and feeds on insects, nectar, gum of acacias and pollen. The species may forage in the upper and lower forest canopies and in the shrub understorey of the Coastal Plains Scribbly Gum Woodland (*Figure 4*). Smooth-barked eucalyptus tree species (such as Scribbly Gum- *E. hamestoma* and Forest Red Gum- *E. tereticornis*) in the study area are preferred for dens as these eucalypts form tree hollows more readily than rough barked species. The diet of the Squirrel Glider varies according to season and availability, and during winter when other food resources are scarce it may feed on flowers in the Swamp Mahogany Woodlands (Smith & Murray 2003). Xanthorrhoea grasses, Hairpin Banksia (*Banksia spinulosa*) and mature acacias within the study area also provides a valuable food source for the glider.

The conservation of the species is reliant on the mosaic of many fragmented and isolated patches of woodland and forest (Van de Deer 2002). The major threats to the species are:

- loss and fragmentation of habitat through clearing and associated activities
- logging of old growth elements that remove hollow bearing trees
- inappropriate fire regimes that may deplete food resources and isolate populations making them susceptible to regional catastrophic events
- predation by foxes and cats (NSW National Parks and Wildlife Service 1999a).

Wyong Shire supports the greatest known concentration of squirrel glider records in New South Wales (Smith & Murray 2003). Although the species was not recorded during targeted surveys of the site, the Department of Environment and Conservation Atlas of NSW Wildlife has recorded the species within the project locality and the glider has been recorded in the study area by Smith (2003) within Coastal Plains Scribbly Gum Woodland located north of proposal (*Figure 1*).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

It is possible that a viable population of Squirrel Glider exists in the Coastal Plains Scribbly Gum Woodland/ Smooth-barked Apple Woodland despite not being recorded in the current survey. The impact area for the proposal is largely contained within the existing electricity transmission easement. Although there is a small number of tree hollows present in the margins of the easements. The habitat for Squirrel Gliders is in poor condition. The proposal does involve the removal of a relatively small area of foraging resources for the species, however, this is unlikely to interrupt important lifecycle components or place a viable population at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Endangered populations are listed under Schedule 1, Part 2 of the *TSC Act*. The site and the surrounding study area does not contain a listed Endangered Population of Squirrel Glider.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Approximately 10.5 hectares of Coastal Plains Scribbly Gum Woodland/ Smooth-barked Apple Woodland would be removed for proposal. These areas provide marginal foraging areas for the species, however, important habitat resources (such as tree hollows) will remain unaffected.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Squirrel Gliders have a home range of up to 9 hectares and the home range of a family group varies according to habitat quality and availability of resources. Nightly movements are estimated between 300 and 500 metres (Strahan 1995). The linear nature of the clearing adjacent to the existing transmission easement or roadside will not fragment habitat or isolate populations from other foraging areas within the Squirrel Glider's range.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of Critical Habitat. The habitat within the study area is not listed as a Critical Habitat for the Sugar Glider.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

The Department of Environment and Conservation Atlas of NSW wildlife records show that the Squirrel Glider has been recorded in a number of coastal conservation reserves throughout the Sydney Basin bioregion (Department of Environment and Conservation 2004). The conservation reserves include Blue Mountains National Park, Brisbane Water National Park, Toolom National Park, Border Ranges National Park, Mount Warning National Park, Warrambungle National Park and Binnaway Nature Reserve (NSW National Parks and Wildlife Service 1999a). Populations of the Squirrel Glider have been established at nine sites within Munmorah and Lake Macquarie State Recreation areas, predominantly within large coastal reserves in north-east Wyong Shire (Smith & Murray 2003).

However, based on rarity of the species it is unlikely they are adequately conserved in the Sydney basin bioregion.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Schedule 3 of the *TSC Act* currently recognises 26 Key Threatening Processes. It is considered that of these only four are relevant to the proposed action and Squirrel Glider:

- Clearing of native vegetation
- Removal of dead wood and dead trees
- Increased predation by feral cats
- Increased predation by the European red fox.

Known threats to the species include:

- Loss of hollow-bearing trees.
- Loss of flowering understorey and midstorey shrubs in forests.
- Individuals can get caught in barbed wire fences while gliding.

The proposed development action will remove a maximum of 10.5 hectares of native vegetation along alongside a seven kilometre linear stretch of the existing transmission easement. The removed vegetation contains insignificant numbers of suitable tree hollows or dead wood for nesting. It is unlikely that predation by feral cats and European Red Fox would be significantly increased from the proposal.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The Squirrel Glider is sparsely distributed along the eastern coast and immediate inland districts from western Victoria to north Queensland. Therefore, this species is not at the limit of its known distribution in the study area.

Conclusion

The impacts resulting from the operation and construction of the proposal would not interfere with the recovery of the Squirrel Glider.

Wallum Froglet – *Crinia tinnula* (TSC Act Assessment)

The Wallum Froglet is listed as Vulnerable under the *TSC Act*.

The species is found amongst fringing vegetation in Wallum wetlands characterised by low nutrient (Cogger 2000) including highly acidic, tannin stained waters that are typically dominated by paperbark and tea trees as well as sedgeland and wet heathland (Anstis 2003).

In the study area the Wallum Froglet is likely to be found associated with the pock-marked undulations which are found in the small wet soak areas of the Coastal Plains Scribbly Gum

Woodland (*Figure 1*). During normal times the species is found restricted to Swamp Mahogany Woodland, but during heavy rain they move upslope through the pock-marked undulations of Coastal Plains Scribbly Gum Woodland to breed (Payne 2002b). Although the species was not recorded during the current survey potential habitat exists in a two metre wide ephemeral drainage line in the central part of the site and the species was previously recorded in the study area within Coastal Plains Scribbly Gum Woodland where the species breeds (Department of Environment and Conservation 2005b).

The major threat to the species are the loss of habitat through clearing and associated activities (NSW National Parks and Wildlife Service 1999a).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction

The major breeding sites for the species in the study area are the pock-marked undulations which occur in the Coastal Plains Scribbly Gum Woodland which will not be subject to a significant amount of habitat clearing. The species may potentially occur in the tributary drainage line of Spring Creek which occurs three kilometres to the east of the intersection between the railway line (*Figure 1*). This area would not be considered a significant breeding ground for the species.

The majority of the easement does not provide suitable habitat for the species, and disturbance to potential habitats in the proposed route would not significantly affect the lifecycle of a viable population.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Endangered populations are listed under Schedule 1, Part 2 of the *TSC Act*. The site and the surrounding study area does not contain a listed Endangered Population of Wallum Froglet.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The affected habitat for the Wallum Froglet includes a drainage line which is a tributary of Spring Creek. The construction of a gas connection pipeline across the drainage line would modify but not destroy the habitat and there have been no previous recordings of the frog in the impacted area. The tributary is not a prescribed creek and the habitat is insignificant in relation to the availability of breeding habitat elsewhere within the site and study area. The remainder of the preferred route along the transmission easement does not contain significant habitat for the species.

Impacts and modifications to the potential habitat for the Wallum Froglet are not considered to be significant in relation to the availability of Coastal Plains Scribbly Gum Woodland within the study area and the wider distribution of known habitat within the Sydney Basin bioregion.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The nature of the clearing will not fragment habitat and the Wallum Froglet is able to move to adjacent areas of suitable habitat within the drainage line or to the upper slope ridges of the Coastal Plains Scribbly Gum Woodland which are located within the species range.

Whether critical habitat will be affected

The Director-General of the Department of Environment and Conservation maintains a register of critical habitat. There is no critical habitat listed for the Wallum Froglet.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

The Wallum Froglet is mostly associated with areas of poor drainage in near Melaleuca swamps that contain acidic water quality parameters and are closely associated with freshwater habitats of the coastal zone (NSW National Parks and Wildlife Service 1999a). These habitats are largely restricted to the coastal fringe areas of New South Wales which have been subject to clearing and modification of land for development and there is a limited amount of these habitats remaining. It is therefore, unlikely the species and its habitats are adequately represented in conservation reserves or National Parks within Sydney Basin bioregion.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Schedule 3 of the *TSC Act* currently recognises 26 actions classified as Key Threatening Processes. It is considered that of these only two are relevant to the proposed action and the Wallum Froglet:

- Clearing of native vegetation
- Alteration to natural flow regimes of rivers, streams floodplains and wetlands.

Other known threats to the species include:

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

Impacts that could occur as a result of the proposal involve the modification of a tributary of Spring Creek which is relatively small in size (maximum width of two metres). In this particular case, the threatening processes would not interfere with the recovery of the species.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The coastal distribution for Wallum Froglet extends from Fraser Island in Queensland to Kurnell in Sydney, NSW. The study area is not within the distributional limit for the Wallum Froglet.

Conclusion

The impacts resulting from the operation and construction of the proposal would not have a significant effect on the recovery of the Wallum Froglet.