Kyoto energypark

Appendix A(iii)

Flora and Fauna Assessment Report
CEG Consult
(Dec 2007)

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CONACHER TRAVERS
environmental consultants

FLORA AND FAUNA ASSESSMENT REPORT

KYOTO ENERGY PARK
MIDDLEBROOK STATION
AND MOUNTAIN STATION
SCONE

DECEMBER 2007
(REF: 7091F/2 CE40)

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AND MOUNTAIN STATION
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Conacher Travers

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PREFACE

This Flora and Fauna Assessment has been prepared by *Conacher Travers Pty Ltd* for the proposed construction of an Energy Park at Middlebrook Station on Middle Brook Road Scone and Mountain Station at Owens Gap Scone, in the Upper Hunter Shire Council Local Government Area. This Report provides an assessment of existing habitats and the potential for the proposed development to significantly impact on threatened species, populations or ecological communities according to Section 5(A) of the *Environmental Planning and Assessment Act* (1979) and the *Threatened Species Conservation Act* (1995).

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SECTION 1

INTRODUCTION

1.1 INTRODUCTION

Conacher Travers Pty Ltd has been engaged to prepare a Flora and Fauna Assessment Report for the proposed construction of an Energy Park at Middlebrook Station on Middle Brook Road Scone and Mountain Station at Owens Gap Scone, in the Upper Hunter Shire Council Local Government Area.

This Flora and Fauna Assessment Report has been prepared to identify the flora and fauna characteristics of the site. This report will also determine whether or not a Species Impact Statement should be prepared for the proposed development according to the provisions of the *Threatened Species Conservation Act (TSC) (1995)* and Section 5(A) of the *Environmental Planning & Assessment (EP&A) Act (1979).*

This report has been prepared to provide details and assessments in relation to the work undertaken up to the end of December 2007. This report does not include an assessment of the proposed development in accordance with the Part 3A Requirements issued by the Director General of the Department of Planning or in accordance with the referral requirements of the Environmental Protection and Biodiversity Conservation Act. These specific assessments and reports will be completed as separate documentation to this report. This report has been prepared for informative purposes only and is not to be used as the final report for the assessment of the Kyoto Energy Park proposal.

1.2 SITE CHARACTERISTICS

The planning and cadastral details of the subject site are provided in Table 1.1 while Table 1.2 summarises the geographical characteristics of the site.

TABLE 1.1
SITE DETAILS

Location	"Middlebrook Station" Middle Brook Road Scone and Mountain Station on Merriwa Road Owens Gap, Scone.
Area	1923.76ha Middlebrook Station & 2030.12ha Mountain Station
Topographic Map	Parkville 1:25,000, Bunnan 1:25000 and Muswellbrook 1:100,000
Grid Reference	Middlebrook Station 291500E 6461500N MGA Mountain Station 287500E 6451500N MGA
Local Government Area	Upper Hunter Shire Council
Existing Land Use	Pastoral, sheep grazing
Proposed Development	Energy Park

TABLE 1.2 SITE CHARACTERISTICS	
Topography	Middlebrook Station: Undulating creek flats to steep rocky ridges and escarpments rising to undulating plateaus. Mountain Station: Elevated undulating plateaus falling to steep rocky slopes and escarpments and narrow gullies.
Slope	Varying from 5% to 80% along escarpments.
Aspect	Various, mostly east and west.
Soil Types of proposed development areas	Shallow to very shallow well to moderately drained Claustic Ridosols and Orthic Tenosols on crests and side slopes of the Wingen Maid soil landscape; Shallow to deep well to moderately drained Black Red and Brown Chromosols and Dermosols on crests and side slopes of the Ant Hill soil landscape; Moderately well drained, moderately deep Haplic Mesotrophic Black Dermosols across the plateau surfaces
Catchment	Hunter River
Drainage	Middlebrook Station: Overland flow into Middle Brook draining to Kingdom Ponds then the Hunter River to the east and draining to the west to Dart Brook then into the Hunter River. Mountain Station: Overland flow into via Bullock and Little Bullock Gullies into Middle Brook to the east and draining into the Hunter River.
Vegetation	A total of seventeen (17) vegetation communities have been identified within the subject site by *Conacher Travers* or previous surveys (Hill *et al.,* 2001 and Peak, 2006). Refer to Section 2.2 for details

1.3 PROPOSED DEVELOPMENT

The proposed development is for the construction of an Energy Park (Figures 1.1 and 1.2) which will comprise the utilization of a combination of various energy producing technologies as outlined below.

Wind Turbine Generators: It is proposed to construct approximately 12 turbines on Middlebrook Station and a maximum of 35 turbines within Mountain Station. Turbines are expected to be between 80 -105m in height with a blade length of 45m and will be positioned along the ridgelines to enable access to prevailing winds. Construction will require the clearing of vegetation to provide for construction of anchorage pads and access roads.

Solar Thermal Plant: The solar thermal plant will cover between 50-100 hectares of existing cleared land on the plateau of Mountain Station, it is expected that clearing of native vegetation will not be required for its construction.

Closed Loop Hyrdo Plant: The closed loop hydro plant will be located within the central valley of Mountain Station where the steep slopes are able to provide sufficient water velocity to generate power. Construction of this plant will require the removal of native vegetation and habitat disturbance to provide for the construction and access roads.

Visitors and Education Centre: This centre will be located on the cleared plateau of Mountain Station in the vicinity of the Solar Thermal Plant. The proposed area is already cleared and it is unlikely that further clearing for bushfire protection areas and access will be required.

Electricity Transmission Lines: This project will require the installation of some sections of electricity transmission lines to connect the proposed electricity generating facilities to the existing electricity infrastructure. Some parts of the existing electricity transmission infrastructure will also need to be upgraded. Several route options for the proposed power lines have been selected for consideration and assessment. Details of these options are provided in separate documentation.

Associated Infrastructure:

The proposal also includes infrastructure and associated developments such as:

- Construction depot
- Substation and switchyard
- Material storage areas
- On-site quarries
- Managers residence
- Operational offices
- Construction access
- Permanent tracks
- Bushfire asset protection zones
- Installation or upgrading of local electricity transmission lines
- Water, electrical and telephone services including underground and overhead lines.

SECTION 2

FLORA CHARACTERISTICS

2.1 VEGETATION SURVEY METHODOLOGY

To determine the likely and actual occurrence of flora species and plant communities on the subject site field survey work was undertaken to supplement literature reviews and previous flora surveys of the area. The methods utilised for the flora survey are outlined below.

Literature Review

A review of available literature for the area was undertaken to obtain reference material and background information for this study. Two local vegetation survey and mapping projects, (Hill *et al.,* 2001, Peak 2006) have been completed within parts of the Middlebrook Station and to a lesser extent Mountain Station properties. The vegetation mapping from these studies was used to represent the distribution of vegetation communities within the local area and those areas of the subject site not surveyed by this study.

A search of the Atlas of NSW Wildlife (DECC 2007) was undertaken to identify records of threatened flora species located within 10km of the site. This enabled the preparation of a predictive list of threatened flora species that could possibly occur within the habitats found on the site.

Aerial Photograph Interpretation (API)

The site's vegetation community boundaries were initially identified using API of vegetation within the subject site from an aerial photo. This is provided in Figures 2.1 and 2.2, of this report. Analysis of these photos identified past land use practices, disturbances, native vegetation regrowth, changes in vegetation structure and floristics throughout the subjects site represented by changes in colour, patterns and height of the vegetation. This analysis provided an initial split of the vegetation communities within the subject site into simple structural and disturbance classifications.

Field Survey

Detailed 'ground truthing' of the existing initial vegetation mapping (Hill *et al* 2001, Peak 2006) and the API was conducted on the 9th-11th May, 12th-14th June 2007 predominately within the areas of impact. 'Ground truthing' is a term given to the validation process of conducting a flora survey within vegetation communities that have been mapped and identified remotely (for example, by aerial photo interpretation or modeling). Additional flora surveys were undertaken on 12-14 August 2007 and 17 September.

The field survey also consisted of a meandering transect survey (Cropper 1993), targeted threatened species searches and sampling of systematically placed 20 x 20 metre flora quadrats within vegetation communities identified by aerial photo interpretation or subsequently during the field validation to occur within the area of impact. The transect survey assisted in the ground truthing of the vegetation community boundaries and identification of the dominant floristic species observed within each vegetation community.

Quadrat Survey

The locations of the flora quadrats were generally restricted to the areas of direct or indirect impacts from the proposed development ('the study area') and gave consideration to important influencing environmental variables such as geographic location; geology, soil type and/or physiographic location. The quadrat survey was completed to assist in identifying the dominant floristic characteristics of each vegetation community and provided detailed information on community's structure and their complete floristic assemblage. The approximate locations of these surveys are provided in Figures 2.1 and 2.2.

A total of forty-one (41) 20 X 20 metre quadrat plots were completed within the subject site.

Each 20 x 20m plot survey recorded the presence of vascular plant taxa and assigned a cover abundance estimate for each species based on a modified Braun-Blanquet 1-6 scale. The cover abundance values for each 1 to 6 class is provided in Table 2.1.

TABLE 2.1
COVER ABUNDANCE SCALE USED IN FLORISTIC SURVEY

Class	Cover Abundance	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: < 5 individuals Shrubs and small trees: < 5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 –20% cover	
4	20 –50% cover	
5	50 –70% cover	
6	70 – 100% cover	

Specimens of plants not readily identified in the field were collected for identification.

Determination of species composition as well as structural descriptions of the vegetation on the site according to Specht *et. al.* (1995) was also carried out. All vascular plants were identified using keys and nomenclature in Harden (1990a, 1991, 1992 and 1993), Harden and Murray (2000) and Harden, G.J. (2002). Wherever they were known, changes to nomenclature and classification have been incorporated into the results.

EPBC Act Box Gum Woodland Condition Assessment

Detailed condition sampling was completed on 31 July and 1 August 2007 in accordance with the guidelines for assessment identified within the EPBC Act Policy Statements – White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (DEH 2006).

This survey involved the systematic sampling of 15, 30 x 30 metre plots (approximately 0.09ha), within patches of highest quality remnant Box Gum Woodlands. Each plot recorded the presence of vascular plant taxa and assigned a cover abundance estimate for each species based on a modified Braun-Blanquet 1-6 scale.

Analysis of the results for each plot, was completed to identify the following questions;

- Does the plot have a predominately native understorey, defined as an area where more than 50% of the perennial cover is comprised of native species. and;

- Based on the list of species provided by the Department of Environment and Water Resources, are there at least 12 of the characteristic native species and one important species within the understorey?

Seasonal Surveys

A detailed search was carried out for terrestrial orchids during the flora survey of the site. However, as orchids generally only flower for short seasonal periods, and can sometimes erratically miss several seasons, their observation is difficult. In order to detect species that flower at other times of the year additional targeted searches may be required. Details of threatened cryptic flora known within the local area are provided in Table 2.2.

TABLE 2.2
FLOWERING TIMES OF CRYPTIC FLORA

Species	Flowering Period	Surveyed
Diuris pedunculata	August - September	17th September 2007
Diuris tricolor	September - November	17th September 2007

Vegetation Community Nomenclature

The vegetation communities identified within the site by *Conacher Travers* were classified according to a modified Walker and Hopkins (1990) methodology, however within these descriptions the dominant canopy species are listed after the structural description. Vegetation communities identified within the subject site by Hill *et al* (2001) and Peak (2006) have generally been described as previously reported.

For each vegetation community identified within the subject site, corresponding vegetation communities identified within the local area by Hill *et al* (2001) and Peak (2006) are also provided. Corresponding Endangered Ecological Communities listed on both the TSC Act and EPBC Act are also provided.

Survey Limitations

The floristic survey was affected by limitations in time, existing levels of disturbance and seasonal influences. Identification to the species level of several specimens recorded in the survey was also limited by the availability of flowering and/or fruiting material. As the surveys were carried out during autumn, winter and spring after a prolonged period of drought, the diversity of annual herbs and grasses was expected to be under-represented within the recorded ground flora. These layers were likely to have been further under represented in sampling due to the intensive sheep grazing regime that coincided with the prolonged drought within the majority of the subject site.

Field validation of the previous local area vegetation mapping by Hill *et al*., (2001) and Peak (2006) was restricted to those areas immediately surrounding the proposal.

2.2 VEGETATION COMMUNITY DESCRIPTIONS

The flora species observed during surveys are listed in Table 2.3.

A total of seventeen (17) vegetation communities have been identified within the subject site by *Conacher Travers* or previous surveys (Hill *et al.,* 2001 and Peak, 2006). The community descriptions for those vegetation types mapped by the previous surveys and not sampled in this study have been adapted from their corresponding reports (Hill *et al.,* 2001 and Peak, 2006).

The communities identified and mapped are:

1. Dry Rainforest Closed Forest
2. Ironbark - Box Open Forest
3. Ironbark Open Forest
4. Ironbark-Stringybark Open Forest
5. Grey Gum -Ironbark Open Forest
6. Grey Gum – Stringybark Open Forest
7. Grey Gum – Apple Open Forest
8. Slaty Gum Open Forest
9. Box Woodland
10. Box – Ironbark Grassy Woodland
11. Box Ironbark Red Gum Woodland
12. Exposed Ironbark Woodland
13. Exposed Ironbark Cyperus Woodland
14. Red Gum Woodland
15. Exposed Acacia Low Open Woodland
16. Rocky Heathland on Sandstone Benches
17. Grassland with Scattered Trees

A flora species list is of the subject site is provided in Table 2.3 while a general description of the vegetation communities is provided below. Figures 2.1 and 2.2 show the distribution of the vegetation on the site.

1) DRY RAINFOREST CLOSED FOREST – (*Backhousia myrtifolia - Ficus rubiginosa*)

Previous Vegetation Studies:
Hill et al., (2001) – RF3 Dry Rainforest in Sandstone Gorges
Peak (2006) – Map Unit 3 Depauperate Dry Rainforest
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

Structure

Emergent Trees:	To 20 metres high with a Projected Foliage Cover (PFC) of <10%
Trees:	To 18 metres high with a 60-90% PFC.
Low Trees:	To 6 metres high with a variable 5-40% PFC.
Shrubs:	To 1 metre high with a <5% PFC.
Ground:	To 0.5m with a variable 30-100% PFC.

Species

Emergent Trees: *Allocasuarina torulosa* (Forest Oak), *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus punctata* (Grey Gum).

Trees: *Backhousia myrtifolia* (Grey Myrtle) and *Ficus rubiginosa* (Port Jackson *Fig).*

Low Trees: *Cassinia australis var. australis* (Red Olive Plum), *Ficus coronata* (Sandpaper Fig), *Notelaea microcarpa var. macrocarpa* (Native Olive), *Pittosporum undulatum* (Sweet Pittosporum), *Rapanea variabilis* (Muttonwood), and *Trema tomentosa var. viridis* (Native Peach).

Shrubs: *Breynia oblongifolia* (Coffee Bush), *Clerodendrum tomentosum* (Hairy Clerodendrum) and *Hymenanthera dentata* (Tree Violet).

Sub-shrubs: *Nyssanthes diffusa* (Barbwire Weed), *Sigesbeckia orientalis var. orientalis* and *Solanum stelligerum* (Devil's Needles)

Herbs: *Urtica incisa* (Stinging Nettle), *Dendrobium speciosum* (Rock Orchid), *Commelina cyanea* (Scurvy Weed)

Grasses: *Oplismenus aemulus* (Basket Grass), *Oplismenus imbecillis* and *Poa seiberiana* (Tussock Grass).

Ferns: *Adiantum aethiopicum* (Common Maidenhair), *Doodia aspera* (Rasp fern), *Pyrrosia rupestris* (Rock Felt Fern), *Adiantum hispidulum* (Rough Maidenhair), *Asplenium flabellifolium* (Necklace Fern), *Pellaea falcata* (Sickle Fern).

Vines: *Cayratia clematidea*, *Cissus antarctica, Clematis glycinoides var. glycinoides, Dichondra repens, Eustrephus latifolius, Morinda jasminoides* and *Pandorea pandorana ssp. pandorana*.

Sedges: *Cyperus imbecillis.*

Location and Distribution:
This community develops in sheltered gullies and slopes on Narrabeen Sandstone that have deeper, more fertile soils than surrounding sandstone areas. These sheltered sites are provided protection from desiccation by adjacent cliffs and steep slopes (Hill *et al.,* 2001). It also occurs in a small number of pockets on exposed and steep slopes derive from Basalt. Within the subject site this community was restricted to isolated occurrences along steeper sheltered slopes of Middlebrook Station and a number of deep valleys in the east of Mountain Station.

Disturbance:
With the exception of bushfires, this community is subject to very few disturbances.

Weed Invasion:
This community exhibits very little weed invasion.

2) IRONBARK - BOX OPEN FOREST (*Eucalyptus crebra*)

Previous Vegetation Studies:

Hill et al., (2001) - Narrow Leaved Ironbark Open Forest on Basalt
Peak (2006) - Upper Hunter White Box - Ironbark Grassy Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**

Trees: To 25 metres high with a Projected Foliage Cover (PFC) of 15-40%.

Shrubs: To 4 metres high with a variable 30-75% PFC.

Groundlayer: To 1.5 metres high with variable 20 - 45% PFC.

Floristics:
(Main Species Present)

Trees: *Angophora floribunda* (Rough-barked Apple), *Eucalyptus albens – molacanna* (White Box/Grey Box intergrade) and *Eucalyptus crebra* (Narrow leaved Ironbark*)*.

Shrubs: *Acacia paradoxa* (Kangaroo Thorn), *Cassinia quinquefaria, Beyeria viscosa*, *Dodonaea viscosa subsp. angustifolia* (Hop Bush), *Notelaea microcarpa var. macrocarpa* (Native Olive) and *Olearia elliptica* (Sticky Daisy-bush).

Sub-Shrubs: *Abutilon oxycarpum* (Flannel Weed), *Hibbertia acicularis* (Prickly Guinea Flower) *Sigesbeckia orientalis var. orientalis* (Indian Weed) and *Spartothamnella juncea.*

Groundlayer: *Aristida ramosa var. speciosa* (Wire Grass), *Asperula conferta* (Woodruff) *Calotis lappulacea, Cyperus gracilis, Daucus glochidiatus* (Native Carrot), *Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Eragrostis brownii* (Brown's Lovegrass)*, Lomandra filiformis ssp. coriacea* (Wattle Mat-rush), *Microlaena stipoides var. stipoides* (Weeping Rice Grass), *Pratia purpurascens* (Whiteroot), *Rostellularia adscendens ssp. adscendnes var. pogonanthera,* and *Vittadinia sulcata.*

Vines: *Desmodium varians* and *Dichondra repens, Glycine tabacina* species complex

Ferns: *Cheilanthes austrotenuifolia, Cheilanthes distans*

Location and Distribution:
This vegetation community occupies the steeper mid and lower slopes of Middlebrook Station on basalt soils.

Variation:
There are a number of minor variations within this community's canopy, particularly in regards to variations in the structure and dominant species.

Disturbance:
This community has been disturbed by low levels of weed invasion in the shrub and ground layers, a history of rural activities, grazing and selective clearing.

Weed Invasion:
This community exhibits low weed levels of invasion in both the shrub and ground layers. Areas of *Opuntia stricta var. stricta* are scattered throughout the community, while a variety of exotic herbs and pasture grasses occur within the ground layer.

3) IRONBARK OPEN FOREST *(Eucalyptus crebra)*

Previous Vegetation Studies:

Hill et al., (2001) - Narrow Leaved Ironbark Open Forest on Basalt
Peak (2006) - Upper Hunter White Box - Ironbark Grassy Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**

Trees: To 25 metres high with a Projected Foliage Cover (PFC) of 25-40%.

Shrubs: To 4 metres high with a 50% PFC.

Groundlayer: To 1.5 metres high with variable 30 - 65% PFC.

Floristics:
(Main Species Present)

Trees: *Angophora floribunda* (Rough-barked Apple), *Allocasuarina luehmannii* (Bull Oak), *Callitris endlicheri* (Black Cyperus Pine), *Eucalyptus punctata, Eucalyptus crebra* (Narrow-leaved Ironbark).

Shrubs: *Acacia paradoxa* (Kangaroo Thorn), *Bursaria spinosa var. spinosa (Blackthorn), Cassinia aculeata, Dodonaea viscosa subsp. angustifolia* (Hop Bush), *Leucopogon muticus, Myoporum montanum* (Western Boobialla), *Spartothamnella juncea* and *Xanthorrhoea johnsonii* (Grass Tree).

Sub-Shrubs: *Hibbertia obtusifolia* (Grey Guinea Flower), *Melichrus urceolatus* (Urn Heath), **Opuntia stricta var. stricta* (Prickly Pear) and *Solanum prinophyllum* (Forest Nightshade).

Groundlayer: *Aristida ramosa var. peciosa* (Wire Grass), *Einadia polygonoides*, *Eragrostis brownii* (Brown's Lovegrass), *Lepidosperma laterale* (Variable Sword Sege) *Lomandra multiflora* (Many-flowered Mat-rush) and *Pratia purpurascens* (White Root).

Vines: *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex.

Ferns: *Cheilanthes sieberi subsp. sieberi*

Location and Distribution:
This vegetation community is located on the mid-slopes of the southern ridge of Middlebrook Station downslope of the Box Ironbark Community. It generally appears to be associated with those areas where the basalt capping has been eroded leaving a relatively high sandstone influence.

Variation:
There are a number of minor variations within this community's canopy, particularly in regards to variations in the structure and dominant species. Both *Allocasuarina luehmannii* (Bull Oak) and *Callitris endlicheri* dominate a sub tree layer in the southern portion of this community. In generally their appears to be broad transition zone between this and the adjoining Box- Ironbark and Grey Gum- Ironbark communities.

Disturbance:
This community has been disturbed by extensive grazing, minor track construction and selective clearing, weed invasion in the shrub and ground layers and a history of rural activities.

Weed Invasion:
This community exhibits low levels of weed invasion in both the shrub and ground layers.

4) IRONBARK-STRINGYBARK OPEN FOREST (*Eucalyptus nubila, Eucalyptus sparsifolia*)

Previous Vegetation Studies:

Hill et al., (2001) – OF 7 Ironbark-Stringybark Open Forest on Sandstone
Peak (2006) – Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

Structure
Emergent Trees: To 15-25 metres high with a Projected Foliage Cover (PFC) of 5-10%
Trees: To 8-20 metres high with a 20-45% PFC.
Low Trees: To 4-8 metres high with a variable <5-15% PFC.
Shrubs: To 0.5-4 metre high with a 5-45% PFC.
Ground: To <1m with a variable 5-50% PFC.
Floristics:
(Main Species Present)

Trees: *Eucalyptus nubila, Eucalyptus sparsifolia, Callitris endlicheri, Acacia implexa* and *Eucalyptus punctata*

Low Trees: *Persoonia linearis, Acacia crassa ssp. crassa* and *Xanthorrhoea johnsonii*

Shrubs: *Leucopogon muticus, Hibbertia circumdans, Podolobium ilicifolium, Calytrix tetragona, Leptospermum polyanthum, Dodonaea triangularis, Acacia piligera*

Herbs: *Pomax umbellata, Goodenia hederacea ssp. hederacea, Dianella revoluta var. revoluta, Platysace ericoides, *Hypochaeris radicata* and *Acianthus collinus*

Grasses: *Cleistochloa rigida, Microlaena stipoides var. stipoides, Paspalidium distans* and *Entolasia stricta*

Ferns: *Cheilanthes sieberi ssp. sieberi*

Vines: *Billardiera scandens*

Sedges: *Lepidosperma laterale, Lomandra glauca, Lomandra multiflora ssp. multiflora* and *Lomandra confertifolia*

Location and Distribution:
This vegetation community is restricted to the western escarpment of the northern portion of Middlebrook Station.

Disturbance:
This community has been disturbed by low levels of weed invasion in the shrub and ground layers, grazing and selective clearing.

5) GREY GUM - IRONBARK OPEN FOREST (*Eucalyptus punctata - Eucalyptus crebra*)

Previous Vegetation Studies:

Hill et al., (2001) - Grey Gum - Stringybark Sheltered Open Forest/ Narrow Leaved Ironbark Open Forest on Basalt
Peak (2006) - Upper Hunter Hills Sheltered Moist Forest/Upper Hunter White Box - Ironbark Grassy Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**
Trees: To 30 metres high with a Projected Foliage Cover (PFC) of 25-40%.
Shrubs: To 4 metres high with a <10% PFC.
Groundlayer: To 1.5 metres high with variable 40 - 75% PFC.

Floristics:
(Main Species Present)

Trees: *Angophora floribunda* (Rough-barked Apple), *Eucalyptus punctata, Eucalyptus crebra* (Narrow-leaved Ironbark).

Shrubs: *Acacia verniciflua* (Varnish Wattle), *Acacia paradoxa* (Kangaroo Thorn), *Cassinia aculeata, Indigofera australis* (Native Indigo), *Leucopogon muticus, Podolobium ilicifolium* (Prickly Shaggy Pea) and *Xanthorrhoea johnsonii* (Grass Tree).

Sub-Shrubs: *Hibbertia obtusifolia* (Grey Guinea Flower), *Melichrus urceolatus* (Urn Heath), **Opuntia stricta var. stricta* (Prickly Pear), *Phyllanthus hirtellus* (Thyme Spurge), *Solanum prinophyllum* (Forest Nightshade).

Groundlayer: *Aristida ramosa var. peciosa* (Wire Grass), *Einadia hastata* (Berry Saltbush), *Eragrostis brownii* (Brown's Lovegrass), *Lepidosperma laterale* (Variable Sword Sege) *Lomandra multiflora* (Many-flowered Mat-rush) and *Pratia purpurascens* (White Root).

Vines: *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex.

Ferns: *Cheilanthes sieberi subsp. sieberi*

Location and Distribution:
This vegetation community occurs downslope of the Narrow-leaved Ironbark - Box Open Forest community and is associated with more sheltered slopes with a minor basalt influence within the soil. It is located within the central portion of Middlebrook Station surrounding the quarried areas of the site.

Disturbance:
This community has been disturbed by low levels of weed invasion in the shrub and ground layers, a history of rural activities, grazing and selective clearing.

Weed Invasion:
This community exhibits low weed invasion in both the shrub and ground layers. Areas of *Opuntia stricta var. stricta* are scattered throughout the community, while a variety of exotic herbs and pasture grasses occur within the ground layer.

6) GREY GUM- STRINGYBARK OPEN FOREST (*Eucalyptus punctata, Eucalyptus sparsifolia*)

Previous Vegetation Studies:
Hill et al., (2001) – OF6 Grey Gum- Stringybark Sheltered Forest
Peak (2006) – Map Unit 29 Upper Hunter Hill Sheltered Moist Forest
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

Structure

Trees:	To 12-30 metres high with a 35-60% PFC.
Low Trees:	To 2-5 metres high with a variable 10-25% PFC.
Shrubs:	To 0.5-3 metre high with a 5-30% PFC.
Ground:	To <0.5m with a variable 30-90% PFC.

Floristics:
(Main Species Present)

Trees:	*Eucalyptus punctata, Eucalyptus sparsifolia, Eucalyptus crebra, (Eucalyptus nubila)*
Low Trees:	*Persoonia linearis, Pittosporum undulatum, Choretrum* species A
Shrubs:	*Leucopogon muticus, Acacia verniciflua, Indigofera australis, Podolobium ilicifolium, Leptospermum polyanthum, Dodonaea triangularis, Acacia filicifolia, Acacia piligera, Bursaria spinosa ssp. spinosa, Canthium buxifolium, Cassinia aculeata, Cassinia laevis* and *Cassinia quinquefaria*
Herbs:	*Pomax umbellata, *Senecio madagascariensis, Pratia purpurascens, *Hypochaeris radicata, Einadia hastata* and *Gonocarpus elatus*
Grasses:	*Cleistochloa rigida, Digitaria ramularis* and *Microlaena stipoides var. stipoides*
Ferns:	*Cheilanthes sieberi ssp. sieberi*
Vines:	*Desmodium varians, Glycine clandestina* species complex*, Dichondra repens, Billardiera scandens, Cassytha glabella*
Sedges:	*Lepidosperma laterale* and *Gahnia aspera*

Location and Distribution:
This vegetation community is restricted to south facing upper slopes above the escarpment in the north-west of Middlebrook Station.

Disturbance:
This community exhibits very little disturbances with the exception of an isolated fire trail and past bushfires.

7) GREY GUM – APPLE OPEN FOREST (*Eucalyptus punctata, Angophora floribunda* and *E. crebra*)

Previous Vegetation Studies:
Hill *et al*., (2001) - AOF1 Grey Gum – Alluvial Open Forest
Peak (2006) - Map Unit 29 Upper Hunter Hill Sheltered Moist Forest
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

Structure
Trees: To 20-30 metres high with a 30-40% PFC.
Low Trees: To 4-15 metres high with a variable 10-60% PFC.
Shrubs: To 0.5-3 metre high with a 15-50% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus punctata, Angophora floribunda, Allocasuarina torulosa, E. blakelyi, E. tereticornis* and *E. crebra.*

Low Trees: *Notelaea microcarpa var. microcarpa, Pittosporum undulatum, Rapanea variabilis* and *Persoonia linearis.*

Shrubs: *Breynia oblongifolia, Clerodendrum tomentosum, Maytenus silvestris, Spartothamnella juncea, Acacia filicifolia, Leptospermum polyanthum, Indigofera australis, Leptospermum polygalifolium, Bursaria spinosa ssp. spinosa, Hymenanthera dentata* and *Olearia elliptica.*

Herbs: *Pratia purpurascens, *Bidens pilosa, *Conyza albida, Plectranthus parviflorus, Galium propinquum, Hydrocotyle laxiflora, *Hypochaeris radicata, Einadia hastata, Viola hederacea, Rostellularia adscendens ssp. adscendnes var. pogonanthera, Lagenifera stipitata* and **Stellaria media.*

Grasses: *Microlaena stipoides var. stipoides, Oplismenus aemulus, Oplismenus imbecillis, Echinopogon intermedius* and *Echinopogon ovatus.*

Ferns: *Asplenium flabellifolium, Pyrrosia rupestris, Cheilanthes sieberi ssp. sieberi, Adiantum aethiopicum, Adiantum hispidulum, Pellaea falcata* and *Pellaea paradoxa.*

Vines: *Desmodium varians, Glycine clandestina species complex, Glycine tabacina species complex, Dichondra repens, Dichondra species A, Clematis glycinoides, Pandorea pandorana ssp. pandorana, Eustrephus latifolius, Billardiera scandens, Clematis glycinoides var. glycinoides, Passiflora herbertiana ssp. herbertiana* and *Tylophora barbata.*

Sedges: *Gahnia aspera, Lepidosperma laterale, Lomandra confertifolia ssp. pallida* and *Cyperus gracilis.*

Location and Distribution:
This vegetation community dominates sheltered alluvial drainage lines and lower slopes throughout Middlebrook Station.

Disturbance:
This community has been moderately disturbed by weed invasion, clearing, intensive grazing, construction of roads and alterations to the natural drainage.

8) SLATY GUM OPEN FOREST (*Eucalyptus dawsonii*)

Previous Vegetation Studies:

Hill et al., (2001) - NA
Peak (2006) - In part Upper Hunter White Box - Ironbark Grassy Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**

Trees: To 30 metres high with a Projected Foliage Cover (PFC) of 25-40%.

Shrubs: To 4 metres high with a 50% PFC.

Groundlayer: To 1.5 metres high with variable 30 - 65% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus dawsonii* (Slaty Gum).

Shrubs: *Notelaea microcarpa var. macrocarpa* (Native Olive), *Spartothamnella juncea* and *Xanthorrhoea johnsonii* (Grass Tree).

Sub-Shrubs: *Phyllanthus hirtellus* (Thyme Spurge), and *Spartothamnella juncea.*

Groundlayer: *Aristida ramosa var. peciosa* (Wire Grass), *Cyperus gracilis, Einadia hastata* (Berry Saltbush), *Eragrostis brownii* (Brown's Lovegrass), *Gahnia aspera* (Saw Sedge), *Lomandra filiformis subsp. filiformis* (Wattle Mat-rush) and *Vittadinia sulcata.*

Vines: *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex

Ferns: *Cheilanthes distans* (Bristly Cloak Fern)

Location and Distribution:
This vegetation community is located on the east facing lower slope of a single valley within Mountain Station.

Disturbance:
This community has been disturbed by extensive grazing and selective clearing, weed invasion in the shrub and ground layers and a history of rural activities.

Weed Invasion:
This community exhibits low levels of weed invasion in both the shrub and ground layers.

9) BOX WOODLAND - *(Eucalyptus albens – molacanna* and *Eucalyptus blakelyi)*

Previous Vegetation Studies:

Hill et al., (2001) – OF9 Box Open Forest on Basalt
Peak (2006) – In part Map Unit 11 Upper Hunter White Box - Ironbark Grassy Woodland
EEC on the TSC Act – In Part, White Box Yellow Box Blakely's Red Gum Woodland
CEEC on the EPBC Act - In Part, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

***Structure*:**

Trees: To 25 metres high with a Projected Foliage Cover (PFC) of 5-30%.

Shrubs: To 4 metres high with a variable <5- 60% PFC.

Groundlayer: To 1.5 metres high with variable 20 - 75% PFC.

Floristics:
(Main Species Present)

Trees: *Angophora floribunda* (Rough-barked Apple), *Brachychiton populneus* (Kurrajong), *Eucalyptus albens – molacanna* (White Box/Grey Box intergrade)*, Eucalyptus blakelyi* (Blakely's Red Gum) and *Ficus rubiginosa* (Port Jackson Fig).

Shrubs: *Dodonaea viscosa subsp. angustifolia* (Hop Bush), *Indigofera australis* (Native Indigo), *Notelaea microcarpa* (Native Olive)*, Olearia elliptica* (Sticky Daisy-bush), *Pittosporum undulatum* (Sweet Pittosporum).

Sub-Shrubs: *Hibbertia acicularis* (Prickly Guinea Flower), *Swainsona galegifolia* (Smooth Darling Pea), *Spartothamnella juncea* and *Urtica incisa* (Stinging Nettle*)*

Groundlayer: *Acaena novae-zelandiae* (Bidgee-Widgee), *Aristida ramosa var. peciosa* (Wire Grass), *Aristida calycina* (Wire Grass), *Asperula conferta* (Woodruff) *Austrodanthonia bipartita* (Wallaby Grass), *Austrostipa ramosissima* (Stout Bamboo Grass), *Bothriochloa decipiens* (Redleg Grass), *Chrysocephalum apiculatum* (Common Everlasting), *Cyperus gracilis, Daucus glochidiatus* (Native Carrot), *Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Galium migrans* (Bedstraw)*, Geranium potentilloides var. potentilloides, Lomandra longifolia* (Spiky-headed Mat-rush), *Microlaena stipoides var. stipoides* (Weeping Rice Grass), *Plectranthus parviflorus* (Cockspur Flower)*, Plantago debilis* (Slender Plantain)*, Rostellularia adscendens ssp. adscendnes var. pogonanthera, Rumex brownie* (Swamp Dock) and *Vittadinia sulcata.*

Vines: *Desmodium brachypodum, Glycine tabacina* species complex*, Dichondra repens* and *Pandorea pandorana (Wonga Vine).*

Ferns: *Cheilanthes sieberi subsp. sieberi* and *Cheilanthes distans*

Location and Distribution:
At higher elevations this community develops on the basalt capping of the upper ridges of Middlebrook Station and most of the uncleared areas of basalt capping within Mountain Station.

Variation:
There are a number of variations within this community's canopy, particularly in regards to variations in the structure and dominant species. Many of the exposed ridge and upper slope areas of Mountain Station and to a lesser extent Middlebrook Station are dominated by almost pure stands of *Eucalyptus blakelyi* with a similar floristic assemblage within the understorey to those adjoining areas with a canopy dominated by *Eucalyptus albens* (White Box).

A significant structural variation of this community has been mapped separately within the subject site as Shrubby Box Woodland. This variation occupies the steeper upper slopes of both Mountain and Middlebrook Stations and contains a dense (>50%) shrub layer. Shrubby Box Woodland has been mapped separately for assessment purposes as it does not meet the specific criteria of the listed Endangered Ecological Community, White Box – Yellow Box – Blakeley's Redgum Woodland.

Disturbance:
This community has been extensively cleared and disturbed by a history of weed invasion and grazing in the shrub and ground layers. Large parts of this community, particularly on Mountain Station have also been subjected to exotic pasture improvement activities. Clearing for fence lines and access roads has also occurred throughout these communities.

Weed Invasion:
This community exhibits extensive weed invasion in both the shrub and ground layers. Large areas of this community have been subjected to exotic pasture improvement activities while the existing grazing pressures have also contributed significantly to the spread of a variety of exotic and native grasses and herbs within the understorey.

10) BOX- IRONBARK GRASSY WOODLAND

Previous Vegetation Studies:
Hill et al., (2001) – OF 10 Narrow-leaved Ironbark Open Forest on basalt slopes/OF9 Box Open Forest on Basalt
Peak (2006) - Map Unit 11 Upper Hunter White Box- Ironbark Grassy Woodland
EEC on the TSC Act - In Part White Box Yellow Box Blakely's Red Gum Woodland
CEEC on the EPBC Act – In Part White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Structure
Trees: To 10-20 metres high with a 10-30% PFC.
Shrubs: To 2-5 metre high with a 10-40% PFC.
Ground: To <0.5 metre high with a 50-90% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus crebra, Eucalyptus albens – molucanna, Brachychiton populneus subsp. populneus.*

Shrubs: *Notelaea microcarpa var. microcarpa, Acacia paradoxa, Olearia elliptica subsp. Elliptica.*

Sub-Shrubs: *Myoporum montanum, Acacia decora, Maireana microphylla* and *Bursaria spinosa subsp. spinosa*

Herbs: *Calotis lappulacea, Einadia hastata, Einadia nutans and Eremophila debilis*

Grasses: *Arisitida ramosa, Austrostipa verticillata, Chloris ventricosa, Eragrostis leptostachya, Cynodon dactylon, Sporobolus creber, Cymbopogan refractus* and *Dichanthium sericeum subsp. sericeum.*

Ferns: *Cheilanthes sieberi subsp. sieberi*

Vines: *Clematis glycinoides* and *Eustrephus latifolius*

Sedges: *Cyperus fulvus*

Location and Distribution:
This vegetation community occurs throughout the south and east of Middlebrook Station on the more fertile lower slopes often associated with highly disturbed grazing areas.

Disturbance:
This community has been highly disturbed in areas by extensive weed invasion, clearing, grazing and the construction of roads.

11) BOX- IRONBARK- RED GUM WOODLAND (*Eucalyptus albensx molacanna, E. crebra & E. blakelyi*)

Previous Vegetation Studies:
Hill et al., (2001) – OF 10 Narrow-leaved Ironbark Open Forest on basalt slopes
Peak (2006) - Map Unit 9 Upper Hunter Hills Box- Ironbark- Red Gum Woodland
EEC on the TSC Act - **NA**
EEC on the EPBC Act - **NA**

Structure
Trees: To 12-20 metres high with a 15-25% PFC.
Shrubs: To 0.5 metre high with a 35-50% PFC.
Ground: To <0.5 metre high with a 40-85% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus albens – molucanna, E. crebra, E. canaliculata, E. laevopinea, E. blakelyi* and *Brachychiton populneus subsp. populneus.*

Low Trees: *Pittosporum undulatum*

Shrubs: *Notelaea microcarpa var. microcarpa* and *Olearia elliptica subsp. elliptica*

Sub-Shrubs: *Myoporum montanum, Sigesbeckia orientalis subsp. orientalis* and *Spartothamnella juncea.*

Herbs: *Pratia purpurascens, Dichondra repens, Lomandra multiflora subsp multiflora* and *Scutellaria humilis*

Grasses: *Microlaena stipoides var. stipoides, Arisitida ramosa, Austrodanthonia fulva* and *Cymbopogan refractus*

Ferns: *Cheilanthes sieberi subsp. sieberi, Pellaea paradoxa* and *Cheilanthes distans.*

Vines: *Cayratia clematidea, Clematis glycinoides, Pandorea pandorana ssp. pandorana, Eustrephus latifolius* and *Cissus opaca*.

Sedges: *Carex incomitata, Lepidosperma laterale, Cyperus imbecillis, Cyperus gracilis, Carex inversa* and *Carex appressa*

Location and Distribution:
This vegetation community occupies upper slopes and ridges of both Middlebrook and Mountain Stations often associated with colluviums adjoining basalt capping.

Disturbance:
This community has been highly disturbed by low to moderate weed invasion, clearing, and in some areas intensive grazing.

12) EXPOSED IRONBARK WOODLAND (*Eucalyptus crebra*)

Previous Vegetation Studies:
Hill et al., (2001) – OF 7 Ironbark - Stringybark Open Forest on Sandstone
Peak (2006) - Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland
***EEC on the TSC Act* - NA**
***EEC on the EPBC Act* - NA**

Structure
Trees: To 12-20 metres high with a 20-30% PFC.
Low Trees: To 5-8 metres high with a variable 20% PFC.
Shrubs: To 1-3 metre high with a 15-40% PFC.
Ground: To <1 metre high with a 40-70% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus crebra, Angophora floribunda, Brachychiton populneus subsp. populneus, E. blakelyi* and *Eucalyptus albens – molucanna.*

Low Trees: *Pittosporum undulatum, Rapanea variabilis* and *Acacia implexa*

Shrubs: *Notelaea macrocarpa var. macrocarpa, Olearia elliptica subsp. elliptica, Breynia oblongifolia* and *Acacia paradoxa*

Sub-Shrubs: *Myoporum montanum, Sigesbeckia orientalis subsp. orientalis* and *Spartothamnella juncea.*

Herbs: *Dichondra repens, Senecio quadridentatus, Daucus glochidiatus, Plantago debilis, Cynoglossum australe* and *Rumex brownii*

Grasses: *Dichelachne micrantha* and *Microlaena stipoides*

Ferns: *Cheilanthes sieberi subsp. sieberi* and *Cheilanthes distans*

Vines: *Desmodium brachypodum, Glycine clandestina, Glycine tabacina species complex, Clematis glycinoides, Pandorea pandorana ssp. pandorana, Eustrephus latifolius* and *Rubus parvifolius*.

Sedges: *Scleria mackaviensis, Lepidosperma laterale, Gahnia aspera, Cyperus gracilis* and *Carex appressa*

Location and Distribution:
This vegetation community occurs throughout the subject site associated with highly exposed slopes, ridges and escarpments.

Disturbance:
This community exhibits only slight disturbance by weed invasion, clearing and grazing.

13) EXPOSED IRONBARK CYPERUS WOODLAND (*Eucalyptus crebra* and *Callitris endlicheri*)

Previous Vegetation Studies:
Hill et al., (2001) – OF 7 Ironbark - Stringybark Open Forest on Sandstone
Peak (2006) - Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland
***EEC on the TSC Act* - NA**
***EEC on the EPBC Act* - NA**

Structure
Trees: To 12-20 metres high with a 20-30% PFC.
Low Trees: To 5-8 metres high with a variable 20% PFC.
Shrubs: To 1-3 metre high with a 15-40% PFC.
Ground: To <1 metre high with a 40-70% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus crebra, Eucalyptus albens – molucanna* and *Angophora floribunda.*

Low Trees: *Callitris endlicheri* and *Persoonia linearis*

Shrubs: *Notelaea microcarpa var. microcarpa, Olearia elliptica subsp. elliptica* and *Leucopogon muticus Podolobium ilicifolium*

Sub-Shrubs: *Melichrus urceolatus.*

Herbs: *Pomax umbellata, Dianella revoluta var. revoluta and Dichondra repens.*

Grasses: *Cleistochloa rigida, Microlaena stipoides var. stipoides, Paspalidium distans* and *Entolasia stricta*

Ferns: *Cheilanthes sieberi subsp. sieberi*

Vines: *Desmodium brachypodum, Glycine clandestina, Glycine tabacina species complex* and *Pandorea pandorana ssp. pandorana*.

Sedges: *Lepidosperma laterale* and *Gahnia aspera.*

Location and Distribution:
This vegetation community occurs throughout the subject site associated with highly exposed slopes ridges and escarpments on Narrabeen sediments.

Disturbance:
This community exhibits only slight disturbance by weed invasion, clearing and grazing.

14) RED GUM WOODLAND (*E. tereticornis*)

Previous Vegetation Studies:

Hill et al., (2001) – NA
Peak (2006) - Map Unit 13 Hunter Floodplain Red Gum Woodland Complex
***EEC on the TSC Act* - NA**
***EEC on the EPBC Act* - NA**

Structure
Trees: To 18-35 metres high with a 5-25% PFC.
Ground: To <1 metre high with a 60-90% PFC.

Floristics:
(Main Species Present)

Trees: *E. tereticornis, E. melliodora, Angophora floribunda* and *Casuarina cunninghamiana subsp. cunninghamiana.*

Shrubs: *Bursaria spinosa, Exocarpus strictus*

Sub-Shrubs: *Solanum cinereum*

Herbs: *Dichondra repens, Einadia hastata, Pratia purpurascens, Alternanthera denticulata, Calotis lappulacea, Commelina cyanea, Einadia trigonos* and *Rumex brownii.*

Grasses: *Austrostipa verticillata, Cynodon dactylon, Arisitida ramosa, Microlaena stipoides var stipoides, Austrodanthonia fulva* and *Sporobolus creber.*

Ferns: *Cheilanthes sieberi subsp. sieberi* and *Cheilanthes austrotenuifolia*

Vines: *Glycine tabacina, Desmodium varians and Glycine clandestina*

Sedges: *Carex sp, Cyperus fulvus* and *Cyperus gracillis*

Location and Distribution:
This vegetation community is restricted to the southern portion of Middlebrook Station on the deep alluvial soils associated with the floodplain.

Disturbance:
This community has been highly disturbed by extensive weed invasion, clearing intensive grazing, construction of roads and alterations to the natural drainage.

15) Exposed Acacia Low Open Forest

Previous Vegetation Studies:
Hill et al., (2001) – Map Unit OF5 Acacia Exposed Low Open Forest
Peak (2006) - Map Unit 16 Upper Hunter Narrabeen Escarpment Acacia Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**

Emergent Trees: To 15 metres high with a Projected Foliage Cover (PFC) of <10%
Trees: To 10 metres high with a 25-45% PFC
Shrubs: To 2 metres high with a 20-60% PFC
Ground: To <1 metres high with a 10-30% PFC

Floristics:
(Main Species Present)

Emergent Trees: *Eucalyptus crebra* and *Eucalyptus sparsifolia*

Trees: *Acacia crassa ssp. crassa, Acacia maidenii, Persoonia linearis, Choretrum* species A*,*

Shrubs: *Hibbertia circumdans, Leucopogon muticus, Hovea lanceolata, Goodenia ovata, Leptospermum polyanthum, Phebalium squamulosum ssp. lineare, Cassinia uncata, Olearia elliptica, Calytrix tetragona, Leptospermum parvifolium.*

Herbs: *Pomax umbellata, Gonocarpus tetragynus* and *Goodenia hederacea ssp. hederacea*

Grasses: *Cleistochloa rigida, Entolasia stricta* and *Digitaria ramularis*

Ferns: *Cheilanthes sieberi ssp. sieberi* and *Cheilanthes austrotenuifolia*

Vines: *Cassytha glabella*

Sedges: *Lepidosperma laterale* and *Lomandra confertifolia ssp. pallida*

Location and Distribution:
This community develops on Narrabeen Sandstone in exposed sites with a northern aspect and containing skele*tal al* soils and steep slopes (Hill and Peak 2000). Within the subject site this community is restricted to isolated occurrences along the north facing pagodas of the escarpments in Middlebrook Station.

Disturbance:
With the exception of bushfires, this community is subject to very few disturbances.

Weed Invasion:
This community exhibits very little weed invasion.

16) ROCKY HEATHLAND ON SANDSTONE BENCHES

Previous Vegetation Studies:
Hill *et al*., (2001) – *Map Unit HL2 Rocky Heathland on Sandstone Benches*
Peak (2006) - Mu 6 Upper Hunter Hills Exposed Ironbark Woodland
EEC on the TSC Act - NA
EEC on the EPBC Act - NA

***Structure*:**

Emergent Trees: To 15 metres high with a Projected Foliage Cover (PFC) of <10%
Trees: To 10 metres high with a 25-45% PFC
Shrubs: To 2 metres high with a 20-60% PFC
Ground: To <1 metres high with a 10-30% PFC

Floristics:
(Main Species Present)

Trees: *Eucalyptus crebra and Eucalyptus sparsifolia*

Trees: *Acacia crassa ssp. crassa, Acacia doratoxylon, Acacia maidenii, Persoonia linearis*

Shrubs: *Dodonaea boroniifolia, Phebalium squamulosum subsp. lineare, Calytrix tetragona, Hovea lanceolata, Leptospermum parvifolium, Zieria cytisoides* and *Xanthorrhoea johnsonii*

Herbs: *Pomax umbellata, Goodenia hederacea ssp. hederacea, Stylidium laricifolium Cleistochloa rigida, Poranthera microphylla Lomandra glauca* and *L. confertifolia ssp. pallida*

Grasses: *Cleistochloa rigida, Entolasia stricta* and *Digitaria ramularis*

Ferns: *Cheilanthes sieberi ssp. sieberi* and *Cheilanthes austrotenuifolia*

Vines: *Cassytha glabella*

Sedges: *Lepidosperma laterale* and *Lomandra confertifolia ssp. pallida*

Location and Distribution:
This community develops on Narrabeen Sandstone in exposed sites with a northern aspect and containing skeletal soils and steep slopes (Hill and Peak 2000). Within the subject site this community was restricted to isolated occurrences along the escarpments in Middlebrook and Mountain Stations.

Disturbance:
With the exception of bushfires, this community is subject to very few disturbances.

Weed Invasion:
This community exhibits very little weed invasion.

17) GRASSLAND WITH SCATTERED TREES

***Structure*:**

Trees: To 25 metres high with a Projected Foliage Cover (PFC) of <5%.

Shrubs: To 5 metres high with a <5% PFC.

Groundlayer: To 1.5 metres high with variable 20 - 95% PFC.

Floristics:
(Main Species Present)

Trees: *Angophora floribunda* (Rough-barked Apple), *Brachychiton populneus* (Kurrajong), *Eucalyptus albens – molacanna* (White Box/Grey Box intergrade)*, Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus tereticornis* (Red gum).

Shrubs: *Acacia spp. Gomphocarpus fruiticosus* (Narrow-leaved Cotton Bush) and *Opuntia stricta* (Prickly Pear).

Groundlayer: *Acaena novae-zelandiae* (Bidgee-Widgee), *Aristida ramosa var. peciosa* (Wire Grass), *Aristida calycina* (Wire Grass), *Austrodanthonia bipartita* (Wallaby Grass), *Austrostipa ramosissima* (Stout Bamboo Grass), *Bidens pilosa* (Cobbler's Pegs), *Bothriochloa decipiens* (Redleg Grass), *Chrysocephalum apiculatum* (Common Everlasting), *Cyperus gracilis, Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Echium plantagineum* (Paterson's Curse), *Lomandra longifolia* (Spiky-headed Mat-rush), *Microlaena stipoides var. stipoides* (Weeping Rice Grass), *Plantago debilis* (Slender Plantain)*, Plantago lanceolata* (Ribwort), *Rostellularia adscendens ssp. adscendnes var. pogonanthera, Rumex brownie* (Swamp Dock), *Senecio madagascariensis* (Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Urtica urens* (Small Stinging Nettle) and *Vittadinia sulcata.*

Location and Distribution:
This vegetation community occurs throughout the subject site and is associated with highly disturbed areas of pasture and grazing.

Variation:
This community contains a number of considerable variations largely associated with the degree of disturbance and topographic location. Scattered along the western portion of the subject site are a number of artificial dams. These water bodies contain a variety of aquatic and semi aquatic herbs around their perimeters.

Disturbance:
This community has been highly disturbed by extensive weed invasion, clearing, grazing, construction of roads and alterations to the natural drainage.

Weed Invasion:
This community exhibits extensive weed invasion in both the shrub and ground layers.

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
TREES		
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Casuarinaceae	*Casuarina cunninghamiana*	River Oak
Cupressaceae	*Callitris endlicheri*	Black Cyperus Pine
Cupressaceae	*Callitris glaucophylla*	White Cyperus Pine
Meliaceae	*Melia azedarach* var. *australasica*	White Cedar
Mimosaceae	*Acacia irrorata* subsp. *irrorata*	Green Wattle
Mimosaceae	*Acacia maidenii*	Maiden's Wattle
Mimosaceae	*Acacia parvipinnula*	Silver-stemmed Wattle
Mimosaceae	*Acacia salicina*	Native Willow
Mimosaceae	*Acacia stenophylla*	River Cooba
Moraceae	*Ficus coronata*	Sandpaper Fig
Moraceae	*Ficus rubiginosa*	Port Jackson Fig
Myrsinaceae	*Rapanea howittiana*	Brush Muttonwood
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle
Myrtaceae	*Eucalyptus albens*	White Box
Myrtaceae	*Eucalyptus albensx molacanna*	White Box/Grey Box intergrade
Myrtaceae	*Eucalyptus blakelyi*	Blakelys Red Gum
Myrtaceae	*Eucalyptus canaliculata*	Large Fruited Grey Gum
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus dalrympleana*	Mountain Gum
Myrtaceae	*Eucalyptus dawsonii*	Slaty Gum
Myrtaceae	*Eucalyptus laevopinea*	Silver-top Stringybark
Myrtaceae	*Eucalyptus melliodora*	Yellow Box
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus sideroxylon*	Red Ironbark
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Oleaceae	*Notelaea microcarpa* var. *microcarpa*	Native Olive
Oleaceae	*Notelaea microcarpa* var. *velutina*	Native Olive
Oleaceae	*Olea europa* subsp. *africana**	Common Olive
Pittosporaceae	*Pittosporaceae undulatum*	Sweet Pittosporum
Rhamnaceae	*Alphitonia excelsa*	Red Ash
Rutaceae	*Melicope micrococca*	White Euodia
Santalaceae	*Exocarpos cupressiformis*	Native Cherry
Santalaceae	*Exocarpos strictus*	Pale Ballart
Sterculiaceae	*Brachychiton populneus* ssp. *populneus*	Kurrajong
SHRUBS		
Amaranthaceae	*Nyssanthes diffusa*	Barbwire Weed
Asclepidaceae	*Gomphocarpus fruiticosus**	Narrow Leaf Cotton Bush

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
SHRUBS (Cont.)		
Asteraceae	*Cassinia aculeata*	Dolly Bush
Asteraceae	*Cassinia cunninghamii*	-
Asteraceae	*Cassinia quinquefaria*	-
Asteraceae	*Olearia elliptica*	Sticky Daisy-bush
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting
Asteraceae	*Xanthium spinosum**	Bathurst Burr
Cactaceae	*Opuntia stricta* var. *stricta**	Common Prickly Pear
Celastraceae	*Cassine australis* var. *australis*	Red Olive Plum
Celastraceae	*Maytenus silvestris*	-
Cesalpinioideae	*Senna aciphylla*	-
Dilleniaceae	*Hibbertia acicularis*	Prickly Guinea Flower
Ericaceae - styphelioideae	*Leucopogon lanceolatus* var. *lanceolatus*	Lance Bearded Heath
Ericaceae - styphelioideae	*Leucopogon muticus*	-
Ericaceae - styphelioideae	*Leucopogon* sp.	
Ericaceae - styphelioideae	*Lissanthe strigosa* subsp. *strigosa*	Peach Heath
Ericaceae - styphelioideae	*Melichrus procumbens*	Jam Tarts
Ericaceae - styphelioideae	*Melichrus urceolatus*	Urn Heath
Ericaceae - styphelioideae	*Styphelia triflora*	Five Corners
Euphorbiaceae	*Beyeria viscosa*	-
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Fabaceae	*Daviesia genistifolia*	-
Fabaceae	*Hovea lanceolata*	-
Fabaceae	*Hovea linearis*	-
Fabaceae	*Indigofera australis*	Native Indigo
Fabaceae	*Swainsona galegifolia*	Smooth Darling Pea
Faboideae	*Podolobium ilicifolium*	Prickly Shaggy Pea
Lamiaceae	*Prostanthera ovalifolia*	-
Lamiaceae	*Spartothamnella juncea*	-
Mimosaceae	*Acacia crassa* ssp.*crassa*	-
Mimosaceae	*Acacia cremiflora*	-
Mimosaceae	*Acacia cultriformis*	Knife-leaved Wattle
Mimosaceae	*Acacia decora*	Western Golden Wattle
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia implexa*	Hickory
Mimosaceae	*Acacia paradoxa*	Kangaroo Thorn
Mimosaceae	*Acacia piligera*	-
Mimosaceae	*Acacia terminalis*	Sunshine Wattle
Mimosaceae	*Acacia ulicifolia*	Prickly Moses
Mimosaceae	*Acacia verniciflua*	Varnish Wattle
Myoporaceae	*Eremophila debilis*	Winter Apple
Myoporaceae	*Myoporum montanum*	Western Boobialla

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
SHRUBS (Cont.)		
Myrsinaceae	*Rapanea variabilis*	Muttonwood
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush
Myrtaceae	*Calytrix tetragona*	-
Myrtaceae	*Leptospermum parvifolium*	Small-leaved Tea-tree
Myrtaceae	*Leptospermum polygalifolium*	Lemon-scented Tea-tree
Myrtaceae	*Melaleuca nodosa*	Ball Honey Myrtle
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Rhamnaceae	*Cryptandra amara* var. *amara*	-
Rhamnaceae	*Cryptandra spinescens*	-
Rhamnaceae	*Spyridium buxifolium*	-
Rosaceae	*Rubus parvifolius*	Native Raspberry
Rubiaceae	*Canthium buxifolium*	-
Rubiaceae	*Opercularia aspera*	Common Stinkweed
Rubiaceae	*Opercularia diphylla*	-
Rubiaceae	*Psychotria loniceroides*	-
Rutaceae	*Boronia angustisepala*	-
Rutaceae	*Geijera parviflora*	-
Rutaceae	*Phebalium squamulosum* subsp. lineare	Scaly Phebalium
Rutaceae	*Zieria cytisoides*	Downy Zieria
Santalaceae	*Choretrum candollei*	-
Sapindaceae	*Alectryon subcinereus*	Native Quince
Sapindaceae	*Dodonaea triquetra*	Hop Bush
Sapindaceae	*Dodonaea boroniifolia*	-
Sapindaceae	*Dodonaea viscosa* subsp. *angustifolia*	-
Sapindaceae	*Dodonaea viscosa* subsp. *cuneata*	-
Solanaceae	*Solanum aviculare*	Kangaroo Apple
Solanaceae	*Solanum elegans*	Spiny Kangaroo Apple
Solanaceae	*Solanum nigrum**	Black-berry Nightshade
Solanaceae	*Solanum radicans**	-
Solanaceae	*Solanum stelligerum*	Devil's Needles
Thymelaeaceae	*Pimelea linifolia*	Rice Flower
Ulmaceae	*Trema tomentosa* var. *viridis*	Native Peach
Verbenaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum
Violaceae	*Hymenanthera dentata*	Tree Violet
GROUNDCOVERS		
Acanthaceae	*Brunoniella australis*	Blue Trumpet
Acanthaceae	*Rostellularia adscendens* var. *pogonanthera*	-
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair
Adiantaceae	*Pellaea falcata*	Sickle Fern

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla Lily
Apiaceae	*Centella asiatica*	Pennywort
Apiaceae	*Conium maculatum**	Hemlock
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Apiaceae	*Daucus glochidiatus*	Native Carrot
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Aspleniaceae	*Asplenium flabellifolium*	Necklace Fern
Asteraceae	*Arctotheca calendula**	Capeweed
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Asteraceae	*Calotis cuneifolia*	Purple Burr Daisy
Asteraceae	*Calotis lappulacea*	Yellow Burr Daisy
Asteraceae	*Chondrilla juncea**	Skeleton Weed
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza albida**	Tall Fleabane
Asteraceae	*Conyza bonariensis**	Flax-leaf Fleabane
Asteraceae	*Cotula australis*	Common Cotula
Asteraceae	*Cymbonotus lawsonianus*	Bears-ear
Asteraceae	*Euchiton* sp.	-
Asteraceae	*Gamochaeta* sp.*	-
Asteraceae	*Glossogyne tannensis*	Cobbler's Tack
Asteraceae	*Hypochaeris radicata**	Catsear
Asteraceae	*Lactuca serriola**	Prickly Lettuce
Asteraceae	*Lagenifera stipitata*	-
Asteraceae	*Pseudognaphalium luteoalbum*	Cudweed
Asteraceae	*Senecio madagascariensis**	Fireweed
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed
Asteraceae	*Sigesbeckia orientalis* var. *orientalis*	Indian Weed
Asteraceae	*Silybum marianum**	Variegated Thistle
Asteraceae	*Soliva* sp.*	Bindii
Asteraceae	*Sonchus asper* subsp. *glaucescens**	Rough Sowthistle
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Asteraceae	*Taraxacum officinale**	Dandelion
Asteraceae	*Vernonia cinerea* var. *cinerea*	-
Asteraceae	*Vittadinia cuneata* var. *cuneata*	Fuzzweed
Asteraceae	*Vittadinia sulcata*	-
Boraginaceae	*Cynoglossum latifolium*	-
Boraginaceae	*Echium plantagineum**	Patterson's Curse
Brassicaceae	*Capsella bursa-pastoris**	Shepherds Purse
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell
Campanulaceae	*Wahlenbergia luteola*	Bluebell

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Campanulaceae	*Wahlenbergia* sp.	Native Bluebell
Campanulaceae	*Wahlenbergia stricta* subsp. *stricta*	Austral Bluebell
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed
Caryophyllaceae	*Stellaria media**	Common Chickweed
Chenopodiaceae	*Chenopodium christatum*	Crested Goosefoot
Chenopodiaceae	*Chenopodium pumilo*	-
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia polygonoides*	Saltbush
Colchicaceae	*Burchardia umbellata*	Milkmaids
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Convolvulaceae	*Dichondra repens*	Kidney Weed
Convolvulaceae	*Dichondra* species A	Hairy Kidney Weed
Crassulaceae	*Crassula sieberiana*	Australian Stonecrop
Cucurbitaceae	*Citrullus lanatus* var *lanatus**	Bitter Melon
Cyperaceae	*Carex appressa*	Tall Sedge
Cyperaceae	*Carex inversa*	Knob Sedge
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus gracilis*	-
Cyperaceae	*Cyperus imbecilis*	-
Cyperaceae	*Gahnia aspera*	Saw Sedge
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Cyperaceae	*Lepidosperma* sp.	-
Cyperaceae	*Scleria mackaviensis*	-
Dilleniaceae	*Hibbertia linearis*	-
Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea Flower
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed
Euphorbiaceae	*Euphorbia planiticola*	-
Euphorbiaceae	*Poranthera microphylla*	-
Fabaceae	*Melilotus indicus**	-
Fabaceae	*Medicago arabica**	-
Fabaceae	*Trifolium repens**	White Clover
Fabaceae	*Trifolium* sp.*	Clover
Gentianaceae	*Centaurium erythraea**	Common Centaury
Geraniaceae	*Erodium* sp.*	Storksbills
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Geraniaceae	*Geranium potentilloides* var. *potentilloides*	-
Geraniaceae	*Geranium solanderi* var. *solanderi*	Cutleaf Cranesbill
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Goodeniaceae	*Goodenia ovata*	-
Goodeniaceae	*Goodenia* sp.	-

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Iridaceae	*Romulea rosea**	Onion Grass
Lamiaceae	*Marrubium vulgare**	Horehound
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower
Lamiaceae	*Scutellaria humilis*	Dwarf Skull Cap
Lamiaceae	*Stachys arvensis**	Stagger Weed
Liliaceae	*Caesia parviflora* var. *parviflora*	Pale Grass Lily
Liliaceae	*Dianella revoluta*	Mauve Flax Lily
Lobeliaceae	*Isotoma axillaris*	Showy Isotoma
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Loliaceae	*Dianella longifolia*	-
Lomandraceae	*Lomandra confertifolia*	-
Lomandraceae	*Lomandra confertifolia* subsp. *pallida*	-
Lomandraceae	*Lomandra filiformis* subsp. *coriacea*	Wattle Mat-rush
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra glauca* subsp. *glauca*	-
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush
Malvaceae	*Abutilon oxycarpum*	Flannel Weed
Malvaceae	*Malva parviflora**	Paddy Melon
Malvaceae	*Sida corrugata*	-
Malvaceae	*Sida cunninghamii*	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Orchidaceae	*Acianthus fornicatus*	Pixie Caps
Orchidaceae	*Corybas* sp.	Helmet Orchid
Orchidaceae	*Pterostylis concinna*	Trim Greenhord
Orchidaceae	*Pterostylis* sp.	Greenhood
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel
Oxalidaceae	*Oxalis exilis*	-
Oxalidaceae	*Oxalis latifolia*	Fish-tail Oxalis
Oxalidaceae	*Oxalis perrenans*	-
Oxalidaceae	*Oxalis pes caprae*	Soursob
Phormiaceae	*Dianella caerulea* var. *cinerascens*	Blue Flax Lily
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily
Plantaginaceae	*Plantago debilis*	Slender Plantain
Plantaginaceae	*Plantago gaudichaudii*	-
Plantaginaceae	*Plantago lanceolata**	Ribwort
Poaceae	*Aristida calycina*	Wire Grass
Poaceae	*Aristida ramosa*	Wire Grass
Poaceae	*Aristida ramosa* var. *speciosa*	Wire Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Aristida warburgii*	Wire Grass

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Poaceae	*Austrodanthonia bipartita*	Wallaby Grass
Poaceae	*Austrodanthonia linkii* var. *fulva*	Wallaby Grass
Poaceae	*Austrodanthonia* sp.	Wallaby Grass
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass
Poaceae	*Austrostipa setacea*	Corkscrew Grass
Poaceae	*Austrostipa verticillata*	-
Poaceae	*Bothriochloa decipiens*	Redleg Grass
Poaceae	*Cenchrus caliculatus*	Hillside Burr-grass
Poaceae	*Cenchrus incertus**	Spiny Burr-grass
Poaceae	*Chloris truncata*	Windmill Grass
Poaceae	*Chloris ventricosa*	Tall Chloris
Poaceae	*Cleistochloa rigida*	-
Poaceae	*Cleistochloa rigida*	-
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Poaceae	*Dichanthium sericeum* subsp. *sericeum*	Queensland Bluegrass
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass
Poaceae	*Digitaria ramularis*	-
Poaceae	*Echinopogon caespitosus*	Tufted Hedgehog Grass
Poaceae	*Echinopogon intermedius*	Erect Hedgehog Grass
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Poaceae	*Oplismenus aemulus*	Basket Grass
Poaceae	*Oplismenus imbecillis*	-
Poaceae	*Panicum effusum*	Hairy Panic
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Poa seiberiana*	Tussock Grass
Poaceae	*Themeda australis*	Kangaroo Grass
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass
Polygonaceae	*Acetosella vulgaris**	Sheep Sorrel
Polygonaceae	*Rumex brownii*	Swamp Dock
Polygonaceae	*Rumex pulcher**	Fiddle Dock
Polygoniaceae	*Polygonum arviculare**	Wireweed
Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel
Primulaceae	*Anagallis* sp.*	Pimpernel
Rosaceae	*Acaena novae-zelandiae*	Bidgee-widgee
Rosaceae	*Acaena ovina*	Biddy Biddy
Rubiaceae	*Asperula conferta*	Common Woodruff
Rubiaceae	*Galium migrans*	Bedstraw

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Rubiaceae	*Pomax umbellata*	Whiteroot
Scrophulariaceae	*Verbascum thapsus* ssp. *thapsus**	Aaron's Rod
Scrophulariaceae	*Veronica plebia*	Creeping Speedwell
Sinopteridaceae	*Cheilanthes austrotenuifolia*	-
Sinopteridaceae	*Cheilanthes distans*	Bristly Cloak Fern
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern
Sinopteridaceae	*Pellaea paradoxa*	-
Solanaceae	*Solanum americanum**	Glossy Nightshade
Solanaceae	*Solanum campanulatum*	-
Solanaceae	*Solanum cinereum*	Narrawa Burr
Solanaceae	*Solanum parvifolium*	-
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum* sp.	-
Stackhousiae	*Stackhousia monogyna*	Creamy Candles
Stylidiaceae	*Stylidium* sp.	Trigger Plant
Thymelaeaceae	*Pimelea curviflora*	
Urticaceae	*Urtica incisa*	Stinging Nettle
Urticaceae	*Urtica urens**	Small Stinging Nettle
Xanthorrhoaceae	*Xanthorrhoea glauca* subsp. *glauca*	-
Xanthorrhoaceae	*Xanthorrhoea johnsonii*	-
Zamiaceae	*Macrozamia concinna*	-
Epiphytes		
Loranthaceae	*Amyema pendulum* ssp. *pendulum*	Drooping Mistletoe
Orchidaceae	*Cymbidium canaliculatum*	Tiger Orchid
Orchidaceae	*Cymbidium suave*	Native Cymbidium
Orchidaceae	*Dendrobium liguiforme* var *liguiforme*	Rock Lily
Orchidaceae	*Dendrobium speciosum*	Rock Lily
Polypodiaceae	*Pyrrosia rupestris*	Rock Felt Fern
VINES		
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Bignoniaceae	*Pandorea pandorana* ssp. *pandorana*	Wonga Vine
Chenopodiaceae	*Einadia nutans* subsp. *nutans*	Climbing Saltbush
Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil
Fabaceae	*Desmodium varians*	-
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine latifolia*	-
Fabaceae	*Glycine tabacina*	Twining Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Fabaceae	*Glycine tabacina* species complex	Glycine
Lauraceae	*Cassytha glabella* forma *glabella*	Slender Devil's Twine
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily

TABLE 2.3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
VINES (Cont.)		
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Ranunculaceae	*Clematis glycinoides* var. *glycinoides*	Clematis
Vitaceae	*Cayratia clematidea*	Slender Grape
Vitaceae	*Cissus antarctica*	Native Grape
Species name^{TS} = Threatened Species * = Introduced Species		

2.3 RARE OR THREATENED FLORA SPECIES

A search of the BioNet (Map 2007) Database and DECC (2007) Atlas Database for the entire Muswellbrook 1:100,000 sheet was undertaken to identify records of threatened flora species located within the locality of the site. This allowed for a specific targeted search for threatened flora to be undertaken within the study site. Details on threatened flora species as listed in Schedules 1 and 2 of the *TSC Act* (1995), with a known or possible occurrence within the local area, are provided in Table 2.4.

TABLE 2.4 THREATENED FLORA SPECIES OF THE AREA				
Species	**TSC Act**	**EPBC Act**	**Growth Form and Habitat Requirements**	**Comments**
Commersonia rosea	E1	-	A prostrate shrub 0.1 - 0.3m high, producing trailing branches up to 60cm long. Occurs on skele*tal al* sandy soils in scrub or heath. Only known from four localities in the Sandy Hollow district of the upper Hunter Valley, New South Wales, all within an 8km radius of Sandy Hollow.	Suitable habitat present. Not observed during flora survey
Cymbidium canaliculatum	E2	-	Epiphyte with sympodial growth; Grows in the hollows of trees in dry sclerophyll forest or woodland; north from the Hunter Valley, chiefly in inland districts, west to New Angledool. Distributed north from the Hunter Valley, chiefly in inland districts, west to New Angledool to Gympie in Qld.	Suitable habitat present. 7 individual populations were observed during flora survey within the Box Woodland vegetation community
Digitaria porrecta	E1	E	A loosely tufted grass growing to 60 cm tall that favours White Box grassy woodlands In NSW it is restricted to the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran.	Suitable habitat present. Not observed during flora survey

TABLE 2.4 (Cont.) THREATENED FLORA SPECIES OF THE AREA				
Species	**TSC Act**	**EPBC Act**	**Growth Form and Habitat Requirements**	**Comments**
Diuris pedunculata	E	E	The Small Snake Orchid is less than 10 cm tall. Favouring grassy slopes or flats often on peaty soils in moist areas. Also on shale and trap soils, on fine granite, and among boulders. Confined to NSW. It was originally found scattered from Tenterfield south to the Hawkesbury River, but is now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor	Suitable habitat present. Not observed during flora survey
Diuris tricolor	V	V	The Pine Donkey Orchid is a terrestrial species to 30 centimetres long and 4mm wide that favours Callitris – Ironbark Woodlands and Acacia shrubland. Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW.	Suitable habitat present. Not observed during flora survey
Goodenia macbarronii	V	-	A short-lived perennial herb to 30 cm tall. It favours moist, shaded, sandy sites, soils with impeded drainage, spring-fed paddocks and open areas where water is more available. It is widely distributed throughout the tablelands, western slopes and western plains.	Suitable habitat present. Not observed during flora survey
Kennedia retrorsa	V	V	A vigorous, climbing perennial herb covered with rusty or white hairs. Found in a variety of habitats from mountainsides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines. Believed to be restricted to the Mount Dangar area and the adjacent Goulburn River catchment, within the Muswellbrook and adjacent Merriwa local government areas.	Suitable habitat present. Not observed during flora survey
Lasiopetalum longistamineum	V	V	Spreading shrub to 1.5 m high with dense rusty- intertwined hairs on branches. Grows in grassy woodlands of *Eucalyptus albens* (white box). Occurs in the Mt Dangar - Gungal area within Merriwa and Muswellbrook Local Government Areas.	Suitable habitat present. Not observed during flora survey
Ozothamnus tesselatus	V	V	Dense shrub to 1 m high which favours sandstone eucalypt woodland. Restricted to a few locations north of Rylstone.	Suitable habitat present. Not observed during flora survey

TABLE 2.4 (Cont.) THREATENED FLORA SPECIES OF THE AREA				
Species	**TSC Act**	**EPBC Act**	**Growth Form and Habitat Requirements**	**Comments**
Philotheca ericifolia	V	V	Much-branched and wide spreading shrub, 1-2 m high, with sparsely warty branchlets. It Favours dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW.	Suitable habitat present. Not observed during flora survey
Pomaderris bodalla	V	-	Bodalla Pomaderris is a shrub between 2 and 4 metres high. In the upper Hunter Valley, it occurs in open forest or woodland on open slopes. Bodalla Pomaderris is endemic to NSW and is currently known to occur on the south coast between Bodalla and Merimbula, and in the upper Hunter Valley near Muswellbrook	Suitable habitat present. Not observed during flora survey
Pomaderris queenslandica	E1	-	Scant Pomaderris is a medium-sized shrub 2 - 3m tall that favours moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. Widely scattered but not common in north-east NSW and in Queensland.	Suitable habitat is present. Not observed during flora survey. Previously recorded from the adjoining Towarri NP
Pomaderris reperta	E1	-	Shrub, 1 to 3 metres high that favours woodland in association with Eucalyptus crebra, E. blakelyi, Notelaea microcarpa, and Allocasuarina littoralis. Recorded from a small number of sites along a single ridgeline near Denman in the upper Hunter Valley (Muswellbrook local government area).	Suitable habitat present. Not observed during flora survey
Prostanthera cineolifera	V	V	Erect shrub, 1-4 m high, strongly aromatic; branches moderately to densely covered with short, curled hairs and +/- sessile glands. Found in Sclerophyll forest. The distribution of this taxon is uncertain.	Suitable habitat present. Not observed during flora survey
Prostanthera cryptandroides subsp. Cryptandroides	V	V	A low-spreading shrub with a distinctive, pleasant aroma commonly growing 0.5 - 1 m tall that favours in rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities Occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into Queensland	Suitable habitat present. Not observed during flora survey.

TABLE 2.4 (Cont.) THREATENED FLORA SPECIES OF THE AREA				
Species	**TSC Act**	**EPBC Act**	**Growth Form and Habitat Requirements**	**Comments**
Rulingia procumbens	V	V	Prostrate shrub with slender trailing stems to 30 cm long. Plants covered with star-shaped hairs on all parts. This species favours sandy sites. Endemic to NSW mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and four additional populations found in Goonoo SF.	Marginal habitat present. Not observed during flora survey
Thesium australe	V	V	Erect herb to 0.4 m high. Root parasite. Grassland or woodland often damp or fertile soils. Distribution limits N - Tweed Heads S - south of Eden.	Suitable habitat present. Not observed during flora survey

Following detailed consideration of the site and species listed in Table 2.4 it is considered that there is suitable and / or sub-optimal habitat on the subject site for the following species:

- *Commersonia rosea*
- *Cymbidium canaliculatum*
- *Diuris pedunculata*
- *Diuris tricolor*
- *Digitaria porrecta*
- *Goodenia macbarronii*
- *Kennedia retrorsa*
- *Lasiopet alum longistamineum*
- *Ozothamnus tesselatus*
- *Philotheca ericifolia*
- *Pomaderris bodalla*
- *Pomaderris queenslandica*
- *Pomaderris reperta*
- *Prostanthera cineolifera*
- *Prostanthera cryptandroides subsp. Cryptandroides*
- *Rulingia procumbens*
- *Thesium australe*

One (1) threatened flora species listed in the *TSC Act (1995)* was observed on site. This species were *Cymbidium canaliculatum.*

2.4 LOCAL AND REGIONAL DISTRIBUTION OF VEGETATION

The local and regional distribution of each vegetation community observed within the subject site is provided in Table 2.5. The regional extent, significance and conservation significance of each community has been extrapolated from the corresponding vegetation type described by Peak (2006). The extent of each community's reservation within the local conservation reserve of Towarri NP has been has been extrapolated from the corresponding vegetation type described by Hill *et al.* (2001).

TABLE 2.5 DISTRIBUTION AND CONSERVATION SIGNIFICANCE OF VEGETATION COMMUNITIES				
Community Name	**Region Extent (Peak 2006)**	**Regional Significance (Peak 2006)**	**Conservation Significance (Peak 2006)**	**Extent within Towarri NP (Hill *etal.* 2001)**
1) Dry Rainforest Closed Forest	40ha	Not Significant	Limited extent but not threatened.	36.46ha
2) Ironbark - Box Open Forest	5687ha	Significant (threatened, poorly reserved)	2(L) and 1(V)	360.13ha
3) Ironbark Open Forest	5687ha	Significant (threatened, poorly reserved)	2(L) and 1(V)	360.13ha
4) Ironbark-Stringybark Open Forest on Sandstone	4202ha	Not Significant	2(L)	1092.13ha
5) Grey Gum -Ironbark Open Forest	4202ha	Not Significant	2(L)	688.39ha
6) Grey Gum – Stringybark Sheltered Open Forest	145ha	Not Significant	Limited extent but not threatened.	328.26ha
7) Grey Gum – Apple Alluvial Open Forest	145ha	Not Significant	Limited extent but not threatened.	695.33ha
7) Slaty Gum Open Forest	In part 5687ha	Significant (threatened, poorly reserved)	2(L) and 1(V)	N/A
9) Box Woodland	5687ha	Significant (threatened, poorly reserved)	2(L) and 1(V)	367.57ha
10) Upper Hunter White Box – Ironbark Grassy Woodland	5687ha	Significant (threatened, poorly reserved)	2(L) and 1(V)	360.13ha
11) Upper Hunter Hills Box Ironbark Red Gum Woodland	60ha	Not Significant	Limited extent but not threatened.	360.13ha
12) Upper Hunter Hills Exposed Ironbark Woodland	4202ha	Not Significant	2(L)	1048.57ha
13) Hunter Floodplain Red Gum Woodland Complex	436ha	Significant (very rare, highly cleared, highly threatened and not reserved)	1(C) and 2 (V)	N/A
14) Acacia Heath	215ha	Not Significant	Limited extent but not threatened.	291.30ha
15) Rocky Heathland on Sandstone Benches	In part 4202ha	Not Significant	2(L)	22ha

One regionally significant plant species was observed within the subject site. This species was *Macrozamia concinna* (Burrawang). This species was identified by Hill et al. (2001) as having a conservation status of Nationally Rare but it is not currently listed on the schedules of the TSC Act (1995) or ROTAP lists.

This species was observed scattered throughout the northern portion of Middlebrook and Mountain Stations associated with the Ironbark - Box Open Forest, Ironbark Open Forest, and Ironbark-Stringybark Open Forest on Sandstone vegetation communities, particularly in areas of shallow soil. Hill et al. (2001) describes the distribution of this species in Towarri NP as being recorded from a number of plots in the Dry Creek, Middlebrook and Glen Range additions, all on sandstone and that it was likely to occur throughout these and Castle Rock addition within drier vegetation communities. The proposal will not require the removal of this species within the subject site.

2.5 ENDANGERED FLORA POPULATIONS AND ENDANGERED ECOLOGICAL COMMUNITIES

Endangered Flora Populations

There are four Endangered Flora Populations known within the local area. These are:

- *Acacia pendula*
- *Cymbidium canaliculatum*
- *Eucalyptus camaldulensis*
- *Leionema lamprophyllum* subsp. *obovatum*

Details on these Endangered Flora Populations are provided below.

Acacia pendula - is listed as an endangered population within the Hunter Catchment. The Hunter population of *Acacia pendula* is restricted to fewer than 1000 individuals, from 6 locations – Jerry's Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site.

Cymbidium canaliculatum - is listed as an endangered population within the Hunter Catchment. There are currently 8 records of this species within the Hunter Central Rivers CMA region (BioNet 2007). Seven (7) clumps of this species were observed in the subject site within the Box Woodland vegetation community. Clumps are defined as single clusters which may contain multiple individual bulbs. Each of these populations will be retained as part of the proposal. One of these clumps is isolated within a paddock tree by more than 5km from the nearest other known specimen. It is questionable whether the species at this location will remain viable in the long term.

Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

Eucalyptus camaldulensis - is listed as an endangered population within the Hunter Catchment. This species has not been recorded within 10km of the subject site (DECC, 2007). No specimens of this species were observed within the subject site. The proposal will not require the removal of this species habitat within the subject site.

Leionema lamprophyllum subsp. *obovatum* - is listed as an endangered population within the Hunter Catchment. The Hunter Catchments population occurs near Pokolbin, where it is found on a rocky cliff line in a dry eucalypt forest. This species has not been recorded within 10km of the subject site (DECC, 2007). No specimens of this species were observed within the subject site.

Endangered Ecological Community

There is one Endangered Ecological Community listed on Schedule 1, Part 3 of the TSC Act (1995) that is known to occur within the local area. This is the White Box - Yellow Box Blakely's Red Gum Woodland. This ecological community was observed within the subject site. Details on this Endangered Ecological Community are provided below.

White Box-Yellow Box--Blakely's Red Gum Woodland (WBYBBRW)

General Description

A variable complex of vegetation structures, ranging from woodland to open woodland. This complex has characteristic tree species which include any one of the following: *Eucalyptus albens, Eucalyptus melliodora* or *Eucalyptus blakelyi* (NSW Scientific Committee 2002).

Habitat Requirements

- **Geology / Soils:** relatively fertile soils on the tablelands and western slopes
- **Topography:** Generally undulating
- **Characteristic** Canopy Species: Variable, includes species such as *Allocasuarina verticillata, Brachychiton populneus, Eucalyptus blakelyi, E. albens*, *E. bridgesiana, E. melliodora, E. goniocalyx, E. nortonii* and *E. microcarpa*

Conservation Status and Distribution
Occurs within the North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and South Western Slopes Bioregions. Small areas are known to be reserved in the Goulburn River NP, Wollemi NP, Manobalai NR, Mt Kaputar NP, Oxley Wild Rivers NP, Queanbeyan NR, Towari NP, Warrumbungle NP and Wingen Maid NR (NSW Scientific Committee 2002).

Key Threatening Processes
Clearing of native vegetation.

Occurrence in Subject Site
To assess the occurrence of this community within the subject site, each of the vegetation communities were evaluated against the specific criteria listed within, the *Final Determination for the EEC, White Box Yellow Box Blakely's Red Gum Woodland (*NSW Scientific Committee 2002*)* and the, *Identification guidelines for determining Box Gum Woodland (*NPWS 2002)

Eucalyptus albens (White Box) is one of the key diagnostic tree species of this endangered ecological community, while *Eucalyptus molluccana* (Grey Box) is not. It is considered that a number of box specimens within the subject site were likely to be hybrid crosses between these two species. These hybrid box specimens have been previously recognised within the local area (Peak 2006, Hill *et al.,* 2001). It is considered that the subject site lies on the eastern limit of the *Eucalyptus albens* (White Box) and consequently the White Box Yellow Box Blakely's Red Gum Woodland distribution.

In regards to the communities dominated by hybrid box specimens, the final determination for WBYBBRW specifically states;

"Woodlands including Eucalyptus crebra, Eucalyptus dawsonii and Eucalyptus moluccana (and intergrades with Eucalyptus albens), for example in the Merriwa plateau, Goulburn River National Park and western Wollemi National Park, are also included. (NSW Scientific Committee 2002)"

Therefore, as the subject site is located in the locality of the Merriwa plateau and Goulburn River National Park, it is considered that areas of vegetation containing *Eucalyptus albens x Eucalyptus moluccana* that meet the other specific requirements will be assessed as being the Endangered Ecological Community, WBYBBRW.

Within the subject site four vegetation communities were identified that contain some of the floristic characteristics of WBYBBRW, these communities included;

- 2 - Ironbark - Box Open Forest
- 9 - Box Woodland (Grassy variant)
- 10 - Box – Ironbark Grassy Woodland
- 11 - Box Ironbark Red Gum Woodland

Of these communities, it was found that a shrubby variation of the Box Woodland community, the Box Ironbark Red Gum Woodland and the Ironbark – Box Woodland vegetation community did not meet the characteristic requirements of the EEC. In particular, these communities were located on the steep upper and mid slopes of Middlebrook Station and Mountain Station associated with the areas of shallower soils derived from basalt colluviums over predominately Narrabeen sediments and contained a characteristically dense shrub layer of non- pioneering species.

The Identification guidelines for determining Box Gum Woodland (NPWS 2002) are specific in stating;

"shrubby woodlands, which generally occur in upper or midslope situations on shallower soils, are not part of the EEC". and;

"*Where shrubby woodlands dominated by White Box, Yellow Box or Blakely's Red Gum intergrades with the Box- Gum Woodland the more shrub-free sections of the community should be regarded as Box-Gum Woodland. (NPWS 2002)".*

The vegetation communities found to meet the requirements for WBYBBRW within the subject site and the areas of each are provided in Table 2.6.

TABLE 2.6
ENDANGERED ECOLOGICAL COMMUNITIES

	Middlebrook Station	**Mountain Station**	**Total**
9 - Box Woodland (Grassy variant)	**197**	**289**	**486**
In part, 10 - Box – Ironbark Grassy Woodland	**163**	**0**	**163**
TOTAL	**360**	**289**	**649**

These communities occupied approximately 649ha of the subject site and varied from highly disturbed isolated remnants to relatively undisturbed contiguous patches.

The proposal will require the removal of approximately 8ha or 1.2% of the total occurrence of this community for the construction of wind turbines, small building pads and associated power/road construction. The impacts of the proposal on this endangered ecological community are assessed in detail in Section 4 of this Report.

SECTION 3

FAUNA CHARACTERISTICS

3.1 FAUNA SURVEY METHODOLOGY

In order to detect the possible occurrence of threatened fauna species specific methods targeting these species were employed in addition to the standard fauna survey methods of nocturnal spotlighting and habitat searches. Details on the fauna survey methods are provided below:

Literature Review:

- Review of local resource documents
- A search of the Atlas of NSW Wildlife (DECC 2007) database of threatened fauna records was undertaken to identify records of threatened species located within 10km of the subject site

Fauna Survey (to date)

Fauna survey of the site incorporating the following fauna survey methods was utilised:

- Arboreal & terrestrial mammal trapping (Type A (20) & B (10) Elliott traps for 3 nights)
- Large cage trapping for larger terrestrial fauna.
- Nocturnal spotlighting for birds, arboreal and terrestrial mammals, reptiles and frogs
- Call playback and listening for forest owl and arboreal mammal responses
- Anabat II recording for microchiropteran bat species
- Diurnal habitat searches for frogs, reptiles and mammals
- Bird census

The results of surveys are provided in Section 3.4 and Table 3.3.

The fauna survey details are provided in Table 3.1 and locations shown in Figures 3.1 and 3.2. After examination of the Director Generals Requirements for this development, further surveys across varying seasons are required. The fauna survey completed has been an autumn / winter and a spring / summer survey. Weather conditions causing difficult site access conditions have resulted in some limitations to the fauna surveys particularly the spring / summer survey. It is considered that to provide a more complete spring / summer survey data set further surveys conducted in more favourable weather will be necessary.

TABLE 3.1
FAUNA SURVEY DETAILS

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Diurnal Birds	27/4/07	8/8 cloud, no wind, light rain/ foggy, 18^{0}C	Opportunistic observation	2hrs 0700 – 0900
	8/5/07	1/8 cloud, no wind, no rain, 27^{0}C	Census / opportunistic observation	5hrs 1100 – 1600
	9/5/07	5/8 cloud, no wind, no rain, 16^{0}C	Census / opportunistic observation	6hrs 0700-1300
	11/5/07	8/8 - 2/8 cloud, light SE wind, no rain, early fog, 20^{0}C.	Opportunistic observation	5hrs 0700-1200
	13/6/07	0/8 cloud, light SW wind, 10^{0}C.	Opportunistic observation	5hrs 0745-1245
	1/8/07	0/8 cloud, strong NW wind, 20^{0}C.	Opportunistic observation	2.5hrs 1030-1300
	1/8/07	0/8 cloud, mod NW wind, 25^{0}C.	Opportunistic observation	2hrs 1400-1600
	2/8/07	6/8 cloud, mod NW wind, 18^{0}C.	Opportunistic observation	4hrs 0800-1200
	2/8/07	7/8 cloud, mod NW wind, 22^{0}C.	Opportunistic observation	1hr 1300-1400
	10/12/07	0/8 cloud, light / nil wind, 22^{0}C.	Census / opportunistic observation	6hrs 0700- 1100/ 1500-1700
	11/12/07	7/8 cloud, mod S wind, 18^{0}C, rain.	Census / opportunistic observation	5hrs 0700- 1000/ 1600-1800
	12/12/07	8/8 cloud, strong S wind, 12^{0}C, rain.	Census / opportunistic observation	2hrs 0800- 1000
	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Census / opportunistic observation	3hrs 1500- 1800
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Census / opportunistic observation	9hrs 0730-1230/ 1330-1730
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Census / opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Census / opportunistic observation	2hrs 0800- 1000
Nocturnal Birds	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 20^{0}C	Call playback & spotlighting	2hrs 1745 - 1945
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 16^{0}C	Call playback & spotlighting	1hr 45min 1745 -1930
	10/5/07	8/8 cloud, no wind, no moon, no rain, 12^{0}C	Call playback & spotlighting	1hr 30min 1800 -1930
	1/8/07	5/8 cloud, no wind, moon, no rain, 15^{0}C	Call playback & spotlighting	2hrs 1800 - 2000
Arboreal Mammals	8/5/07	8/8-0/8 cloud, light SE wind, no rain, no moon 20-15^{0}C	Type A (20) Elliott Traps	20trap nights
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 20^{0}C	Spotlighting, Call playback	1hr 15min 1730-1945
	9/5/07	8/8 cloud, mod SE wind, no rain, foggy, no moon,14^{0}C	Type A (20) Elliott Traps	20 trap nights
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 16^{0}C	Spotlighting, Call playback	1hr 30min 1745 -1915
	10/5/07	8/8 cloud, no wind, no moon, light rain, foggy, 10^{0}C	Type A (20) Elliott Traps	20 trap nights
	10/5/07	8/8 cloud, no wind, no moon, no rain, 12^{0}C	Spotlighting, Call playback	1hr 45min 1745 -1930
	1/8/07	5/8 cloud, no wind, moon, no rain, 15^{0}C	Spotlighting	2hrs 1800 - 2000
				Total 60 trap nights

TABLE 3.1 (Cont.) FAUNA SURVEY DETAILS				
Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Terrestrial Mammals	8/5/07 8/5/07 9/5/07 9/5/07 10/5/07 10/5/07 1/8/07	8/8-0/8 cloud, light SE wind, no rain, no moon 20-15^{0}C 0/8 cloud, light SE wind, no moon, no rain, 20^{0}C 8/8 cloud, mod SE wind, no rain, foggy, no moon,14^{0}C 8/8 cloud, light/ mod SE wind, no moon, no rain, 16^{0}C 8/8 cloud, no wind, no moon, light rain, foggy, 10^{0}C 8/8 cloud, no wind, no moon, no rain, 12^{0}C 5/8 cloud, no wind, moon, no rain, 15^{0}C	Type B (10) Elliott Traps/ 2 large cages Spotlighting Type B (10) Elliott Traps/ 2 large cages Spotlighting Type B (10) Elliott Traps/ 2 large cages Spotlighting Spotlighting, opportunistic observation	 1hr 15min 1730-1945 1hr 30min 1745 -1915 1hr 45min 1745 -1930 2hrs 1800 - 2000 Total: 30 Elliott trap nights 6 large cage trap nights
Bats	8/5/07 9/5/07 10/5/07 1/8/07 26/02/08 27/02/08	0/8 cloud, light SE wind, no moon, no rain, 20^{0}C 8/8 cloud, light/ mod SE wind, no moon, no rain, 16^{0}C 8/8 cloud, no wind, no moon, no rain, 12^{0}C. 5/8 cloud, no wind, no moon, no rain, 15^{0}C. 6/8 cloud, no wind, Late 3/4 moon no rain, 20°C 5/8 cloud, no wind, Late ¾ moon, no rain, 18°C	Anabat II x 4/ Spotlight Anabat II x 4/ Spotlight Anabat II x 4/ Spotlight Anabat II x 2/ Spotlight Anabat II x 2 Anabat II x 1	5hrs 1730-1945 9hrs 1745 -1915 7hrs 1745 -1930 4hrs 1800 -2000
Reptiles	27/4/07 8/5/07 8/5/07 9/5/07 9/5/07 10/5/07 11/5/07 1/8/07 1/8/07 2/8/07 2/8/07 10/12/07 11/12/07 12/12/07	8/8 cloud, no wind, light rain/ foggy, 18^{0}C 0/8 cloud, light SE wind, no moon, no rain, 20^{0}C 1/8 cloud, no wind, no rain, 27^{0}C 8/8 cloud, light/ mod SE wind, no moon, no rain, 16^{0}C 5/8 cloud, no wind, no rain, 16^{0}C 8/8 cloud, no wind, no moon, no rain, 12^{0}C 8/8 - 2/8 cloud, light SE wind, no rain, early fog, 20^{0}C 0/8 cloud, strong NW wind, 20^{0}C. 0/8 cloud, mod NW wind, 25^{0}C. 6/8 cloud, mod NW wind, 18^{0}C. 7/8 cloud, mod NW wind, 22^{0}C 0/8 cloud, light / nil wind, 22^{0}C. 7/8 cloud, mod S wind, 18^{0}C, rain. 8/8 cloud, strong S wind, 12^{0}C, rain.	Habitat search, Opportunistic observation Spotlight Habitat search, Opportunistic observation Spotlight Habitat search, Opportunistic observation Spotlight Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation Habitat search, Opportunistic observation	2hrs 0700 – 0900 1hr 15min 1730-1945 5hrs 1100 – 1600 1hr 30min 1745 -1915 6hrs 0700-1300 1hr 45min 1745 -1930 5hrs 0700-1200 2.5hrs 1030-1300 2hrs 1400-1600 4hrs 0800-1200 1hr 1300-1400 6hrs 0700-1100/1500-1700 5hrs 0700-1000/1600-1800 2hrs 0800- 1000

TABLE 3.1 (Cont.) FAUNA SURVEY DETAILS				
Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Reptiles (cont.)	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Habitat search, Opportunistic observation	3hrs 1500- 1800
	26/02/08	6/8 cloud, no wind, 20°C, approaching storm	Spotlight	1.5hrs 2000-2130
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Habitat search, Opportunistic observation	9hrs 0730-1230/ 1330-1730
	27/02/08	8/8 cloud, no wind, 15°C, light rain	Spotlight	1.5hrs 2000-2130
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Habitat search, Opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Habitat search, Opportunistic observation	2hrs 0800- 1000
Amphibians	27/4/07	8/8 cloud, no wind, light rain/ foggy, 18^0C	Habitat search, Call identification	2hrs 0700 – 0900
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 20^0C	Spotlight, Call identification	1hr 15min 1730-1945
	8/5/07	1/8 cloud, no wind, no rain, 27^0C	Habitat search, Call identification	5hrs 1100 – 1600
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 16^0C	Spotlight, Call identification	1hr 30min 1745 -1915
	9/5/07	5/8 cloud, no wind, no rain, 16^0C	Habitat search, Call identification	6hrs 0700-1300
	10/5/07	8/8 cloud, no wind, no moon, no rain, 12^0C	Spotlight, Call identification	1hr 45min 1745 -1930
	11/5/07	8/8 - 2/8 cloud, light SE wind, no rain, early fog, 20^0	Habitat search, Call identification	5hrs 0700-1200
	1/8/07	5/8 cloud, no wind, moon, no rain, 15^0C	Spotlight, Call identification	2hrs 1800 – 2000
	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Habitat search, Opportunistic observation	3hrs 1500- 1800
	26/02/08	6/8 cloud, no wind, 20°C, approaching storm	Spotlight	1.5hrs 2000-2130
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Habitat search, Opportunistic observation	9hrs 0730-1230/ 1330-1730
	27/02/08	8/8 cloud, no wind, 15°C, light rain	Spotlight	1.5hrs 2000-2130
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Habitat search, Opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Habitat search, Opportunistic observation	2hrs 0800- 1000

3.2 FAUNA HABITATS

The subject site is divided into two separate sections, Middlebrook Station and the Mountain Station in the Owens Gap area. Both these areas have similar available habitats for locally occurring fauna species. Owens Gap has incurred higher levels of disturbance through clearing for stock grazing. The vegetation of these two areas consists mainly of dry open forest, woodland and cleared areas. Within the vegetation communities identified a range of fauna habitats are present and include:

- Flower, nectar and seed producing tree and shrub species of the dry open forest, and woodland.
- Hollow bearing trees and stags
- Sparse to dense shrub layer and understorey
- Sparse to dense grassy layer
- Moderately dense to sparse leaf litter layer
- Fallen timber and hollow logs
- Rocky outcrops and caves
- Farm dams

A range of habitat types and values exist across the subject site. The subject site consists mainly of dry open forest, woodland and cleared areas. The flower, nectar and seed producing tree and shrub species of these communities provide a foraging resource for bird and arboreal mammal species. Scattered hollow bearing trees and stags, and fallen timber and hollow logs provide breeding and shelter habitat for arboreal mammal, bird and reptile species. The grassy groundcover may provide foraging habitat for a range of small mammals such as rodents, large mammals such as macropods, granivorous birds such as parrots and foraging areas for raptors.

The rocky outcrops and associated rock caves and crevices provide suitable shelter and foraging habitat for reptiles, small mammals, some amphibians and some microbat species.

The small farm dams scattered throughout the two areas provide foraging and water nourishment for a range of mammal, bird, reptile and amphibian species.

Middlebrook Station adjoins Towarri National Park to the north and displays similar habitats types and values to that of Middlebrook Station. Owens Gap is surrounded by similar habitat types associated with the adjoining grazing properties.

3.3 THREATENED FAUNA SPECIES

A search of the Atlas of NSW Wildlife (DECC 2007) was conducted for threatened fauna recorded within 20km of the subject site. This revealed a number of threatened species that may be present in the area. Details on threatened fauna species (Schedule 1 or 2), of the TSC Act (1995) or EPBC Act (1999) which are known to occur within the area are provided in Table 3.2.

TABLE 3.2 RECORDED THREATENED FAUNA OF THE AREA				
Common Name ***Scientific Name***	**TSC Act**	**EPBC Act**	**Preferred Habitat**	**Comments**
Giant Barred Frog *Mixophyes iteratus*	E	E	Terrestrial inhabitant of rainforest and open forests. Distribution Limit- N-Border Ranges National Park. S-Narooma.	No suitable habitat.
Green and Golden Bell Frog *Litoria aurea*	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution Limit - N-Byron Bay. S-South of Eden	No suitable habitat.
Freckled Duck *Stictonetta naevosa*	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. Distribution Limit - N- Tenterfield. S-Albury.	Sub optimal foraging and roosting habitat.
Black-necked Stork *Ephippiorhynchus asiaticus*	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats. Distribution Limit - N-Tweed Heads. S-Nowra.	Sub-optimal foraging and roosting habitat.
Red Goshawk *Erythrotriorchis radiatus*	E	V	Inhabits tall open forests and woodlands. Breeds in tall trees adjacent to watercourses of wetlands. Distribution Limit - N-Border Ranges National Park S-Foster.	Sub optimal foraging and roosting habitat.
Square-tailed Kite *Lophoictinia isura*	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. Distribution Limit - N-Goondiwindi. S-South of Eden.	Suitable foraging and roosting habitat present.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit –mid north coast of NSW to western Victoria	Suitable foraging and roosting habitat present.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V	-	Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit – N-Tweed Heads. S-South of Eden.	Suitable foraging and roosting habitat present. Observed during surveys.
Swift Parrot *Lathamus discolor*	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit – N-Border Ranges National Park. S-South of Eden.	Suitable foraging habitat present.

TABLE 3.2 (Cont.) RECORDED THREATENED FAUNA OF THE AREA				
Common Name ***Scientific Name***	**TSC Act**	**EPBC Act**	**Preferred Habitat**	**Comments**
Superb Parrot *Polytelis swainsonii*	V	V	Inhabits open woodland and riverine forests of inland NSW. Distribution Limit - N-Near Walgett. S-South of Deniliquin.	Suitable foraging and roosting habitat present.
Turquoise Parrot *Neophema pulchella*	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. Distribution Limit – N-Near Tenterfield. S-South of Eden.	Suitable foraging and roosting habitat present.
Barking Owl *Ninox connivens*	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. Distribution Limits- N-Border Ranges National Park S-Eden	Suitable foraging and roosting habitat present.
Powerful Owl *Ninox strenua*	V	-	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits – N-Border Ranges National Park. S-Eden	Suitable foraging and roosting habitat present.
Masked Owl *Tyto novaehollandiae*	V	-	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit - N-Border Ranges National Park. S-Eden	Suitable foraging and roosting habitat present.
Brown Treecreeper *Climacteris picumnus victoriae*	V	-	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. Distribution Limit. (Sub species *victoriae)* Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.	Suitable foraging and roosting habitat present.
Regent Honeyeater *Xanthomyza phrygia*	E	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit - N-Urbanville. S-Eden	Suitable foraging and roosting habitat present.
Grey-crowned Babbler *Pomatostoomus temporalis temporalis*	V	-	Found in dry open forests, woodland scrubland, and farmland with isolated trees. Distribution Limit mostly west of Great Divide except Hunter Valley. N – Qld widespread S- Mornington pen. E-se SA	Suitable foraging and roosting habitat present. Observed during surveys.
Speckled Warbler *Pyrrholaemus saggitatus*	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit - N-Urbanville. S-Eden	Suitable foraging and roosting habitat present. Observed during surveys.

TABLE 3.2 (Cont.) RECORDED THREATENED FAUNA OF THE AREA				
Common Name ***Scientific Name***	**TSC Act**	**EPBC Act**	**Preferred Habitat**	**Comments**
Black-chinned Honeyeater *Melithreptus gularis gularis*	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. Distribution Limit. N – Cape York pen. Qld. S – Victor H. Mt Lofty Ra & Flinders Ra. SA	Suitable foraging and roosting habitat present.
Painted Honeyeater *Grantiella picta*	V	-	Found in open forest, woodland and scrubland feeding on mistletoe fruits. Distribution Limit- N-Boggabilla S-Albury.	Suitable foraging and roosting habitat present.
Hooded Robin *Melanodryas cucullata cucullata*	V	-	Found in Eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. Distribution Limit N – Central Qld S – Spencer Gulf SA	Suitable foraging and roosting habitat present.
Diamond Firetail *Stagonopleura guttata*	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. Distribution Limit N Rockhampton Q. S- Eyre Pen Kangaroo Is. SA.	Suitable foraging and roosting habitat present.
Spotted-tailed Quoll *Dasyurus maculatus*	V	V	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park S-South of Eden.	Suitable foraging and shelter habitat present.
Koala *Phascolarctos cinereus*	V	-	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit - N-Tweed Heads. S-South of Eden	Suitable foraging and shelter habitat present.
Yellow-bellied Glider *Petaurus australis*	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	Suitable foraging and shelter habitat present.
Squirrel Glider *Petaurus norfolcensis*	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit - N- Tweed Heads S-Albury	Suitable foraging and shelter habitat present.
Brush-tailed Phascogale *Phascogale tapoatafa*	V	E	A largely arboreal mammal of open forests and woodlands using hollows as nesting in hollow bearing trees. Distribution Limit - N-Border Ranges National Park. S-Eden.	Suitable foraging and shelter habitat present.

TABLE 3.2 (Cont.) RECORDED THREATENED FAUNA OF THE AREA				
Common Name ***Scientific Name***	**TSC Act**	**EPBC Act**	**Preferred Habitat**	**Comments**
Brush-tailed Rock-wallaby *Petrogale penicillata*	V	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. Distribution Limit - N-North of Tenterfield. S-Bombala.	Suitable foraging and shelter habitat present.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. Distribution Limit – N – Tweed Heads S - Eden	Suitable foraging and shelter habitat present. Observed during surveys.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	-	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney	Suitable foraging and roosting habitat present. Observed during surveys.
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. Distribution Limit - N-Woodenbong. S-Pambula.	Suitable foraging and roosting habitat present.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit - N-Border Ranges Nation Park. S-Wollongong.	Suitable foraging and roosting habitat present.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula	Suitable foraging and roosting habitat present.
Little Bentwing-bat *Miniopterus australis*	V	-	Roosts in caves, old buildings and tree hollows in the higher rainfall forests along the south coast of Australia. Distribution Limit - N-Border Ranges National Park. S-Sydney.	Suitable foraging and roosting habitat present
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging and roosting habitat present. Observed during surveys.
Greater Long-eared Bat *Nyctophilus timoriensis*	V	V	Known from dry open woodlands and along water courses and lakes. Roosts in tree hollows and under bark. Distribution Limit - N-Barringun. S-Albury.	Suitable foraging and roosting habitat present.

TABLE 3.2 (Cont.) RECORDED THREATENED FAUNA OF THE AREA				
Common Name ***Scientific Name***	**TSC Act**	**EPBC Act**	**Preferred Habitat**	**Comments**
Eastern Cave Bat *Vespadelus troughtoni*	V	-	Inhabits drier open forests and woodlands. Roosts in well-lit parts of caves and mineshafts. Distribution Limit –Along GDR from N- Tweed Heads. S-Kempsey.	Suitable foraging and roosting habitat present. Observed during surveys
Large-footed Myotis *Myotis adversus*	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. Distribution limits - N - Border Ranges National Park, S - South of Eden.	Suitable foraging and roosting habitat present.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit - N-Border Ranges National Park. S-Pambula.	Suitable foraging and roosting habitat present.
E = Endangered Species V = Vulnerable Species				

3.4 FAUNA OBSERVED DURING SURVEYS

The fauna species observed during surveys are listed within Table 3.3. Seven (7) threatened fauna species the Glossy Black-Cockatoo, Speckled Warbler, Grey-crowned Babbler, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, Eastern Bentwing-bat and the Eastern Cave Bat, as listed on Schedules 2 of the *Threatened Species Conservation Act* (1995), were observed during the fauna surveys. Details of these observations are provided below with locations of observations shown in Figure 3.1 and Figure 3.2:

Glossy Black-Cockatoo
This species was observed foraging within Allocasuarina trees upon the Glen Ridge on Middlebrook Station during surveys conducted on the 9th May 2007, chewed Allocasurina cones were also observed on top of the Glen Ridge toward Elephant Rock during surveys conducted on 2nd August 2007.

Speckled Warbler
This species was observed in two separate locations upon the Glen Ridge on Middlebrook Station during surveys conducted on the 8th & 9th May 2007 and resighted in the same location during surveys conducted on the 1st and 2nd August 2007.

Grey-crowned Babbler
A small group of two (2) birds were observed in the foothills of the Glen Ridge at Middlebrook Station on all survey days. A larger group of approximately five (5) birds were observed at the gate to the haul road at Middlebrook Station during surveys conducted on the 13th June 2007, this group was further observed during surveys conducted on the 1st and 2nd August 2007 and again on the 10th and 11th December 2007.

Grey-headed Flying-fox
Two Grey-headed Flying-foxes were observed flying over the Glen Ridge on Middlebrook Station during nocturnal surveys conducted on the evening of the 9th May 2007.

Yellow-bellied Sheathtail-bat
This species was detected foraging near the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26th April 2007.

Eastern Bentwing-bat
This species was detected foraging along the northern sector of Glen Ridge on the evening of the 26th April and 8th May 2007 and along the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26th April 2007. This species was also captured whilst roosting within the rafters of the shearing sheds on Mountain Station on the 10th May 2007 and positively identified.

Eastern Cave Bat
This species was detected via Anabat II detection surveys conducted on the 8th May 2007, foraging within the vicinity of the proposed maintenance shed on Mountain Station, Owens Gap and at the north-western spur area near a communications tower also on Mountain Station.

TABLE 3.3
FAUNA OBSERVED AND RECORDED

Common Name	***Scientific Name***	**Method May 07**	**Method Aug 07**	**Method Dec 07**	**Method Feb 08**
Birds					
Stubble Quail	*Coturnix pectoralis*				C
Brown Quail	*Coturnix ypsilophora*				C
Pacific Black Duck	*Anas superciliosa*	OC		OC	O
Grey Teal	*Anas gracilis*	OC	OC	OC	O
Australian Wood Duck	*Chenonetta jubata*	OC	OC	OC	O
Australasian Grebe	*Tachybaptus novaehollandiae*	OC	OC	OC	
Black-fronted Dotterel	*Elseyornis melanops*	O		O	O SP
Masked Lapwing	*Vanellus miles*	OC		OC	
Brown Goshawk	*Accipiter fasciatus*				O
Wedge-tailed Eagle	*Aquila audax*	O	O	O	O
Little Eagle	*Hieraaetus morphnoides*	O		O	
Whistling Kite	*Haliastur sphenurus*			O	
Brown Falcon	*Falco berigora*	O			O
Nankeen Kestrel	*Falco cenchroides*	O		OC	O
Black-shouldered Kite	*Elanus axillaris*	O			
Australian Hobby	*Falco longipennis*				O
Little Button-quail	*Turnix velox*				O
Wonga Pigeon	*Leucosarcia melanoleuca*	C			
Common Bronzewing	*Phaps chalcoptera*	O	O	O	O
Crested Pigeon	*Ocyphaps lophotes*	O	O		O
Glossy Black-Cockatoo TS	*Calyptorhynchus lathami*	OC	Sc		
Sulphur-crested Cockatoo	*Cacatua galerita*	OC	OC	OC	O
Little Corella	*Cacatua sanguinea*	OC	OC		
Galah	*Cacatua roseicapilla*	OC	OC	OC	O
Little Lorikeet	*Glossopsitta pusilla*				OC
Musk Lorikeet	*Glossopsitta concinna*				OC
Australian King-Parrot	*Alisterus scapularis*	OC	OC	OC	O
Crimson Rosella	*Platycerous elegans*	OC	OC	OC	O
Eastern Rosella	*Platycercus eximius*	OC	OC	OC	O
Red-rumped Parrot	*Psephotus haematonotus*	OC	OC		
Fan-tailed Cuckoo	*Cacomantis flabelliformis*			OC	
Eastern Koel	*Eudynamys orientalis*				C
Channel-billed Cuckoo	*Scythrops novaehollandiae*				O
Southern Boobook	*Ninox novaeseelandiae*	C			C
White-throated Nightjar	*Eurostopodus mystacalis*				SP

TABLE 3.3 (Cont.)
FAUNA OBSERVED AND RECORDED

Common Name	*Scientific Name*	Method May 07	Method Aug 07	Method Dec 07	Method Feb 08
Birds (Cont.)					
White-throated Needletail	*Hirundapus caudactus*				O
Laughing Kookaburra	*Dacelo novaeguineae*	OC	OC	OC	O
Sacred Kingfisher	*Todiramphus sanctus*			OC	
Rainbow Bee-eater	*Merops ornatus*				O
Dollarbird	*Eurystomus orientalis*			OC	
White-throated Treecreeper	*Cormobates leucophaeus*		OC	OC	C
Superb Fairy-wren	*Malurus cyaneus*	OC			O
Spotted Pardalote	*Pardalotus punctatus*	OC	OC		C
Striated Pardalote	*Pardalotus striatus*	OC	OC	OC	OC
White-browed Scrubwren	*Sericornis frontalis*	OC	OC		
Speckled Warbler TS	*Pyrrholaemus saggitata*	OC	OC		
Brown Gerygone	*Gerygone mouki*	OC			
White-throated Gerygone	*Gerygone olivacea*				C
Brown Thornbill	*Acanthiza pusilla*	O C	OC		
Buff-rumped Thornbill	*Acanthiza reguloides*				C
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	OC	OC	OC	OC
Yellow Thornbill	*Acanthiza nana*	OC	OC		
Noisy Friarbird	*Philemon corniculatus*	O C		OC	OC
Red Wattlebird	*Anthochaera carunculata*	OC	OC	OC	O
Noisy Miner	*Manorina melanocephala*	O C	OC	OC	OC
Striped Honey-eater	*Plectorhyncha lanceolata*				O
Yellow-faced Honeyeater	*Lichenostomus chrysops*		OC	OC	
White-eared Honeyeater	*Lichenostomus leucotis*	OC			
White-plumed Honeyeater	*Lichenostomus penicillatus*	O C			
Eastern Yellow Robin	*Eopsaltria australis*	O	O		
Scarlet Robin	*Petroica multicolor*	OC			
Jacky Winter	*Microeca fascinans*		OC		
Rufous Whistler	*Pachycephala rufiventris*			OC	C
Grey Shrike-thrush	*Colliuricincla harmonica*				C
Grey-crowned Babbler TS	*Pomatostomus temporalis*	OC	OC	OC	OC
Golden Whistler	*Pachycephala pectoralis*	OC			
Willie Wagtail	*Rhipidura leucophrys*	OC			O
Grey Fantail	*Rhipidura fuliginosa*	OC	OC		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	OC	OC	OC	
Olive-backed Oriole	*Oriolus sagittatus*	OC			
Pied Butcherbird	*Cracticus nigrogularis*	OC		OC	C
Grey Butcherbird	*Cracticus torquatus*	OC			O
Australian Magpie	*Gymnorhina tibicen*	O C	OC	OC	OC
Magpie-lark	*Grallina cyanoleuca*	O C	OC		O
Pied Currawong	*Strepera graculina*	O C	OC	OC	OC
White-winged Chough	*Corcorax melanorhamphos*	OC	OC	OC	O
Australian Raven	*Corvus coronoides*	OC	OC		OC
Satin Bowerbird	*Ptilonorhynchus violaceus*	OC	OC		
Rufous Songlark	*Cincloramphus mathewsi*			OC	C
Australasian Pipit	*Anthus novaeseelandiae*				O
Zebra Finch	*Taeniopygia guttata*			OC	
Fairy Martin	*Hirundo ariel*	OC	OC		
Welcome Swallow	*Hirundo neoxena*	OC	OC		O
Common Myna *	*Acridotheres tristis*	OC	OC		O
Common Starling *	*Sturnus vulgaris*	OC	OC		O
Mammals					
Common Ringtail Possum	*Pseudocheirus peregrinus*	Sp	Sp		
Common Brushtail Possum	*Trichosurus vulpecula*	Sp	Sp		Sp
Common Wombat	*Vombatus ursinus*	Sc	Sc		Sp
Swamp Wallaby	*Wallabia bicolor*	O	Sp	O	O

TABLE 3.3 (Cont.)
FAUNA OBSERVED AND RECORDED

Common Name	*Scientific Name*	Method May 07	Method Aug 07	Method Dec 07	Method Feb 08
Mammals (Cont.)					
Common Wollaroo	*Macropus robustus*	O Sp	O		O
Eastern Grey Kangaroo	*Macropus giganteus*	O	O	O	O
Red-necked Wallaby	*Macropus rufogriseus*				O
Grey-headed Flying-fox TS	*Pteropus poliocephalus*	Sp			
Freetail Bat	*Mormopterus sp. 2*	A			A
Gould's Wattled Bat	*Chalinolobus gouldii*	A	A		
Eastern Bentwing-bat TS	*Miniopterus schreibersii oceansis*	A			H
White-striped Freetail-bat	*Nyctinomus australis*	A			
Long-eared Bat	*Nyctophilus spp*		A		
Yellow-bellied Sheathtail-bat TS	*Saccolaimus flaviventris*	A			
Little Forest Bat	*Vespedalus vulturnus*				A
Eastern Cave Bat TS	*Vespadelus troughtoni*	A			
Little Forest Bat	*Vespadelus vulturnus*	A			
Eastern Horseshoe-bat	*Rhinolophus megaphyllus*	A	A		
Horse *	*Equus caballus*	O	O	0	
Sheep*	*Ovis aries*	O	O	0	
Goat *	*Capra hircus*	O Sc			
Cow *	*Bos taurus*	O	O	0	
Rabbit *	*Oryctolagus cuniculus*	Sc O	Sc O		
Brown Hare *	*Lepus lepus*				Sp
European Red Fox *	*Vulpes vulpes*	O Sc			Sp
Dog *	*Canis familiaris*	OC			
Amphibians					
Common Eastern Froglet	*Crinia signifera*				C
Bleating Tree Frog	*Litoria dentata*				C
Rocket Frog	*Litoria nasuta*				C
Peron's Tree Frog	*Litoria peronii*				C
Reptiles					
Eastern Snake-necked Turtle	*Chelodina longicollis*				O
Punctate Worm-skink	*Anomalopus swansoni*	S			
South-eastern Morethia Skink	*Morethia boulengeri*	S	S		
White's Rock-skink	*Egernia whitii*	S			S
Copper Tailed Ctenotus	*Ctenotus taeniolatus*		S		S
Lesueur's Velvet Gecko	*Oedura lesueurii*		S		

Key to Methods of Observation

O	-	Observation	S	-	Search
C	-	Call identification	A	-	Anabat II
Sp	-	Spotlight	Sc	-	Scat, Track or Sign
E	-	Elliott or Cage Trap			

* = Exotic species TS = Threatened species

3.5 ENDANGERED POPULATIONS

There is one endangered fauna population as identified within the Threatened Species Conservation Act (1995) occurring within the Upper Hunter LGA. This is the Broad-toothed Rat at Barrington Tops in the local government areas of Gloucester, Scone (Upper Hunter) and Dungog.

3.6 KOALA HABITAT ASSESSMENT

The subject area was assessed for activity by Koalas using the following methods.

i. A search of the Atlas of NSW Wildlife (DECC 2007) was undertaken to identify records of koalas located in the area.

ii. The site was surveyed on foot, with Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for the presence of Koalas, characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally the location and density of droppings if found were documented.

iii. Koalas were also targeted during spotlight surveys.

iv. Identification and an assessment of the density of tree species listed as Koala feed trees in State Environmental Planning Policy No. 44 - Koala Habitat Protection was undertaken across the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

No Koalas were observed during fauna surveys and there was no evidence of previous Koala habitation within the subject site.

White Box (*Eucalyptus albens*), Grey Gum (*Eucalyptus punctata*) and Forest Red Gum (*Eucalyptus tereticornis*) (Koala food tree species listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection), were observed within the subject site. These trees comprised more than the 15% required under SEPP 44 for classification as Potential Koala Habitat. As such the subject site is considered to comprise Potential Koala Habitat as defined under SEPP 44. However no evidence of Koala utilisation of the site (scats, scratch marks or Koalas) were observed on the site. It is considered that the site does not form core Koala habitat and therefore no further assessment under this Policy is required.

SECTION 4

DISCUSSION AND CONCLUSION

4.1 ASSESSMENT OF IMPACT ON THREATENED SPECIES

As identified in Section 5(A) of the *EP&A Act* 1979 the following matters need to be addressed to determine whether or not a significant effect on threatened species, populations or ecological communities or their habitats is likely to result from the proposed development.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

FLORA
There is suitable habitat on site for; *Commersonia rosea, Diuris pedunculata, Diuris tricolour, Goodenia macbarronii, Kennedia retrorosa, Lasiopetalum longistamineum, Ozothamnus tesselatus, Philotheca ericifolia, Pomaderris bodalla, Pomaderris queenslandica, Pomaderris reperta, Prostanthera cineolifera, Prostanthera cryptandroides subsp. Cryptandroides, Rulingia procumbens* and *Thesium australe.* In relation to these threatened species, the following assessments are provided.

Commersonia rosea
This prostrate shrub occurs on skeletal sandy soils in scrub or heath. This species is known from four localities in the Sandy Hollow district of the upper Hunter Valley. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Digitaria porrecta
This tufted grass occurs in grassy white box woodlands. No specimens of this species were observed within the subject site during surveys. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Diuris pedunculata
This species is known from eastern NSW between Sydney and Tenterfield, growing in moist grassy areas in sclerophyll forest on stony areas or sometimes on moist flats (Bishop, 2000). The flowering period for this species is mainly between August and September (Harden, 1994). No specimens of this species were observed within the subject site during surveys. While the vegetation community at the site may provide similar conditions to those preferred

by this species its absence from the locality and the grazing by livestock within the majority of the proposed development area indicate that the presence of this species is unlikely. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Diuris tricolour
Diuris tricolor is a terrestrial orchid and flowers between September - November. This species grows in sclerophyll forest among grass, often with Callitris. No specimens of this species were observed within the subject site during surveys. While the vegetation community at the site may provide similar conditions to those preferred by this species its absence from the locality and the grazing by livestock within the majority of the proposed development area indicate that the presence of this species is unlikely. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Goodenia macbarronii
This short-lived perennial herb favours moist, shaded, sandy sites, soils with impeded drainage. It is widely distributed throughout the tablelands, western slopes and western plains. No specimens of this species were observed within the subject site during surveys. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Kennedia retrorosa
This vigorous, climbing perennial herb is found in a variety of habitats from mountainsides to riparian zones, however, is currently believed to be restricted to the Mount Dangar area and the adjacent Goulburn River catchment. While currently located outside of the known distribution, the subject site provides potential habitat for this species. No specimens of this species were observed within the subject site during surveys. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Lasiopetalum longistamineum
This spreading shrub grows in grassy woodlands of Eucalyptus albens (white box) in the Mt Dangar - Gungal area. While currently located outside of the known distribution, the subject site provides potential habitat for this species. No specimens of this species were observed within the subject site during surveys. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Ozothamnus tesselatus
A dense shrub which favours sandstone eucalypt woodland and is restricted to a few locations north of Rylstone. While currently located outside of the known distribution, the subject site provides potential habitat for this species. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Philotheca ericifolia
This spreading shrub grows in dry sclerophyll forest and heath. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Pomaderris bodalla
Bodalla Pomaderris is a shrub between 2 and 4 metres high. In the upper Hunter Valley, it occurs in open forest or woodland on open slopes. While currently located outside of the known distribution, the subject site provides potential habitat for this species. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Pomaderris queenslandica
Scant Pomaderris is a medium-sized shrub 2 - 3m tall that favours moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. This species has been previously recorded within Towarri NP in close vicinity to the Northern boundary of the Middlebrook station. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Pomaderris reperta
This shrub favours woodland in association with *Eucalyptus crebra, E. blakelyi, Notelaea microcarpa*, and *Allocasuarina littoralis* and has been recorded from a small number of sites along a single ridgeline near Denman in the upper Hunter Valley. While currently located outside of the known distribution, the subject site provides potential habitat for this species. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Prostanthera cineolifera
Little is known about this species distribution and habitats other than it favors sclerophyll forest. A record of this species from 1991 (BioNet 2007) is located at little Gap, immediately adjoining the northern boundary of Mountain station. Targeted surveys within this area and similar habitats within the subject site identified 3 populations of a *Prostanthera* species similar to *Prostanthera cineolifera* within Mountain Station. Each of these populations were located on colluviums soil benches/ledges within the escarpment or immediately below small ledges. Specimens from these populations, including the previously recorded population at Little Gap, were sent to the Royal Botanic Gardens (RBG) for confirmation of the species indentification. The RBG subsequently identified the specimens as *Prostanthera ovalifolia* and NOT the threatened species *Prostanthera cineolifera,* acknowledging that identification between these two species is largely determent on the oil content of the leaves and not physiological characteristics. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Prostanthera cryptandroides subsp. cryptandroides
This low-spreading shrub with favours in rocky ridgelines on Narrabeen Group Sandstones. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local

conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Rulingia procumbens
This prostrate shrub favours sandy sites and has recently been collected made from the Upper Hunter region. No specimens of this species were observed within the subject site during surveys. The proposal will not require the removal of this species habitat within the subject site. Large areas of suitable and known habitat for this species are retained within the local conservation network of the upper hunter, including Goulbourn River NP, Wollemi NP and the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Thesium australe
The flowering period for *Thesium australe* is Spring to Summer. The preferred habitat for *T. australe* is in Grassland or Woodland, often in damp sites. It is widespread in the northern half of NSW but is considered rare (Harden, 1994). The previous land use such as clearing, pasture improvement and livestock grazing on the subject site indicate that the presence of this species is unlikely. Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

FAUNA
In relation to threatened fauna species with suitable habitat present the following assessments are provided.

Freckled Duck *(Stictonetta naevosa).*
The Freckled Duck is often located within large, well vegetated permanent fresh swamps, in dry periods it moves to fresh or salty permanent open lakes. The Freckled Duck roosts in lignum clumps, overhanging tea-tree branches, flood debris or old nest of Coot. Breeding takes place from September to December or after suitable rainfall. The Freckled Duck disperses to coastal areas in southeast Australia and northern Australia as a summer / winter visitor.

The subject site provides only sub-optimal habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Black-necked Stork *(Ephippiorhynchus asiaticus)*
The Black-necked Stork usually forages singly but also forages in large family groups in fresh or saline waters up to 0.5 metres deep (Marchant & Higgins 1990). This species feeds mainly on fish but will also eat reptiles, frog's crabs, insects, rodents and carrion (Schodde &

Tidemann 1986). The Black-necked Stork occurs throughout tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats and occasionally in grassland and wooded lands (Marchant & Higgins 1990).
The subject site provides only sub-optimal habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Red Goshawk *(Erythrotriorchis radiatus)*
The Red Goshawk occurs over wooded and forested lands of tropical and warm-temperate coastal and sub coastal Australia. This species prefers forest, riverine vegetation and woodland with a mosaic of vegetational types with large population of birds suitable for prey (Marchant & Higgins 1993).

The subject site provides only sub-optimal habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Square-tailed Kite *(Limosa limosa)*
The Square-tailed Kite inhabits the coastal forested and wooded lands of tropical and temperate Australia (Marchant & Higgins 1993). The Square-tailed Kite is a specialist hunter of passerines, especially honeyeaters, and insects in the tree canopy, picking most prey items from the outer foliage (Marchant & Higgins 1993).

The subject site provides only sub-optimal habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Gang-gang Cockatoo *(Callocephalon fimbriatum)*
The Gang-gang Cockatoo is associated with a variety of woodland and forest habitats, and occasionally more open areas in south–eastern New South Wales and Victoria (NSW Scientific Committee, 2001). This species has been observed in eucalypt forests and exotic trees, and is known to feed on the seeds of native shrubs and trees, in addition to some exotic species such as the Hawthorn and Cupressus species (Schodde & Tideman 1986).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of Allocasuarina feed trees. They choose feed trees with larger cone crops but show no sign of selecting trees on the

basis of cone size – concentrating foraging in trees with a high ratio of total seed weight to cone weight. (Clout 1989). They breed in hollow trees or stumps usually in Eucalypts.

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was observed foraging within Allocasuarina trees on the Glen Ridge on Middlebrook Station during surveys conducted on the 9th May 2007 with chewed cones observed during surveys conducted on the 2nd August 2007. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Swift Parrot *(Lathamus discolor)*
This species feeds mainly on nectar and lerp from eucalypt flowers, particularly Blue Gum (*Eucalyptus globulus*). On the mainland, the Swift Parrot congregates where winter flowering species such as Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*), Yellow Gum (*Eucalyptus leucoxylon*) and Swamp Gum (*Eucalyptus ovata*) (Brown, 1989). The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer (Shepherd, 1994). In late March almost the entire population migrates to mainland Australia (Schodde & Tidemann, 1986).

The subject site provides suitable foraging habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Superb Parrot *(Polytelis swainsonii)*
The Superb Parrot has a range of habitats from the River Red Gum forests of the Murray Riverina area to the Forests and Woodlands of the south-west slopes containing White Box, Yellow Box and Blakely's Red Gum. The Superb Parrot occurs from northern central south to the Barmah Forest area of northern Victoria (Blakers *et al.* 1984). Breeding is confined to Red Gum forests along the Murray and Edwards Rivers near Deniliquin and Mathoura; along the Murrumbidgee River from Wagga Wagga to about Darlington Point; and along the Lachlan River to near Cowra. Breeding occurs from September to December usually in a hollow branch or, sometimes in the hollow trunks of tall eucalyptus trees. (Higgins, P.J. 1999)

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Turquoise Parrot (*Neophema pulchella*)
The Turquoise Parrot is a sedentary species inhabiting the foothills of the Great Divide, including steep rocky ridges and gullies, rolling hills, valleys and river-flats, sometimes nearby plains (Higgins 1999). This species feeds on the ground among seeding grasses or weeds usually beneath trees. This species is endemic to eastern Australia, from south-east Queensland through eastern New South Wales to north east Victoria (Higgins 1999).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was

not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Barking Owl (*Ninox connivens*)
This species breeds in large hollows in large, live trees; near or on floodplains. The Barking Owl is associated with woodlands, open forests, partially cleared areas and occasionally near or in rural towns and well treed suburbs. Barking Owls require thickets, such as those characterised by tea trees and wattles, for shelter. As a consequence of the diverse diet of the Barking Owl, species rich habitats such as woodlands and ecotones are considered to be important habitats for this species (Environment Australia, 2000). Barking Owls live in pairs and their territory size is generally large (greater than 100 ha).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Powerful Owl *(Ninox strenua)*
The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. Nest in hollows in large old trees; usually living Eucalyptus, within or below canopy – rarely in dead stags, stumps or broken-off trunks. (Higgins 1999). Powerful Owls are sedentary within home ranges of about 1,000 hectares within open eucalypt, Casuarina or *Callitris* pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations. (Garnett & Crowley 2000). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality. (Lavazanian *et.al.* (1994).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Masked Owl (*Tyto novaehollandiae*)
The Masked Owl is widespread through forests and woodlands, utilising caves for shelter in treeless country. The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land. This species is often found in heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. The Masked Owl is dependent upon hollow bearing trees all year round requiring old mature trees with large hollows for breeding and as diurnal roosting sites.

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Brown Treecreeper *(Climacteris picumnus victoriae)*
This eastern sub-specie of the Brown Treecreeper can be found in eucalypt woodland over much of eastern Australia. They prefer drier forests/woodlands with fallen branches and its distribution is known to coincide with that of River Red Gums and other eucalypts bordering river courses but it prefers rough-barked trees, especially the boxes and peppermints. Hollows in trees are known to be important for Brown Treecreepers. They provide nesting chambers, roosting sites refuges from predators and sources of food (Longmore 1991).
The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Regent Honeyeater *(Xanthomyza phrygia)*
The Regent Honeyeater inhabits mostly dry eucalypt woodlands and forests dominated by box ironbark eucalypts; on inland slopes of Great Divide, especially associations in moister more fertile sites, along creeks, broad river valleys and on lower slopes of foothills. (Higgins, P.J., J.M. Peter & W.K. Steele 2001). Nectar is the principle food but sugary exudates from insects are also used, and insects are essential for breeding. (Oliver 1998, 2000). The Regent Honeyeater is known to breed along the western Slopes of the Great Dividing Range in New South Wales (Bundarra-Barraba district, Capertee Valley). Occasionally breeding elsewhere (Franklin *et al* 1989*.* Schodde *et al.,* 1992).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-crowned Babbler *(Pomatostomus temporalis temporalis)*
The Grey-crowned Babbler occupies open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact groundcover of grass and forbs. This species forages in leaf litter and on the bark of trees (Garnett & Crowley 2000). Birds forage in a group, staying within fifteen metres of each other, but occasionally spreading out to thirty metres (Boles 1988). All members of a group cooperate in (nest) building and caring of the young but only the breeding female incubates and broods. (King.1980). The whole group roosts each night in a roosting nest (dormitory), and many of these are built and maintained throughout the year (Schodde & Tidemann 1986).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. A small group of two (2) birds were observed in the foothills of the Glen Ridge at Middlebrook Station on all survey days. A larger group of approximately five (5) birds were observed at the gate to the haul road at Middlebrook Station during surveys conducted on the 13th June 2007 and again during surveys conducted on the 1st and 2nd August 2007. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Speckled Warbler *(Pyrrholaemus saggitata)*
Speckled Warblers inhabit mainly grassy ground layer of dry sclerophyll forests and woodlands, often with scattered shrubs in the understorey. This species is mainly insectivorous but will also take seeds and other plant material. (Higgins & Peters 2002).

They are sedentary with no migratory or seasonal movements known. They nest solitary with large exclusive breeding territories, the boundaries of which change little over successive years. They breed most of the year round with a peak from September to November (Higgins & Peters 2002).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was observed in two separate locations upon the Glen Ridge on Middlebrook Station during surveys conducted on the 8th & 9th May 2007 and reobserved in the same locations during surveys conducted on the 1st and 2nd August 2007. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Black-chinned Honeyeater (*Melithreptus gularis spp. gularis)*
The Black-chinned Honeyeater inhabits forest and woodlands over much of eastern Australia. This species shows a special preference for areas having rough-barked eucalypts such as ironbark and ash (Longmore 1991). In drier areas it is found within timber along watercourses, often with little understorey. In New South Wales this species is mainly found in woodlands containing box-ironbark associations and River Red Gum (NSW Scientific Committee 2001).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Painted Honeyeater *(Grantiella picta)*
The Painted Honeyeater inhabits dry forests and woodlands. Its primary food is the fruit of the mistletoes in the genus *Amyema* though it will also take nectar and insects. (Garnett & Crowley 2000). The Painted Honeyeater is nomadic moving north in the winter and south in the summer over eastern Australia, usually traveling in pairs, families or small flocks. Breeding takes place between October and March.

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Hooded Robin *(Melanodryas cucullata)*
The Hooded Robin occupies drier eucalypt forest, woodland and scrub, grasses and low shrubs, as well as cleared paddocks with regrowth or stumps. (Environment ACT 1999). In most areas it is considered to be sedentary, and territorial pairs may be found in the same locality for several years. (Boles 1988). The size of territories throughout Australia has been estimated as between 5 to 50 hectares. (Environment ACT 1999).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore,

the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Diamond Firetail *(Stagonopleura guttata)*
The Diamond Firetail inhabits open forests, mallee and savanna grassland preferring the vicinity of watercourses. The Diamond Firetail is sedentary often nesting in the same tree year after year. The Diamond Firetail is threatened by clearance and fragmentation of its habitat. Populations of this species appear unable to persist in areas which lack remnants of native vegetation larger than 200ha (NSW Scientific Committee 2001).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Spotted-tailed Quoll *(Dasyurus maculatus)*
The Spotted-tailed Quoll inhabits a number of habitats including dry to moist open forests or closed forests containing rock caves, hollow logs or trees for shelter / breeding. Although the subject site provides some suitable foraging and breeding habitat, this species was not detected within the subject site.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Koala (*Phascolarctos cinereus*)
Koalas inhabit forested areas with acceptable Eucalypt food trees, also utilising non-Eucalypt species as a food source. Koalas inhabit both wet and dry Eucalypt forest that contains a canopy cover of approximately 10 to 70% growing on high nutrient soils. In NSW, 55 species of *Eucalyptus* and 11 non-eucalypt trees are known to be used and eaten by the Koala (Reed *et al.* 1991).

Three (3) tree species Forest Red Gum *(Eucalyptus tereticornis)*, Grey Gum *(Eucalyptus punctata)* and White Box *(Eucalyptus albens)* listed under schedule 2 of SEPP 44 are present within the subject site. These three (3) trees represent >15% of the total trees present within the subject site, therefore the vegetation within the subject site provides potential Koala habitat as defined by SEPP 44. The most recent record for Koala as listed in the Atlas of NSW Wildlife (DECC 2007) is from March 2000 from an area known as Manobalai Nature Reserve some 15kms south-west of the subject site. Although the subject site represents potential Koala habitat as defined by SEPP 44, no Koalas or evidence of Koala habitation has been recorded during surveys. The proposed development is unlikely to impact with this species or its habitat. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the Koala such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Glider (*Petaurus australis*)
The Yellow-bellied Glider is an arboreal tree-dwelling mammal that utilises tall mature Eucalypt forests which contain high nectar producing species and hollow bearing trees (Russell 1988). The bulk of the diet of the Yellow-bellied Glider consists of plant and insect

exudates including sap, nectar, honeydew and manna while arthropods and pollen are also eaten (Goldingay & Kavanagh 1991). Yellow-bellied Gliders occupy large exclusive home ranges between 30 and 65 hectares in size (Goldingay & Kavanagh 1991).
The subject site provides suitable foraging and shelter habitat for this species within the heavily vegetated gullies below the ridgelines of the subject site. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Squirrel Glider *(Petaurus norfolcensis)*
The Squirrel Glider inhabits dry sclerophyll forest and woodland and nest in small tree hollows (Strahan 1995). Although the subject site provides some suitable foraging and breeding habitat, this species was not detected within the subject site. It is considered that the proposed track upgrading and water pipe installation is unlikely to disrupt the life cycle of this species such that a local viable population of this species is likely to be placed at risk of extinction.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Brush-tailed Phascogale (*Phascogale tapoatafa*)
The Brush-tailed Phascogale utilises dry sclerophyll forests and woodlands with sparse ground cover for foraging and breeding habitats (Edgar 1988). Although the subject site provides some suitable foraging and breeding habitat, this species was not detected within the subject site.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Brush-tailed Rock-wallaby *(Petrogale penicillata)*
The Brush-tailed Rock-wallaby is found in suitable rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi arid country (Eldridge & Close, 1995). This species feeds mainly on grasses and forbs (Eldridge & Close, 1995).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-headed Flying-fox (*Pteropus poliocephalus*)
The Grey-headed Flying-fox is found in a variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas (Churchill, 1998). Grey-headed Flying-foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer

(Churchill, 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are an important resource where mating, birth and rearing of young occurs as well as providing refuge (Strahan, 1995).
The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. Two Grey-headed Flying-foxes were observed flying over the Glen Ridge on Middlebrook Station during nocturnal surveys conducted on the evening of the 9th May 2007. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Sheathtail-bat *(Saccolaimus flaviventris)*
The Yellow-bellied Sheathtail-bat inhabits a wide variety of Eucalypt forests, foraging above the canopy in fast flight movements. This species roosts in tree hollows and occasional old buildings (Hoye & Richards 1995).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was detected foraging near the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26thApril 2007. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Freetail-bat (*Mormopterus norfolkensis)*
The Eastern Freetail-bat is generally found in rainforests, open forests and woodland (Allison & Hoye 1995, AMBS 1995). Colonies have been found roosting under loose bark, in tree hollows (Allison & Hoye 1995), within the roofs of houses and in other modified habitats.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Large-Eared Pied Bat *(Chalinolobus dwyeri)*
It is probable that the Large-eared Pied Bat forages for insects below the forest canopy. During the day these bats may roost in caves, mine tunnels and the abandoned nests of Fairy Martins (Dwyer, 1991). The Large-eared Pied Bat may also utilise tree hollows (Schultz *et. al.* 1994). The Large-eared Pied Bat is mainly found in drier habitat including dry sclerophyll and woodland, east and west of the Great Dividing Ranges. However Hoye and Dwyer (1995) suggest that from records of the species in sub alpine woodland, moist eucalypt forest and near rainforest, it may tolerate a greater range of habitats. The distribution of this bat ranges from inland and south-eastern QLD to central-eastern and north-eastern NSW (Parnaby 1992).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern False Pipistrelle *(Falsistrellus tasmaniensis)*
The Eastern False Pipistrelle inhabits warm to cool temperate moist and dry open forests (Strahan 1995). Little is known about the biology of this species although it has been recorded in logged and unlogged areas (QEM 1994), preferring open areas for foraging (O'Neill & Taylor 1986). The Eastern False Pipistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992, Phillips *et al.* 1985).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Bentwing-bat (*Miniopterus australis)*
The Little Bentwing-bat forages below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995b). This species roost in caves, tunnels, tree hollows and occasionally old buildings (Dwyer 1995b). The subject site provides foraging for this species.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Bentwing-bat (*Miniopterus schreibersii*)
The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and in particular caves (Dwyer, 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer, 1995). Roost sites in tree hollows have not been reported (Churchill, 1998).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was detected foraging along the northern sector of Glen Ridge on the evening of the 26thApril and 8th May 2007 and along the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26thApril 2007. This species was also captured whilst roosting within the rafters of the shearing sheds on Mountain Station on the 10th May 2007 and positively identified. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Greater Long-eared Bat *(Nyctophilus timoriensis).*
In mainland Australia this species prefers semi-arid areas. Greater Long-eared Bats roost in tree hollows, fissures in branches and dried sheets of bark. (Churchill 1998). This species forages within the understorey feeding mostly on insects.

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Cave Bat *(Vespadelus troughtoni)*
This is a poorly known species, which apparently is predominantly a cave/overhang dweller but also occurs in buildings. It has been found roosting in small groups in sandstone overhang caves, boulder piles, mine tunnels and occasionally in buildings. These bats roost sites are near the entrance in generally well lit areas. They roost in small avons or domes in the roofs of the caves as well as in cracks or crevices (Churchill 1998). The Eastern Cave Bat inhabits tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extends into the drier forests of the western slopes and inland areas (Churchill 1998). It forages mainly beneath the canopy in a range of forest types over its range (SFNSW, 1995).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was detected via Anabat II detection surveys conducted on the 8th May 2007, foraging within the vicinity of the proposed maintenance shed on Mountain Station, Owens Gap and at the north-western spur area near a communications tower also on Mountain Station. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Large-footed Myotis *(Myotis adversus)*
The Large-footed Myotis inhabits rainforests and open forests containing creeks and lakes over which it feeds and roosts in tree hollows, caves, mines, under bridges, in tunnels and occasionally buildings (Richards 1995).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)
The Greater Broad-nosed Bat inhabits open forests and woodlands, foraging throughout these forest types and also along creeks and small river systems (Hoye & Richards, 1995). This species roosts in tree hollows and occasionally in old buildings (Hoye & Richards, 1995).

The subject site provides suitable foraging and shelter habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was not observed within the subject site during detailed searches. This species would use the entire potential habitat within the local area and not the subject site exclusively. Therefore, the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Acacia pendula is listed as an endangered population within the Hunter Catchment. The Hunter population of *Acacia pendula* is restricted to fewer than 1000 individuals, from 6 locations – Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. No specimens of this species were observed within the subject site during surveys. The

proposal will not require the removal of this species habitat within the subject site. It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Cymbidium canaliculatum is listed as an endangered population within the Hunter Catchment. There are currently 8 records of this species within the Hunter Central Rivers CMA region (BioNet 2007). The number of plants of *C. canaliculatum* in the Hunter Catchment is currently estimated to be very low, as few as 90. There could be as many as 300 to 500 individuals in the population, assuming an average density of about one plant per 30 square kilometres of estimated habitat for *C. canaliculatum* population in the Hunter Catchment (NSW Scientific Committee 2006). Seven (7) clumps of this species were observed in the subject site within the Box Woodland vegetation community. Clumps are defined as single clusters which may contain multiple individual bulbs. Each of these populations will be retained as part of the proposal. One of these clumps is isolated within a paddock tree by more than 5km from the nearest other known specimen. It is questionable whether the species at this location will remain viable in the long term.

Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP. It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(*Eucalyptus camaldulensis)* is listed as an endangered population within the Hunter Catchment. This species does not occur within 10km of the subject site (DECC, 2007). No specimens of this species were observed within the subject site. The proposal will not require the removal of this species habitat within the subject site. It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of *Eucalyptus camaldulensis* that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The Broad-toothed Rat at Barrington Tops in the local government areas of Gloucester, Scone and Dungog is listed as an endangered population. A search of the Atlas of NSW Wildlife (DECC 2007) revealed no records for this species within 10kms of the subject site. This species preferred habitat generally consists of alpine and sub-alpine heath and sedgelands. It is considered that the subject site does not contain suitable habitat for this species. It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the Broad-toothed Rat that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

There is one Endangered Ecological Community (EEC) known as White Box Yellow Box, Blakely's Red Gum Woodland (WBYBBRW) present within the subject site. This community occupies approximately 761.9ha within the subject site. This community also corresponds in part with the Upper Hunter White Box-Ironbark Grassy Woodland vegetation community mapped by Peak (2006) as occupying approximately 5687ha within the upper hunter region.

This EEC is also known to be securely conserved, albeit poorly represented within the Goulbourn River and Towarri NP upper hunter reserve system.

The proposal is likely to require the removal of approximately 8ha or 1.2% within the site for the upgrading of the vehicle access track and construction of the wind turbines envelopes. The majority of the Box Woodland vegetation required for removal within the subject site is highly disturbed by current intensive grazing practices, exotic weed invasion and clearing.

It is considered that given the relatively low proportion of this community being impacted within the subject site, the retention of approximately 751.9ha or 98.7% of similar or better condition EEC vegetation communities within the region and the presence of securely conserved better quality WBYBBRW within the adjoining secure conservation network, it is unlikely that the proposal will have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

ii) Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,

The corresponding WBYBBRW vegetation communities observed within the subject site already contain moderate to high degrees of exotic weed incursions within the ground and shrub layers and are currently highly disturbed by intensive grazing practices and clearing. It is recommended that a vegetation management plan be prepared that targets weed control/ pasture management practices within the site. Within the locality, these communities have been mapped as occupying 5687ha (Peak 2006). The proposed development is likely to remove approximately 8ha or 1.2% of the White Box Yellow Box, Blakely's Red gum Woodland EEC. Given the retention of approximately 641ha or 98.8% of the White Box Yellow Box, Blakely's Red Gum Woodland EEC occurrence within the subject site, and the moderate to high levels of modification already present within these communities occurrence within the subject site and the presence of much greater areas of similar or better condition EEC's within the locality, it is unlikely that the proposed development will substantially and adversely modify the composition of these communities such that their local occurrence is likely to be placed at risk of extinction

d) In relation to the habitat of threatened species, populations or ecological community:

i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

It is considered that the habitat attributes of the subject site provide known or potential habitat for a number of threatened flora and fauna species as assessed in Part (a) of this 7-part test.

The subject site has an area of approximately 3953.88ha with the development proposing the removal of approximately 8ha or 1.2% of the White Box Yellow Box, Blakely's Red gum Woodland EEC within the subject site. The subject site is connected to similar or better quality vegetation within the local area which also corresponds to the EEC known as White Box Yellow Box, Blakely's Red gum Woodland.

ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed development is likely to remove approximately 8ha or 1.2% of the White Box Yellow Box, Blakely's Red gum Woodland EEC. The site is bound to the north and east by similar native vegetation communities with excellent connectivity to Towarri National Park and surrounding native vegetation. As the proposed development is situated along the southern escarpment part of the remnant bushland within Middlebrook station and the predominately cleared areas of Mountain Station it will not disconnect any corridors or isolate any patch of vegetation it is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become fragmented or isolated as a result of the proposal.

iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The proposed development is likely to remove (but not fragment) approximately 8ha or 1.2% of vegetation within the subject site. Given the conservation of approximately 641ha or 98.8% of the White Box Yellow Box, Blakely's Red gum Woodland EEC occurrence within the subject site, and the occurrence of similar adjoining vegetation it is considered that the habitat to be removed is unlikely to be significant to the long-term survival of the species, populations or ecological communities within the locality.

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

The subject site has not been classed as critical habitat within the provisions of the *Threatened Species Conservation Act* (1995). Therefore it is considered that the proposed action will not have an adverse effect on critical habitat (either directly or indirectly).

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

There are no Recovery Plans for any of the threatened flora species.

There are drafts or final recovery plans for the following threatened fauna species with potential habitat within the subject site: Barking Owl and the Large Forest Owls (Powerful Owl, Masked Owl, and Sooty Owl), the Koala and the Yellow-bellied Glider. The proposed development is considered generally consistent with the objectives or actions of these Recovery Plans. However these plans emphasis the need for protection of suitable habitat for these species. In this regard the removal of vegetation and habitats as a result of the proposed development does not correspond with these objectives of the Recovery Plans.

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

The "Clearing of native vegetation" has been gazetted by the NSW Scientific Committee as a Key Threatening Process. Removal of native vegetation will occur in association with future development and is therefore classified as a threatening process. The removal of native vegetation on the subject site is not likely to significantly affect the biodiversity of the local area due to the extent of better quality natural vegetation within the local area and the comparatively small area of vegetation to be removed.

A final determination exists within the *Threatened Species Conservation Act* (1995) for "Removal of Dead Wood and Dead Trees" as a Key Threatening Process and as such the proposal is of a class of development recognised as a threatening process.

4.2 COMMONWEALTH LEGISLATION (EP&BC ACT)

The *Environment Protection and Biodiversity Conservation Act* (1999) requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals systems for actions that have a significant impact on matters of national environment significance (NES). These may include:-

- Wetlands protected by international treaty (the Ramsar Convention)
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on a NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to the Department of Environment and Water Resources (DEWR).

Areas of an endangered ecological community listed in the EP&BC Act (White Box-Yellow Box-Blakely's Redgum Grassy Woodlands and Derived Native Grasslands) will be impacted on by the proposal. Within the provisions of the EP&BC Act any proposal that reduced the extent of an EEC is required to be referreed to the Department of Environment and Water Resources for their review and assessment. Therefore this proposal will need to be referred to Department of Environment and Water Resources to satisfy the requirements of the EP&BC Act.

An assessment in relation to the EP&BC Act has been completed as a separate report to this document.

4.3 CONCLUSIONS

Based on the detailed field surveys and information provided in this report it is concluded that:

i) One endangered flora population (*Cymbidium canaliculatum*) was detected within the subject site;

ii) No threatened flora species were detected within the subject site;

iii) Seven (7) threatened fauna species, the Glossy Black-Cockatoo, Speckled Warbler, Grey-crowned Babbler, Grey-headed Flying-fox, Yellow-bellied Sheath tailed-bat, Common Bentwing-bat and the Eastern Cave Bat were observed within the subject site;

iv) One endangered ecological community, White Box – Yellow Box – Blakely's Redgum Woodland was observed within the subject site;

v) The proposed development is not likely to have a significant effect on threatened species, populations or ecological communities or their habitats;

vi) A Species Impact Statement should not be required for the proposed development;

vii) A referral to the Department of Environment and Water Resources will be required due to the potential loss of White Box-Yellow-Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland Endangered Ecological Community.

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APPENDIX I

FAUNA SURVEY METHODOLOGY

FAUNA SURVEY METHODOLOGY

Introduction

Fauna survey methods used by *Conacher Travers Pty Ltd* are based upon the standard methods utilised by the NSW National Parks and Wildlife Service (NPWS 1999), State Forests of NSW (York *et al*. 1991), LHCCREMS (2003), Wyong Shire Council (Forest Fauna Surveys *et al*. 1999) and Department of Environment and Conservation (DEC 2004) and adapted to those specific requirements of various local Council fauna survey guidelines where appropriate. Specific fauna groups are targeted using methods specific to that group. This appendix provides specific information on each of the fauna survey methods applied for this survey. During each of the methods used the following data is gathered relating to weather conditions:

Air temperature;
Moon (where relevant) (eg none, 1/4 moon, 1/2 moon, 3/4 moon, full moon);
Rain (eg none, light drizzle, heavy drizzle, heavy rain);
Recent rain events (where relevant);
Wind Strength eg calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).

The survey methods outlined below are the standard survey methods utilised by *Conacher Travers Pty Ltd.* The specific survey methods used for each site will depend upon the site characteristics such as size of the site, number of vegetation communities and amount of disturbance. The specific fauna survey methods used are outlined within Section 3 of this report.

1. *Diurnal Birds*

a. Bird Census

A diurnal bird census is undertaken on each day of the survey. Each census involves a 1-2 hour census throughout the site. Birds may be recorded by the observer traversing the subject site or from targeted census points within the site. A bird census is undertaken during peak activity periods (6am-9am and 3pm-6pm or later depending on season) and birds are identified through observation and call identification. Specific habitats of threatened species are also targeted across the study areas either during the bird census or opportunistically.

Opportunistic bird counts are also made while undertaking other survey work and during spotlight surveys of the site.

Birds are observed and identified using binoculars. Calls are generally identified in the field by the observer. If an unknown call is heard it is recorded and identified using reference libraries.

b. Opportunistic Sampling

When carrying out any particular method of fauna survey, any birds observed or heard are recorded. Signs of birds such as feeding stations are also noted and analysed. This provides a wider opportunity for observation of species.

c. Habitat Searches

Habitat searches involve targeted searches for signs of likely bird activity such as nesting or hollow tree use. Signs of feeding such as the characteristic chew marks of Allocasuarina cones are also targeted during searches.

2. *Nocturnal Birds*

a. Spotlighting

Spotlight surveys are conducted in the evening for 1 hour after sunset in small or highly disturbed sites and for 2 hours in large, undisturbed sites. Surveys are carried out by one or more persons and involve the use of a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting is carried out along existing tracks and/or roads, animal paths, boundary fence lines, woodland or forest with open understorey, individual trees, and where accessible, trapping transects.

b. Owl Call Playback

The recorded calls of the Powerful, Barking, Masked, and Sooty Owls are broadcast at the completion of spotlighting via a 13 watt battery operated loudspeaker. Calls are broadcast separately for 5 minutes followed by a listening period of 2 minutes. The immediate area is then surveyed with a spotlight to detect any responses. Calls for each species are played separately. Calls are broadcast from different locations depending on the size of the site and the length of the survey.

c. Stagwatch

Stagwatch surveys are conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Hollow trees identified with habitat potential are observed for use by fauna. Any owls observed leaving hollows are noted and identified.

3. *Arboreal Mammals*

a. Elliott Trapping

Arboreal mammal trapping involves the use of either Type A or Type B Elliott Traps or a combination of both. Elliott Traps are small folding box traps available in two sizes, Type A (330 x 100 x 100 mm) and Type B (450 x 150 x 150 mm) (Elliott Scientific Co., Victoria). Traps are secured with rubber bands onto mounts that are attached to the trunk of large trees (Diameter at Breast Height - DBH > 100mm) at heights ranging from approximately two to three metres.

The trap mounts consist of 500mm long hardwood planks bolted onto a steel angle bracket. These mounts are then nailed onto the tree trunk at an incline to facilitate drainage. All traps are placed in an open-ended plastic bag to provide captured animals with insulation and protection from inclement weather conditions.

Traps are placed along transects or within grids. Traps are mounted at intervals to the nearest large trees in transects or grids of 5 to 10 traps each depending upon the size of the site and type and number of vegetation communities present. This gives transects of approximately 100-200 metres in length or grids approximately 1 hectare in size.

Traps are set for a period of 3-4 continuous nights.

Traps are baited with a mixture of peanut butter, rolled oats and honey. A 50/50 solution of honey and water is sprayed on the tree trunk, trap and mount to act as an attractant for arboreal mammals.

All traps are checked each morning and closed to prevent unwanted diurnal captures. Traps are reset each afternoon and rebaited if necessary.

When released, captured animals are traced to their den sites if possible.

b. Spotlighting

Spotlight surveys are conducted in the evening for 1 hour after sunset in small or highly disturbed sites and for 2 hours in large, undisturbed sites. Surveys are carried out by one or more persons and involve the use of a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting is carried out along existing tracks and/or roads, animal paths, boundary fence lines, woodland or forest with open understorey, individual trees, and where accessible, trapping transects.

c. Hair Tubes

Hair tubes consist of a 200mm length of PVC stormwater pipe (90mm diameter) fitted with a PVC plug and cap at one end which creates a bait chamber. Bait is placed in the bait chamber between the cap and the plug which has several holes drilled into it. This allows the smell of the bait to permeate from the tube without allowing access to the bait chamber. Strips of Schafco Advance Tape are placed around the inner surface of the tube opening to catch the hairs of fauna visiting the hair tubes.

For arboreal fauna surveying hair tubes are placed on the trunk of trees at approximately two metres height using nails and rubber bands. Tubes are baited with a mixture of rolled oats, peanut butter and honey with a 50/50 honey water mix sprayed on the trunk of the tree. Tubes are placed along transects or within grids with the open side down to prevent rain effecting the adhesiveness of tapes.

When the hair tubes are collected, the hair samples are sent to Barbara Triggs for analysis.

d. Stagwatch

Stagwatch surveys are conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Hollow trees identified with habitat potential are observed for use by fauna. Any arboreal fauna observed leaving hollows are noted and identified.

4. *Terrestrial Mammals*

a. Elliott Trapping

Terrestrial mammal trapping involves the combined use of both Type A and Type B Elliott Traps. Elliott Traps are small folding box traps available in two sizes, Type A (330 x 100 x 100 mm) and Type B (450 x 150 x 150 mm) (Elliott Scientific Co., Victoria). All traps are placed in an open-ended plastic bag to provide captured animals with insulation and protection from inclement weather conditions.

Traps are placed on the ground in transects or grids of 5 to 10 traps each depending upon the size of the site and type and number of vegetation communities present. This gives transects of approximately 100-200 metres in length or grids approximately 1 hectare in size.

Traps are baited with a mixture of rolled oats, honey and peanut butter and set in suitable locations next to animal diggings, burrows, fallen logs, tree trunks and animal runways.

All traps are checked each morning and closed to prevent unwanted diurnal captures. Traps are reset each afternoon and rebaited if necessary.

Traps are set for a period of 3-4 continuous nights.

When released, captured animals are traced to their den sites if possible.

b. Spotlighting

Spotlight surveys are conducted in the evening for 1 hour after sunset in small or highly disturbed sites and for 2 hours in large, undisturbed sites. Surveys are carried out by one or more persons and involve the use of a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting is carried out along existing tracks and/or roads, animal paths, boundary fence lines, woodland or forest with open understorey, individual trees, and where accessible, trapping transects.

c. Hair Tubes

Hair tubes consist of a 200mm length of PVC stormwater pipe (90mm diameter) fitted with a PVC plug and cap at one end which creates a bait chamber. Bait is placed in the bait chamber between the cap and the plug which has several holes drilled into it. This allows the smell of the bait to permeate from the tube without allowing access to the bait chamber. Strips of Schafco Advance Tape are placed around the inner surface of the tube opening to catch the hairs of fauna visiting the hair tubes.

For terrestrial fauna surveying hair tubes are placed along transects or in grids and left in place for approximately 10 days. Along each of the hair tube transects, tubes are baited either with chicken meat or with peanut butter, rolled oats and honey.

For terrestrial fauna surveying hair tubes are placed along transects or in grids and left in place for approximately 10 days. Along each of the hair tube transects, tubes are baited either with chicken meat or with peanut butter, rolled oats and honey.

When the hair tubes are collected, the hair samples are sent to Barbara Triggs for analysis.

d. Cage Trapping

Terrestrial cage mammal trapping involves the use of wire cage traps. Wire cage traps are made of collapsible wire mesh and designed for the capture of larger size mammals.

Traps are baited with chicken or rolled oats, peanut butter and honey and placed within transect lines or grids, usually in conjunction with Elliott trapping.

Traps are checked each morning and triggered to prevent unwanted diurnal captures. All traps are placed in sheltered locations to provide protection from inclement weather.

Traps are set for a period of 3-4 continuous nights.

5. *Bats*

a. Sonar Detection

The ultrasonic calls of Microchiropteran bats are recorded to audio cassette tapes using an Anabat II echolocation call detector. Recordings are made at suitable locations within the study area for a 45 minute continuous recording or all night call activated recording.

An Anabat II ZCA Interface Module and Anabat 5.2b Software package for an IBM Compatible computer are used to analyse the ultrasonic call patterns recorded during the field and to identify those species recorded on site.

b. Harp Traps

Harp traps are placed within suitable "flyways" such as across tracks, trails or creeks to maximise the likelihood of captures. Harp traps are placed within suitable vegetation types for a minimum of three nights.

Harp traps are checked each morning of the survey with all captured bats identified using field identification guides. Bats are then released at the point of capture or placed under bark or within trunk splits of nearby trees.

c. Stagwatch

Stagwatch surveys are conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Hollow trees identified with habitat potential are observed for use by microchiropteran bats. Any bats observed leaving hollows are identified by Anabat II detectors positioned at the base of the tree.

d. Spotlighting

A survey for Flying-foxes can be conducted by spotlighting potential food trees and by identifying their characteristic social calls.

6. *Amphibians*

a. Habitat Search

Habitat searches involve searching likely niches such as dense undergrowth, around trees, under logs and rocks, and aquatic and gully habitats. Amphibian species observed during habitat searches are noted and the calls of species not observed are recorded onto a personal cassette recorder for later comparison with call reference libraries. Captured individuals were identified on site using field reference texts and released.

If aquatic habitats are present on the site they are sampled for the presence of particular fish species to gather information on any predatory fish species such as *Gambusia holbrooki*. A small dip net is passed through the waterbody a number of times to sample the fish stock of the aquatic habitat.

Opportunistic sightings of any reptiles or amphibians are also made while undertaking other survey work and during spotlight surveys of the site.

Field traverses are made across the study area 0.5 hours at a time. Optimal times for conducting habitat searches are early morning, late afternoon or when favourable weather conditions for a particular species prevail.

b. Call Identification

Where suitable habitats are present, areas frogs are heard calling are targeted and any frogs heard calling are identified in the field or recorded onto cassette for later identification. This method is specifically used during times of peak calling activity, that is, after rain/storms and in periods of warm weather.

Field traverses are made across the study area 0.5 hours at a time. Optimal times for conducting habitat searches are early morning, late afternoon or when favourable weather conditions for a particular species prevail.

7. *Reptiles*

a. Habitat Search

Habitat searches involve searching likely niches such as dense undergrowth, around trees, under logs and rocks, and aquatic and gully habitats. Destructive searches whereby bark, logs, debris, rocks and ant-nests are displaced are also carried out. Reptile species observed during habitat searches are noted and if individuals are captured they are identified on site using field reference texts and released.

Opportunistic sightings of any reptiles are also made while undertaking other survey work.

Field traverses are made across the study area for up to 3 hours at a time, usually by one person. Optimal times for conducting habitat searches are between 6am to 9am and 3pm to 6pm, or in suitable weather conditions depending on the season.

b. Spotlighting

Spotlight surveys are conducted in the evening for 1 hour after sunset in small or highly disturbed sites and for 2 hours in large, undisturbed sites to target nocturnal reptile species. Both terrestrial and arboreal habitats are searched during nocturnal searches. Surveys are carried out by one or more persons and involve the use of a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting is carried out along existing tracks and/or roads, animal paths, boundary fence lines, woodland or forest with open understorey, individual trees, and where accessible, trapping transects.

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