1.4 Scope of the Study

This EAR is intended to investigate the potential ecological impacts of the development proposal as required by the Part 3A DGEAR's. The primary impacts are likely to be associated with the removal of vegetation both in terms of direct impacts upon native stands of vegetation and to a lesser extent, upon habitat for native fauna within and directly adjacent to the Development Estates.

At the state level, the proposal is to be assessed pursuant to Part 3A of the EPA Act. To this end, in August 2010, the DGEAR's were issued for the site (Appendix 1).

To ensure completeness, ecological fieldwork and assessment has covered the full extent of the Coal & Allied surplus lands, including all development and Conservation Estates. This EAR should be read in conjunction with the Northern Lands Conservation Estates Ecological Inventory (Refer to Appendix 2) since the proposed protection of the Conservation Estates forms an integral component of the proposal, aiming to offset any potential ecological impacts associated with the Development Estate.

The 'Key' Assessment requirements for investigations required under the DGEAR's are:

- Provide an assessment on impacts on flora and fauna in accordance the with draft Guidelines for Threatened Species Assessment (DEC, July 2005);
- Consider the corridor values or connective importance of any vegetation on the site and the likely cumulative impacts of proposed development on biodiversity;
- Describe the actions that would be taken to avoid or mitigate impacts on biodiversity or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment on the effectiveness and reliability of the measures and any residual impacts after these measures are implemented; and
- Demonstrate that biodiversity impacts can be appropriately offset in accordance with the NSW Government's policy for 'improvement or maintenance' of biodiversity values.

1.5 Definitions

The definitions given below are relevant to the Director-General's requirements:

'development' has the same meaning as in the *NSW Environmental Planning and Assessment Act 1979.*

'activity' has the same meaning as in the *NSW Environmental Planning and Assessment Act 1979.*

'proposal' is the development, activity or action proposed. Other terminology used for the 'proposal' includes the **'current proposal'** or **'development proposal'**.

The **'Site'** refers to the entire land holding, inclusive of development and conservation areas.

The **'Development Estate'** refers to the area(s) scheduled for development.

The **'Conservation Estates'** refers to the area(s) scheduled for dedication to the NSWG. Other terminology used for the 'Conservation Estates' includes the **'Offset Lands'** or **'Dedication Lands'.**

Due to the size and separation of land holdings proposed for development and conservation, they have been broken down into two distinct geographical components. As such the sites have been condensed into the '**Southern Lands'** and **'Northern Lands'**.

All other definitions are the same as those contained in the *NSW TSC Act, 1995*.

1.6 EPBC Act 1999

In November 2008 the proposal for an industrial subdivision at Black Hill was referred to the Federal Department of the Environment, Water, Heritage and the Arts in accordance with provisions of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

- This assessment has been prepared in accordance with the application made to the Federal Minister for the Environment for determination.
- The development and conservation outcomes sought under this proposal remain consistent with those sought under the EPBC Act Referral. Refer to Table 5-1.
- The habitat outcomes proposed within the EPBC Act Referral remain consistent. Refer to Table 5-2.
- To ensure consistency the threatened species, populations and ecological communities assessed within the EPBC Act Referral have been assessed herewith within Table 6-1.

- The dedication of conservation Estates to the NSW Government, management under the provision of a Statement of Interim Management Intent (SIMI) and ongoing management as part of NSW NPWS Estate remain consistent.
- On 23 December the Federal Department notified Coal & Allied that it had decided the proposed action was not considered a controlled action and as such did not require assessment and approval by the Minister for the Environment, Heritage and the Arts before it could proceed.

1.7 Qualifications & Licensing

Qualifications

The principal author of this report was Matthew Doherty BLMC of RPS Harper Somers O'Sullivan Pty Ltd, with additional input from Craig Anderson BAppSc (EAM), Deborah Landenberger BSc (Hons), Allan Richardson BEnvSc (Hons), Sam Bishop BEnvSc, Alex Saddington BAppSc, Shaun Corry Dip Cons & Lnd Mgt, Anna McConville BEnvSc, and Toby Lambert BEnvSc. The academic qualifications and professional experience of all RPS ecologists involved in the project are documented in Appendix 6

Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2011);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

1.8 Sub-consultants, Personal Communications & Observations

Subconsultants

RPS used the following organisations during this study where appropriate input was required.

Plant Species Identification:	Royal Botanic Gardens National Herbarium of NSW The Domain Mrs Macquaries Road SYDNEY NSW 2000 P: (02) 92318111
Microchiropteran Bat Analysis:	Maria Adams 4110 Nelson Bay Road

ANNA BAY NSW 2316
P: (02) 4982 2350
E: mariaadams@aapt.net.au

Personal Observations

Relevant observations made by the authors or other RPS ecologists outside of the project or other published studies have been included within this report as 'personal observations' (pers. obs.).

Agency/ Group/ Organisation Consultation

The following agencies were consulted during the preparation of this EAR. Note this list is not comprehensive. For a full account of the consultation undertaken during the project (Charette) process, refer to the consultation section included within the wider EA submission.

DECCWW (Lucas Grenadier)	NPWS (Tom Bagnat)
Newcastle City Council	LMCC (Robbie Economos/Greg Gilles)
Hunter-Central Rivers CMA	Green Corridor Coalition (Brian Purdue)
Lake Macquarie Coastal and Wetlands Alliance	The Newcastle Wilderness Society
Department of Primary Industries	Hunter Environment Lobby

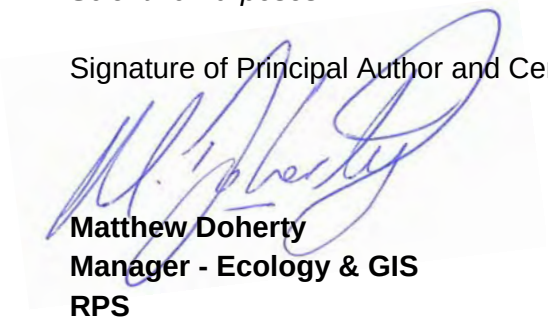
1.9 Certification

As the principal author, I, Matthew Doherty make the following certification:

The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;

All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995, National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.*

Signature of Principal Author and Certifier:



Matthew Doherty
Manager - Ecology & GIS
RPS
January 2011

2 Literature Review

A review of existing literature relevant to the project was undertaken in an effort to glean as much information as possible on the existing environment and ensure a holistic approach to ecological assessment. Notably several specific investigations into the existing environment within the vicinity of the Development Estate have been undertaken in recent times. An account of the information considered is listed below.

Note the following list is not considered comprehensive. Additional references can be viewed within Section 10 of this report.

Ecological Surveys

- EcoBiological (2006) *Abel Underground Mine – Part 3A Assessment, Appendix J Flora and Fauna Lists and Descriptions*. An unpublished report prepared for Donaldson Coal Pty Ltd.
- Harper Somers O'Sullivan (2005) *Phase One Vegetation Assessment Report, over Various Land Holdings in the Lower Hunter/Central Coast, NSW*. A report Prepared for Coal & Allied.
- RPS Harper Somers O'Sullivan (2007a) *Ecological Constraints Investigations Phase 1, Over Various Land Holdings in the Lower Hunter/Central Coast NSW*. A report prepared for Coal & Allied.
- RPS Harper Somers O'Sullivan (2007b) *Ecological Constraints Investigations Phase 1, Over Various Land Holdings in the Lower Hunter/Central Coast NSW – Addendum Report*. A report prepared for Coal & Allied.
- RPS (2010) *Ecological Assessment Report, Northern Lands Link Road – Minmi*. A report prepared for Coal & Allied.
- Umwelt Environmental Consultants (2003) *Minmi corridors Assessment – Maintaining and Enhancing Natural and Cultural Heritage Values*. An unpublished report prepared for Newcastle City Council, August 2003.
- WBM Oceanics Australia (2001) *Review of Rezoning Proposal for the Tank Paddock, Lenaghans Drive, Minmi*. An unpublished report prepared for Newcastle City Council, December 2001.

Scientific Papers

- Barrett, G.W., Ford, H.A. and Recher, H.F. (1994). Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology 1*, 245-256.
- Bell S.A.J. (2001) Notes on the Distribution and Conservation status of some restricted plant species from sandstone environments of the upper Hunter Valley, New South Wales *Cunninghamii* **7(1)** 77-88.
- Driscoll C. (2003) The pollination Ecology of *Tetratheca juncea (Tremandraceae):* Finding the Pollinators. *Cunninghamia* **8(1)** 133-140.
- Payne R.J. (1993) Predication of the Habitat for *Tetratheca juncea* in the Lake

Munmorah Area near Wyong NSW. *Cunninghamia* **3(1) 147-154**.

- Phillips, S., and Callaghan, J. (2000) The tree species preferences of Koalas *(Phascolarctos cinereus)* inhabiting forest and woodland communities on Quaternary deposits in the Port Stephens area, New South Wales. *Wildlife Research* 27(1): 1-10.
- Phillips, S., Callaghan, J. and Thompson, V. (2000) The tree species preferences of Koalas *(Phascolarctos cinereus*) in the Campbelltown area south-west of Sydney, New South Wales. Wildlife Research 27(1): 509-516.
- Kavanagh, R. (2002). Comparative Diets of the *Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa)* and *Masked Owl (Tyto novaehollandiae)* in South-eastern Australia. In: Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds) (2002). Ecology and Conservation of Owls, pp 175-188.
- Quin, D.G. (1995). Population Ecology of the Squirrel Glider (Petaurus norfolcensis) and the Sugar Glider *(P. breviceps)* (Marsupialia : Petauridae) at Limeburners Creek, on the Central North Coast of New South Wales. In: Australian Wildlife Research 22: pp 471-505.
- Wells R.W. (2007) A Review of Threatened Species Considerations for the Proposed Rezoning of Lot 2 DP 534168 and Lot 11 DP 1044935 Minmi Road, Fletcher, New South Wales for Northwest Residential Pty Ltd. *Australian Biodiversity Record* **(10): 1-72.**

Vegetation Mapping Projects

- Bell, S.A.J. (1998) *Lake Macquarie State Recreation Area, Pulbah Island Nature Reserve (NR) and Tingira Heights NR Vegetation Survey – A Fire Management Document, Volumes 1 and 2*. Unpublished Report prepared for NSW National Parks and Wildlife Service, Hunter District by Eastcoast Flora Survey.
- Department of Environment and Conservation (2006) *Pambalong Nature Reserve Plan of Management.*
- Lower Hunter and Central coast Regional Environmental Management Strategy (LHCCREMS) (2000). Updated by House (2003). *Lower Hunter and Central Coast Extant Vegetation.* Draft Report.

Threatened Species Management Plans

- Payne R. J. (2000) *Lake Macquarie Tetratheca juncea Conservation Management Plan*, Robert Payne Ecological Surveys and Management. An unpublished Report Prepared for Lake Macquarie City Council.
- Payne R.J. (2001) *Addendum to the Final November 2000 Tetratheca juncea Conservation Management Plan*. Robert Payne Ecological Surveys and Management and Lake Macquarie City Council.

Fauna Surveys / Reports

- Eby, P. (2001). *Surveys for roost sites/camps for the Grey-headed Flying Fox* (excel file). Surveys commissioned by the Northern Directorate of NPWS.
- Environment Australia (2001). *A Directory of Important Wetlands in Australia*, Third

Edition. Environment Australia, Canberra.

- Forest Fauna Surveys (2002). *Current Status of the Squirrel Glider (Petaurus norfolcensis) in the Eleebana Area.* Draft Report (version no.4) to Lake Macquarie City Council, November 2002.
- Garnett, S. and Crowley, G. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra, ACT.
- Gibbons, P. and Lindenmayer, D. (2002). *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing Collingwood, Victoria.
- Hilton-Taylor, C. (compiler) (2000). *2000 IUCN Red List of Threatened Species.* IUCN, Gland, Switzerland and Cambridge, UK.
- Quin, D.G. (1993). *Sociology of the Squirrel Glider and the Sugar Glider.* PhD Thesis, Department of Ecosystem Management, University of New England.
- Recher, H.F (1995) *The conservation and management of Eucalypt forest birds: resource requirements for nesting and foraging.* Conservation of Australia's Forest Fauna. Royal Zoological Society of NSW, Mosman.
- Shortland Wetlands Consultancy (1996). *Eleebana Local Squirrel Glider Study*. Report to Lake Macquarie City Council, February 1996.
- Smith, A., Watson, G. and Murray, M. (2002). *Fauna Habitat Modelling and Wildlife Linkages in Wyong Shire.* Report to Wyong Shire Council by Austeco Environmental Consultants.
- Smith, A. (1998). *Effects of Residential Subdivision on the Squirrel Glider: Apollo Drive, Lake Macquarie City Council LGA.* Prepared by Austeco Environmental Consultants.
- Smith, A. P. (2002). *Squirrel Glider (Petaurus norfolcensis) Conservation Management Plan: Wyong Shire.* Wyong Shire Council. Wyong.
- Young, J. (1999). *Northlakes Forest Owl Project*. Report to Lake Macquarie City Council, January 1999.

Biodiversity Databases

The Atlas of NSW Wildlife	BioNet
CANRI	Australian Museum Fauna Database
Atlas of Australian Birds	PlantNet
FaunaNet	LMCC Wildlife Database

Regional Conservation Reserves Overview

Blue Gum Hills Regional Park

Blue Gum Hills Regional Park (BGHRP) is located directly adjacent to the proposed Minmi – Link Road development site. The Park aims to become a high quality recreational facility and a conservation asset that will attract visitors to and within the region.

Management Objectives

The Regional Parks Plan of Management identifies a number of objectives designed to

maintain and enhance the Blue Gum Hills' ecological value. Appropriate measures for the proposal will be generated to ensure consistency with conservation plans. The following objectives are considered of high priority to BGHRP.

- Protect and enhance the value of the remnant and regenerated plant communities;
- Acknowledge the dependency of the parks natural systems on surrounding areas;
- Include collaborative process in management, working with adjoining landholders, managers and stakeholders;
- Maintain offsite connectivity via corridors and vegetation patches;
- Develop and explore reciprocal arrangements and management efficiencies between NPWS and adjacent site managers;
- Establish co-operative weed control programmes with adjacent landholders; and
- Encourage councils to plan adjoining open space and pedestrian / cycle ways to link development with the park

Pambalong Nature Reserve

Pambalong Nature Reserve is located west of the Sydney to Newcastle freeway between Lenaghan and Minmi and adjacent to proposed Conservation Estates at Stockrington.

Management Objectives

The main management objectives of Pambalong Nature reserve are outlined below:

- Conservation of the wetland vegetation communities;
- Lathams Snipe is of particular interest to the reserve due to its international status under migratory species agreements. Revegetation of cleared and degraded areas in order to protect the habitat for waders and waterbirds (particularly Latham's Snipe) is a high priority for the Nature reserve;
- The reserve currently has a low level of visitor use, and is limited to bird enthusiasts, researchers and recreational visitors. It is a high priority of the reserve that visitor use remains at a low level and is ecologically sustainable; and
- Aquatic weeds, particularly water hyacinth, have invaded the wetland areas. It is a high priority of the reserve that pest species are controlled and where possible, eradicated.

Hexham Swamp Nature Reserve

Hexham Swamp Nature Reserve is in an extremely important position in terms of the lower Hunter's biodiversity. It forms part of a vital corridor between Watagans and Lake Macquarie, the wetlands of the Hunter Estuary and Stockton Bight.

Management Objectives

The main management objectives of Hexham Swamp Nature Reserve are:

- Manage water and salinity levels to maximise waterfowl habitats and to manage the natural environment of the area for all species;

- Protection and preservation of natural features;
- Negotiate agreements with landholders and/or support acquisition of lands to help ensure water quality in the estuary catchment;
- Conservation of wildlife;
- Encourage plant diversity. Remove weeds adjacent to high tide roosts;
- Undertake monitoring of bird populations; and
- Emphasis within the local community, part neighbours of the nature reserves, the importance and purpose of management programs relating to the protection of their natural values and the control of fire, weeds and feral animals.

Western Corridors Study

The Lower Hunter Regional Strategy (LHRS) provides the land use planning framework to guide sustainable growth over the next 25 years in the Lower Hunter region. The LHRS recognises the lands in the western corridor as proposed urban and employment lands, subject to more detailed planning investigations and analysis.

Management Objectives

The Lower Hunter Regional Strategy (LHRS) recognises the lands in the western corridor as proposed urban and employment lands, subject to more detailed planning investigations and analysis.

The LHRS aims to ensure that adequate land is available and appropriately located to sustainably accommodate the projected housing (115,000 new dwellings) and employment (66,000 new jobs) needs of the Region's population over the next 25 years.

This Strategy recognises a vegetation corridor along Newcastle Link Road connecting to Blackbutt Reserve and also along George Booth Drive to provide a visual green entry statement as well as a fauna (primarily bird) corridor. The width of the corridor shall be determined by flora and fauna investigations.

Vegetation offsets will need to be justified and preferably link or adjoin existing conservation lands, including identified riparian areas, to provide greater biodiversity conservation outcomes.

Department of Environment, Climate Change & Water Guidelines

Developments adjoining Department of Environment, Climate Change & Water (DECCW) or conservation lands are regulated by DECCW guidelines. These guidelines aim to prevent direct or indirect adverse impacts on the land managed by DECCW as a result of development. The following heads of consideration should be incorporated into all developments:

- *Erosion and Sediment Control*

Prevent detrimental change in hydrological regimes, minimise erosion and prevent sediment movement into DECCW land occurring during the construction and post-construction phases of development.

Sedimentation control will comply with the relevant guidelines ('Managing Urban Stormwater – Soils and Construction, Volume 1' (Landcom 2004)) preventing sediment flow from the development site onto DECCW land.

- *Stormwater Runoff*

The aim of this guideline is to assure nutrient levels and flow regimes/patterns of stormwater/ runoff mimic natural levels prior to reaching DECCW land.

Water sensitive urban design techniques will be employed to maximise natural site hydrology and ensure high water quality of stormwater with no excessive export of sediments and nutrients.

- *Management Implications, Pets, Weeds, Edge Effects*

Ensure the development does not promote weed growth, provide Park access to domestic pets, facilitate the use or construction of informal tracks, have any negative impact on cultural or natural heritage due to higher visitation rates, compromise natural fire regimes, or result in encroachments and impede DECCW access for management purposes.

- *Fire and the location of Asset Protection Zones*

DECCW requires all asset protection zones to be located within the development area and not incorporate DECCW land. DECCW require that there will be no expectation for DECCW to alter the existing fire management regimes for the park.

- *Boundary Encroachments*

It is important that no activities associated with construction occur on DECCW land. No pre-construction, construction or post-construction activities are to occur on DECCW managed land. All material and works associated with construction will occur on the proposed development site.

- *Visual, Odour, Noise, Air Quality Impacts and Amenity*

Consideration of visual, odour, noise and air quality impacts that may occur to the on DECCW estate during the construction and post construction stages of development must be made and where possible measures to avoid and mitigate these impacts be taken.

- *Threats to Ecological Connectivity*

Proposals should aim to maintain (and possibly enhance) existing vegetation and habitats that provide a linkage, buffer, home range and/or refuge role on land that is adjacent to DECCW Estate.

3 Methods

The DGEARs stipulate assessment should have due regard to DECCW's Threatened Species Assessment Guidelines. These guidelines refer the user to consult the Threatened Biodiversity Survey and Assessment Guidelines – Working Draft (DECCW 2004) and any relevant recovery plans and threat abatement plans for ecological assessment. To this end these documents have formed the core basis for the adopted ecological assessment methodology over the site.

For the purposes of continuity and to best represent a holistic survey approach, the regional guidelines considered as part of the combined survey design and efforts are as follows:

- The Flora and Fauna Survey Guidelines, Lower Hunter Central Coast Region (Murray et al 2002);
- The Flora and Fauna Survey Guidelines of the Lake Macquarie Local Government Area (July 2001); and
- Wyong Ground Orchid Survey Wyong Shire (Gunninah Environmental Consultants, 2003).

This section refers to the methodology applied to the Development Estate only. Refer to Appendix 2 for a detailed survey methodology for the Conservation Estates.

3.1 Preliminary (Desktop) Assessments

Preliminary assessments drew on a number of information sources including previous preliminary reporting and information held on government databases and archives. Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Preliminary assessment utilised a number of information sources, including:

- Vegetation Assessment Report, Harper Somers O'Sullivan (2005);
- Phase One Ecological Constraints Investigations RPS HSO (2007);
- Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the site;
- Review of fauna and flora records contained in the DECCW Wildlife Atlas (Accessed January 2010);
- Literature reviews;
- LHCCREMS – Vegetation Survey, Classification and Mapping. (NPWS 2000, House 2003);
- Hunter Bird Observers Club (HBOC) records;
- Birdata (web version of Birds Australia's New Atlas of Australian Birds);

- A review of GIS data including aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil Landscapes, Acid Sulphate Soil Potential;
- DECCW database of Threatened Species, Populations and Ecological Communities (website); and
- Collective knowledge gained from extensive work in the area.

3.2 Survey Site Positioning & Delineation of Stratification Units

Stratification of the site was undertaken based on interpretation of Phase 1 base data, API and previous field inspections along with consideration of biophysical, vegetation structure, soil type and floristic boundaries.

Flora Stratification Units

The DECCW Flora Survey Guidelines and other relevant guidelines were consulted to determine survey requirements for large sites. These guidelines suggest that areas should be initially stratified on biophysical attributes (e.g. soil, geology) followed by vegetation structure (e.g. Woodland, Forest, Shrubland) and then floristics i.e. species. Within the Black Hill site, three vegetation structures of Dry Open Forest, Coastal Wet Sclerophyll Forest, and cleared/weeds exist. During ongoing ground truthing, amendments were made and thus some stratification units were dismissed as not occurring within the site, conversely some new units were created. Amendments to the survey effort were based on the area of the communities and thus the number of quadrats and transects were increased to ensure that all stratification units were surveyed across the site.

Fauna Stratification Units

The DECCW Fauna Survey Guidelines were consulted to determine survey requirements for large sites. From these guidelines the requirement to reduce a site into stratification units based on area and the need to represent variation in vegetation communities across a site was derived. Stratification units designated for each trapping transect were defined by encompassing each vegetation community identified within the site and additional transects were added for every 100ha of community.

The site encompasses approximately 183ha and three broad vegetation types. One of the vegetation communities, being Cleared Land, is not considered of sufficient extent (some linear) to support threatened fauna species in isolation for trapping purposes and it did not conform to habitat which might be highly suitable to locally occurring mammal species. For these reasons dedicated trapping transects were not allocated to this community, but trapping transects were located within other habitats in its vicinity. Due to the small area of some of those vegetation communities represented within the Black Hill site, each of the four transects represented approximately 40ha of vegetation.

3.3 Preliminary Vegetation Assessment

A variety of field survey techniques were employed over the course of fieldwork for this assessment to target the full suite of flora species and fauna guilds across the site. Nomenclature and classification of delineated vegetation communities followed the LHCCREMS Vegetation Community Mapping (NPWS 2000, House 2003) wherever those communities were commensurate with those encompassed by LHCCREMS mapping.

3.4 Vegetation Mapping

Flora surveys and vegetation mapping carried out on the site has been undertaken as follows:

- API to map the community(s) extent into definable map units;
- Confirmation of the community type(s) present (dominant species) via the undertaking of detailed flora surveys and identification;
- Review of previous preliminary environmental studies conducted by HSO (2005) and RPS HSO (2007);
- Review of the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) Vegetation Mapping (NPWS 2000: House 2003) for the site and surrounding areas;
- Review of EcoBiological (2006), Abel Underground Mine – Part 3A Assessment, Appendix J Flora and Fauna Lists and Descriptions. This project conducted vegetation surveys over part of the conservation estates and Black Hill Development Estate.
- The conservation status of the derived vegetation communities was considered in light of the findings of the LHCCREMS Vegetation Mapping (2003);
- Vehicle reconnaissance was carried out on all the unformed tracks within the Development Estate. These general traverses were used to gain a general understanding of distribution of the vegetation communities;
- Flora surveys were carried out across the site, with an emphasis on potentially significant species, as outlined below. The general flora survey also included six - 20m X 20m quadrats and six - 100m transects throughout the native vegetation within the site (Figure 3-1), as well as approximately four hours of Random Meanders in line with methodology termed as the “Random Meander Technique” by Cropper (1993) These random meanders entailed 3.5 km of foot traverses throughout the Development Estate (Figure 3-2);
- Map the type and general extent of the community(s) present into definable map units where appropriate; and
- Assessment of the potential for the derived vegetation communities to constitute EEC’s as listed within the *TSC Act (1995*) was also undertaken. The floristic composition, geomorphological characters and geographic distribution were considered when determining whether an EEC was present; and

- Vegetation communities were mapped utilising a combination of the PATN Analysis, API and ground truthing.

3.5 Plant Identification

During this survey when a plant could not be identified accurately in the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1992 – 2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all stratums to ensure that an informed delineation resulted. All flora species recorded are documented in Appendix 3.

Voucher specimens were forwarded to Royal Botanical Gardens, Sydney, for verification of potential threatened flora species considered as difficult to separate from common flora species.

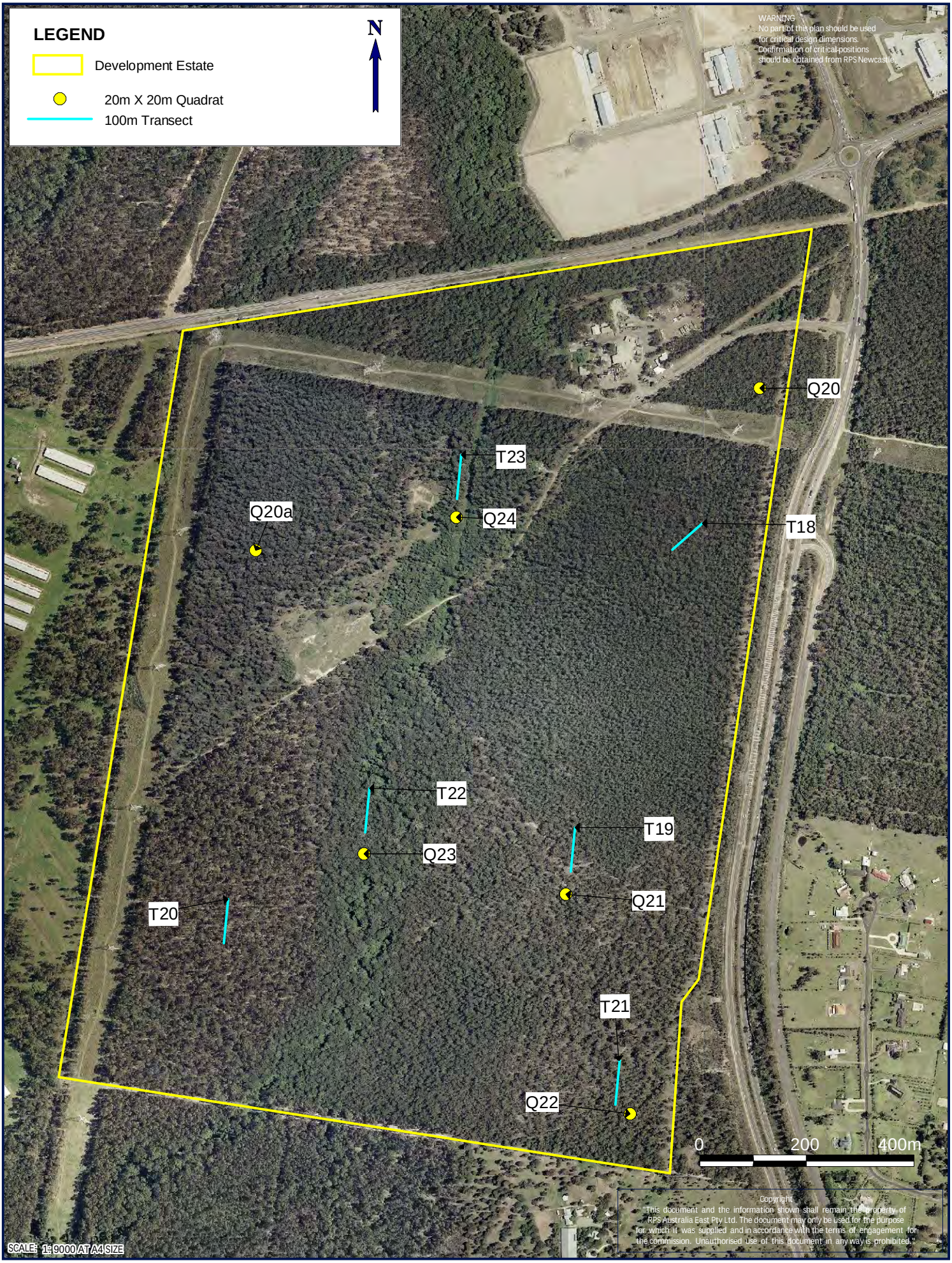
3.6 Landform and Geophysical Information

Topographic information was collected along with measurements of altitude, slope and aspect. Slope was determined from a slope map, which was derived from 2m contours for the entire site. Aspect was measured using a Sunto compass with reference to magnetic north. Information on geology, soils, fire and other disturbances were collected on NPWS survey data sheets. Site location was recorded in eastings and northings using Map Grid of Australia Zone 56 (GDA 94) co-ordinated system on a Trimble GEO XH GPS, which has sub-metre accuracy following post-processing.

3.7 Floristic Structure Information

Vegetation structure was determined based on Specht *et al,* (1995) by estimation of the height and projected foliage cover (PFC) within each stratum present. Individual taxon data for each quadrat/transect was recorded using the NPWS species data forms. Species abundances were recorded utilising a modified Braun-Blanquet (1982) cover abundance six ranking scale as follows:

Cover Code	Projected Canopy Cover
1	<5% and uncommon
2	<5% and common
3	6-20%
4	21-50%
5	51-75%
6	76-100%



TITLE: FIGURE 3-1 FLORA SURVEY LOCATIONS

LOCATION: BLACK HILL

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

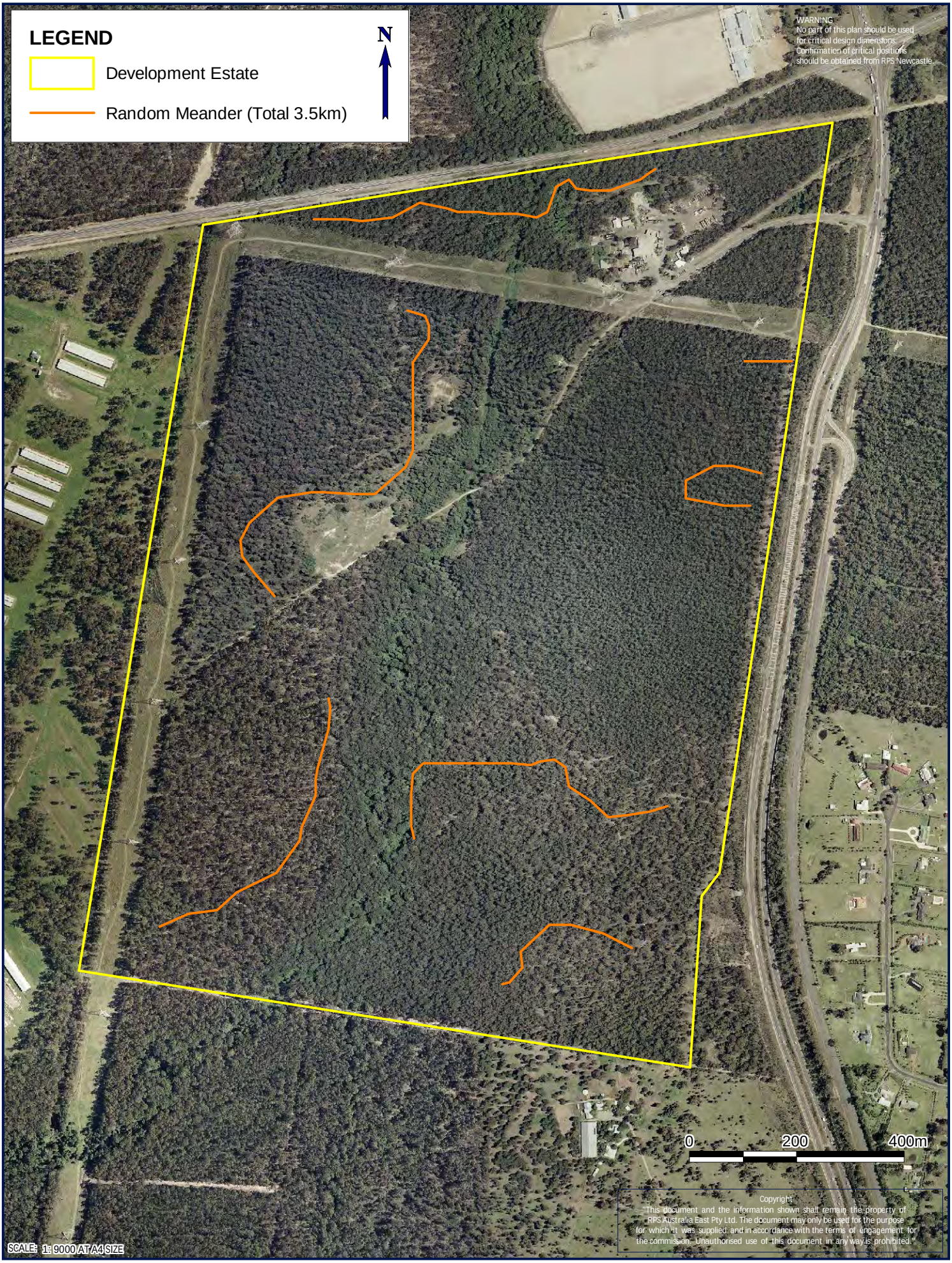
DATE: 18/10/2010
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\BH\Figure 3-1 Flora Survey Locations B A4
VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS



TITLE:	FIGURE 3-2 RANDOM MEANDER SURVEY LOCATIONS	LOCATION:	BLACK HILL	DATUM:	N/A	DATE:	18/10/2010
				PROJECTION:	MGA ZONE 56 (GDA 94)	PURPOSE:	EAR

LAYOUT REF: J:\OBS\24k\24530 Hunter Valley\2010 Work\Draft..\Eco..\North.. Land\BH\24530-2 Figure 3-2 Random Meander Loc...B A4
VERSION (PLAN BY): B (A.P-M.N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

3.8 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included, threatened species (Endangered or Vulnerable) and EECs listed under the *TSC Act* (1995) and ROTAP listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance.

Based on the environmental units and vegetation communities present, targeted searches were conducted for those species deemed as having the potential habitat on the site. Targeted searches were undertaken throughout Development Estate for these species and flora species which were recorded within a 10 km radius of the site during the survey period. Refer to Table 3-1.

Table 3-1: Threatened Flora Species Techniques Analysis

Threatened Flora Species	TSC listed	EPBC listed	Habitats (but not confined to) Map units REMS	Targeted Survey Notes (LMCC Flora & Fauna Survey Guidelines 2002)	Flowering Period (Best time to Survey) in Months of the Year											
					J	F	M	A	M	J	J	A	S	O	N	D
Acacia bynoeana Bynoe's Wattle	E	V	26, 30, 31, 48	Rm, Safr.	■	■	■						■	■	■	■
Arthropteris palisotii	E	-	1, 2, 3, 4	Not in Guidelines Rm, Sa and or Rq	Fern – Non-flowering											
Caladenia tessellata Thick Lip Spider Orchid	V	V	34	Rm, Sfr. Recently burnt areas of note.									■	■	■	
Callistemon linearifolius Netted Bottlebrush	V	-	5, 15, 17, 42	Rm, Sa.	■								■	■	■	■
Cryptostylis hunteriana Leafless Tounge Orchid	V	V	30, 31, 32,33	Rm or Rq, Str	■										■	■
Cynanchum elegans	E	E	6	Rm, Sa.								■	■	■	■	
Dendrobium melaleucaphilum Spider Orchid	V	-	Alluvial, *Melaleuca styphelioides*	Rm - epiphytic orchid *M. styphelioides* of note, Sa.							■	■	■	■	■	
Diuris praecox Newcastle Doubletail	V	V	15, 30, 51	Rm, Sfr.								■	■			
Eucalyptus glaucina Slaty Red Gum	V	V	13, 19	Rm, Sa.			■	■	■							

Threatened Flora Species	TSC listed	EPBC listed	Habitats (but not confined to) Map units REMS	Targeted Survey Notes (LMCC Flora & Fauna Survey Guidelines 2002)	Flowering Period (Best time to Survey) in Months of the Year											
					J	F	M	A	M	J	J	A	S	O	N	D
Grevillea parviflora subsp. *parviflora* Small Flower Grevillea	V	V	5, 15, 17, 30	Rm, Sa	Flowers all year											
Microtis angusii	E	E	31	Rm, Sa												
Rutidosis heterogama Heath Wrinklewort	V	V	17	Rm, Sa												
Syzygium paniculatum Magenta Lilly Pilly	V	V	1,4, 5,6, 50	Rm, Sa (flowering specimens preferential for ID)												
Tetratheca juncea Black-eyed Susan	V	V	5, 11, 15, 17, 30, 31, 34, 34a, 37, 40a, 43, 44, 48	Rm – creekflat to ridgetop. Sfr - two surveys are required; spaced two months apart.												
Zannichellia palustris	E	-	46 and saline habitats	Rm, Safr												

Rm = Random meander, Rq = Replicated Quadrats, Sa = Survey anytime, Safr = Survey anytime, flowering period recommended, Sfr = Survey within flowering period required

3.9 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). An assessment of whether GDEs occur within the Development Estate has been made within this EAR.

In this report the NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002) and Groundwater Dependent Ecosystems Assessment, Registration and Scheduling of High Priority (DWE 2006) were consulted to determine if any GDEs present within the Development Estate and classify them according to these policies.

There are differing types of Groundwater Systems (DLWC, 2002) which include:-

(1) Deep Alluvial Groundwater Systems;

(2) Shallow Alluvial Groundwater Systems;

(3) Fractured Rock Groundwater Systems;

(4) Coastal Sand Bed Groundwater Systems; and

(5) Sedimentary Rock Groundwater Systems.

Three of these types of groundwater systems have the potential to occur in the Hunter region and these include Shallow Alluvial, Coastal Sand Bed and Sedimentary Rock Groundwater Systems. The most likely system to occur within the Development Estate would be Shallow Alluvial Groundwater System and thus the soil mapping is important in assessing the potential for the presence of groundwater aquifers. The soil mapping of Newcastle (Matthei, 1995) was consulted to determine the boundaries of alluvial soil mapping within the Development Estate.

3.10 Data Analysis

Vegetation data was collected from a total of one hundred and seven (107) quadrats within the entire Northern Lands. A total of six (6) quadrats were located within Black Hill Development Estate and thirty-nine (39) quadrats were located within the Link Road, Minmi Development Estate. The remaining sixty-two (62) quadrats were sampled within the Conservation Estates at Tank Paddock and Stockrington. Agglomerative cluster analysis of the vegetation data collected was performed using the PATN Statistical Analysis Package Ver. 3.11 (Belbin 2006), to assist in the delineation of the vegetation communities across the Northern Lands. This statistical program has been used in previous large vegetation surveys in the region (Bell 2002, Bell 2004, Hill 2003, NPWS 2000 & Peake 2006). Cluster analysis groups objects that are similar to one another. In the case of vegetation community analysis this statistical tool groups communities based on the similarity of plant species recorded.

Cluster analysis groups objects (in this case survey sites) together by way of an assessment of the association between data pairs. PATN provides several association measures which are applicable to different types of data. For the data collected within the Northern Lands, both the Bray Curtis and Kulzcynski association measures were explored on the data with the default PATN settings. Belbin (2003) suggests that the Bray Curtis association measure is most appropriate where matches between higher values are more significant than matches between lower values and this would suggest that this measure is the most appropriate for abundance data. An unweighted pair-group arithmetic averaging (UPGMA) clustering strategy was applied to both association matrices with a default beta value of -0.1.

Dendrograms were produced using both association measures, with the Bray Curtis analysis giving clearer delineation of the vegetation communities present. Thus this methodology was employed for the dendrograms and further analysis of vegetation delineation. Exotic species were removed from the analysis to refine the delineations and

give a clear idea of the native vegetation communities present. A two-step analysis was then performed upon the data using the species as variables and the quadrats as objects, to detect noisy and outlier variables (as recommended by Belbin 2008, Marine Community Example). Box Whisker were also produced which are plots which graphically display the ability of a specific variable to discriminate between groups, this analysis also gives a Kruskal-Wallis statistic for each variable (this statistic is a non-parametric version of the f-ratio (Belbin, 2006, PATN ver. 3.11 help)). A two way table was produced and this table assisted in the analysis of which species were dominant in the different variants of the vegetation communities produced.

The data was transposed and using the quadrats as variables and the species as objects, the two-step analysis was performed and noisy quadrats with a low KW statistic (<0.1) were removed from the analysis. Three quadrats were identified as noisy and were removed from the analyses. These quadrats were placed in highly disturbed areas in which few native species were present and were not representative of the vegetation. Two were in the Alluvial Tall Moist Forest and had severe weed infestations, with the remaining quadrat being located in Coastal Foothills Spotted Gum Ironbark Forest which had been recently subjected to a severe fire. Removal of these quadrats and species did not alter the analysis significantly; however it did help to clearly delineate the vegetation communities.

The number of groups which is to be determined from the Dendrogram can be based on the point at which a levelling of scree plot of dissimilarity and number of fusion points occur. At this levelling point many clusters are formed at essentially the same linkage distance. Thus row fusion points were exported from PATN and plotted to assist in determining the cut off point for delineation of the vegetation communities.

The Freshwater Wetland Complex was not included in the data as it is clearly distinct from the dry sclerophyll and wet sclerophyll forests that occur elsewhere within the site. Moreover, quadrats are difficult to perform within this type of vegetation community. In addition, quadrats were not performed within the weeds and cleared areas or the dams vegetation communities. Sampling was undertaken by opportunistic survey and random meanders for these vegetation communities.

3.11 Targeted Flora Survey Methodology

Seasonal surveys were undertaken to maximise detection of all threatened flora species. The following sections detail specific targeted surveys which were undertaken for each species. Refer to Figure 3-3.

***Diuris praecox* (Newcastle Doubletail)**

Four ecologists undertook targeted searches (Refer to Table 3-2 for survey dates) within the Black Hill Development Estate for this species. Parallel transects (Cropper 1993), which were spaced at approximately 25 m intervals, were utilised for searches across the survey area. The locations of all individuals were recorded by the use of a Trimble GeoXH GPS with sub-metre accuracy. Figure 3-3 shows the area surveyed for these targeted searches.

***Caladenia tessellata* (Thick Lip Spider Orchid)**

Targeted searches were not undertaken separately for this species. However there is sub-optimal habitat for this species within the Development Estate and therefore the possibility that it may occur cannot be discounted. Thus, whilst undertaking targeted *Diuris praecox* surveys this species was also targeted. Since the flowering seasons for these two species overlap, they were searched for together. See the discussion below for further information on the methodology used.

***Cryptostylis hunteriana* (Leafless Tounge Orchid)**

No targeted surveys have been undertaken within the Development Estate for this species. However it was identified that no potential habitat is present within the Black Hill site. This species is leafless and thus lacks chlorophyll and survives by an intimate symbiotic relationship with a mycorrhizal fungus at its roots. This fungus provides all the nutrients required by the plant, this fungus in turn obtains these nutrients from the decaying organic matter (Jones, 1988). The pollinator of this species has been recorded as the ichneumonid wasp *Lissopimpla excelsa,* which also pollinates five other *Cryptostylis* species in Australia (Bell, 2001). Therefore, this may be one of the reasons that this species is often found with other *Cryptostylis* species. In the Lake Macquarie region this species has been observed by RPS growing with *Cryptostylis subulata* and *Cryptostylis erecta.* These more common *Cryptostylis* species both have above-ground leaves which are visible all year round. Bell (2001) describes two main vegetation communities in which *C. hunteriana* has been found and these include Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland. Neither of the *Cryptostylis* species or any of their habitats were located within the Black Hill site and thus no targeted surveys were conducted for *C. hunteriana* within the Black Hill Development Estate.

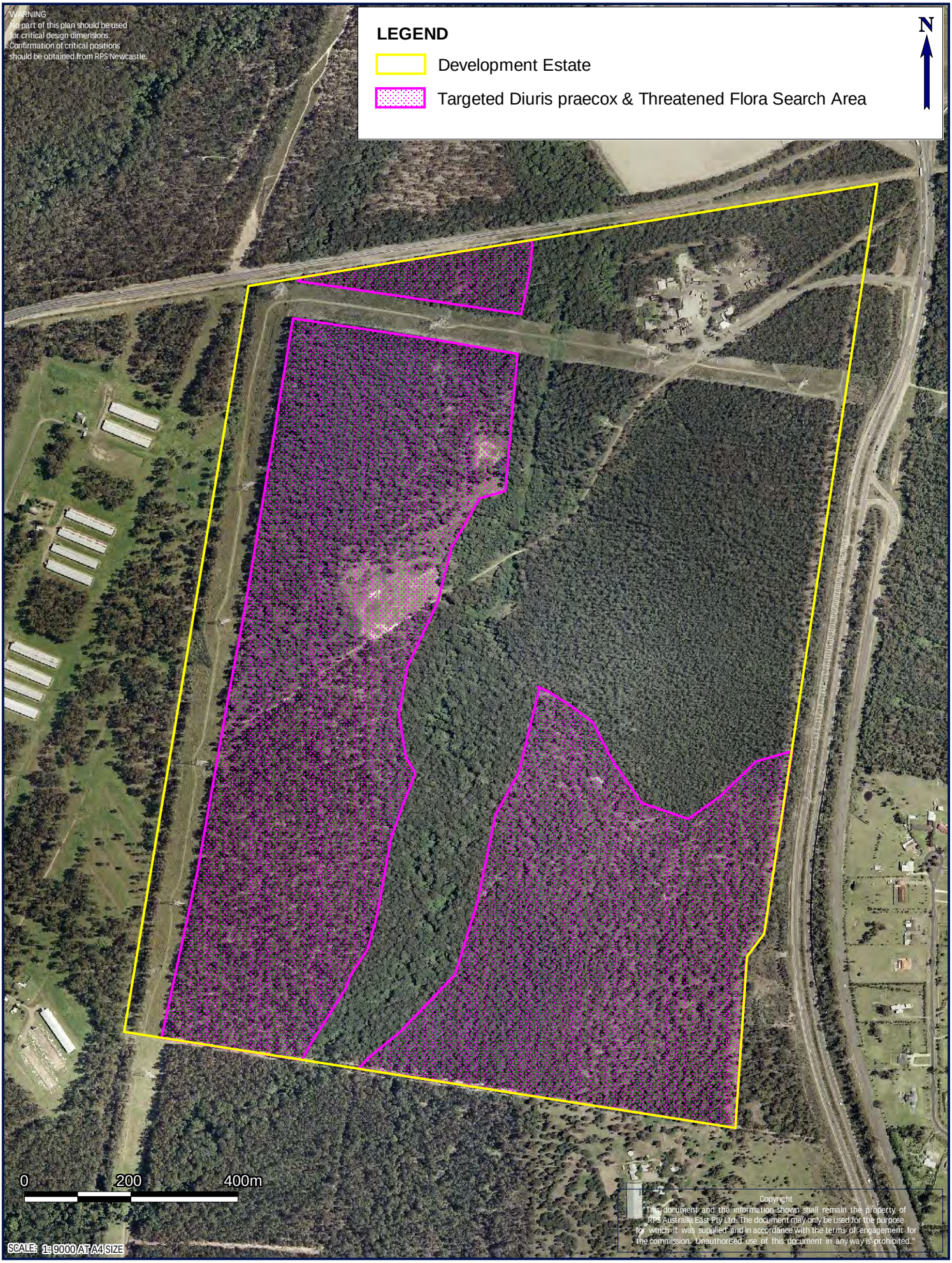
Microtis* sp. aff. *angusii

This species has been tentatively identified on the edge of a wetland adjoining Smooth-barked Apple open forest in the Wyong LGA to the south of the site (Gunninah Environmental Consultants, 2003). *Microtis angusii* has been listed as a threatened flora species on the *TSC Act, 1995* and it is unsure if this species is *M. angusii* or a new species. As the taxonomy of this species has not been fully determined it is difficult to determine if this species would have potential habitat within the site, however a precautionary approach has been taken and it is possible that this species has sub-optimal habitat within the Development Estate. In addition to the aforementioned comments another species of this genus was located within the power easement of the site; therefore this species is considered as having sub-optimal habitat within the Development Estate. Thus, whilst undertaking targeted *Diuris praecox* surveys this species was also targeted. The flowering seasons for these two species overlap therefore concurrent searches were undertaken. See the discussion for *Diuris praecox* above for further information on the methodology used.

Other Threatened Flora Species

Whilst performing the initial vegetation survey and during the *Diuris praecox* targeted searches, the following threatened flora species were surveyed:

- *Acacia bynoeana*;
- *Callistemon linearifolius*;
- *Caladenia tessellata*;
- *Cynanchum elegans*;
- *Dendrobium melaleucaphilum*;
- *Eucalyptus glaucina*;
- *Grevillea parviflora* subsp. *parviflora*;
- *Rutidosis heterogama*;
- *Syzygium paniculatum*; and
- *Tetratheca juncea*.



TITLE: FIGURE 3-3 TARGETED THREATENED FLORA SURVEY LOCATIONS

LOCATION: BLACK HILL

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 18/10/2010
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\BH\24530-2 Figure 3-3 Targeted Threatened Flora Survey Location B A4
VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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3.12 Fauna Assessment

The fauna survey methodology initially consisted of the production of an Expected Fauna Species List for the area (Appendix 4) and an assessment of the potential use of the site by threatened fauna species (as listed under the *TSC Act 1995)* identified from the vicinity of the site. This was achieved by undertaking literature and database reviews followed by confirmation through targeted field surveys. Additional species observed were also noted on the list.

Diurnal Birds

General and targeted searches were undertaken across the entire site during the survey period.

Trap lines were utilised as survey locations within the site through incidental observations during trapping, and targeted bird census surveys were undertaken for a period of 20 minutes at each survey site on at least two separate mornings.

Surveys included targeted searches for threatened species listed as having potential to occur within the site, including the seasonally occurring *Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater). Targeted searches for *Calyptorhynchus lathami* (Glossy Black Cockatoo) were undertaken that included searches for chewed *Allocasuarina* cones indicative of past feeding by this species.

For diurnal surveys, emphasis was placed on peak activity periods, i.e. dawn and dusk, to maximise the chances of species encountered. Birds were identified by direct observation, by recognition of calls or distinctive features such as nests, feathers etc. Furthermore, whenever other survey work was conducted, during both diurnal and nocturnal day periods, opportunistic observations of those bird species encountered were recorded.

Nocturnal Birds

Pre-recorded calls of owl species with the potential to occur within the site were broadcast in an effort to elicit vocal responses from the owls or to attract an owl to the playback site. The calls were broadcast through an amplification system (loud haler) designed to project the sound for at least 1km under still night conditions. As described by Kavanagh and Peake (1993), Debus (1995), and NPWS (1997), the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot. Species surveyed included *Ninox strenua* (Powerful Owl), *Ninox connivens* (Barking Owl), *Tyto tenebricosa* (Sooty Owl) and *Tyto novaehollandiae* (Masked Owl). Nocturnal surveys were carried out across the site over a period of four continuous nights. The callback locations were selected in areas where calls could be broadcast across large areas of the site. The broadcast location selection process was also informed by survey stratification units.

Targeted Swift Parrot Surveys

Swift Parrot surveys were undertaken within proposed Conservation Estates and Development Estates over two days during July 2008. The survey period coincided with known Swift Parrot movements into south-eastern Australia. Surveys encompassed two different methodologies to ensure adequate coverage of potential Swift Parrot habitat was made, and included:

- Targeting of small discrete vegetation community areas containing potential foraging species, such as occur in riparian zones; and
- Driving through more widespread foraging habitat to locate indicators (foraging aggregations of honeyeaters / lorikeets or the presence of blossom) that specific areas may have the potential to attract Swift Parrots during the current season.

As survey effort was limited to one part of the potential Swift Parrot season, habitat evaluation was also undertaken to determine where the most favourable areas of potential Swift Parrot habitat might occur across the Coal & Allied Lands.

Arboreal and Terrestrial Mammals

A total of four trap lines were set for a period of four nights during October 2007 (Table 3-2). Each trap line consisted of 25 terrestrial Elliot A traps, five terrestrial Elliot B traps, 10 arboreal Elliot B traps and a Cage trap. This equates to 400 terrestrial Elliot A trap nights, 80 terrestrial Elliot B trap nights, 160 Arboreal Elliot B trap nights and 16 Cage trap nights per trap line.

Arboreal mammals were further targeted with hair tubes during a second fauna survey exercise. A total of two hair tube survey lines were set over a period of 10 nights during January 2008 (Table 3-2). Survey lines consisted of five small type (tube radius 50mm) hair tubes, five large type (tube radius 100mm) hair tubes and three faunatech hair tubes. This equates to a 130 hair tube nights per survey line, totalling 260 hair tube trap nights within the Black Hill Development Estate.

Spotlighting was undertaken on site via the use of 75-Watt hand-held spotlights and head torches during walking. This was undertaken within each of the habitat assemblages identified, with priority given to those areas that were deemed to be the most likely to contain nocturnal species, particularly arboreal and terrestrial mammals. Two ecologists undertook nocturnal surveys concurrently for duration of two hours per night over four consecutive nights, giving a total of 16 person hours of spotlighting.

The potential presence of *Petaurus australis* (Yellow-bellied Glider) was targeted by call playback through an amplified system at each of the nocturnal survey points during the fieldwork period.

The presence of *Phascolarctos cinereus* (Koala) was assessed through the identification of potential Koala food trees, followed by inspection for signs of Koala usage. Trees were inspected and identified for the presence of *Phascolarctos cinereus* (Koala), characteristic scratch and claw marks on the trunk and scats around the base of each tree. This

species was also targeted through spotlight surveys and the use of call playback through an amplified system.

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

Distinctive scats left by mammals. Any scats unable to be positively identified in the field were collected for further analysis, and scats of predator species containing fur / bones were sent for analysis if appropriate;

- Scratch marks made by various types of arboreal animals;
- Scats consistent with Koalas; and/or
- Feeding scars on *Eucalyptus* trees made by Gliders.

Any other incidental observations of fauna were recorded during all phases of fieldwork.

Refer to Figure 3-4.

Micro-chiropteran Bats

Bat echolocation call recording was undertaken across the site within each stratification unit over the survey period for a total duration of 40 hours.

Bat echolocation calls were recorded using an Anabat II Bat Detector and CF Zcaim. Emphasis was placed on those areas deemed likely to provide potential hunting sites for bats, including flyways, ecotones, forested areas and waterbodies. Anabat call detection was undertaken during trapping periods and nocturnal fieldwork and was carried out via both stationary and mobile forays. The recorded calls were given to a recognised expert in bat species call identification for analysis.

Mega-chiropteran Bats

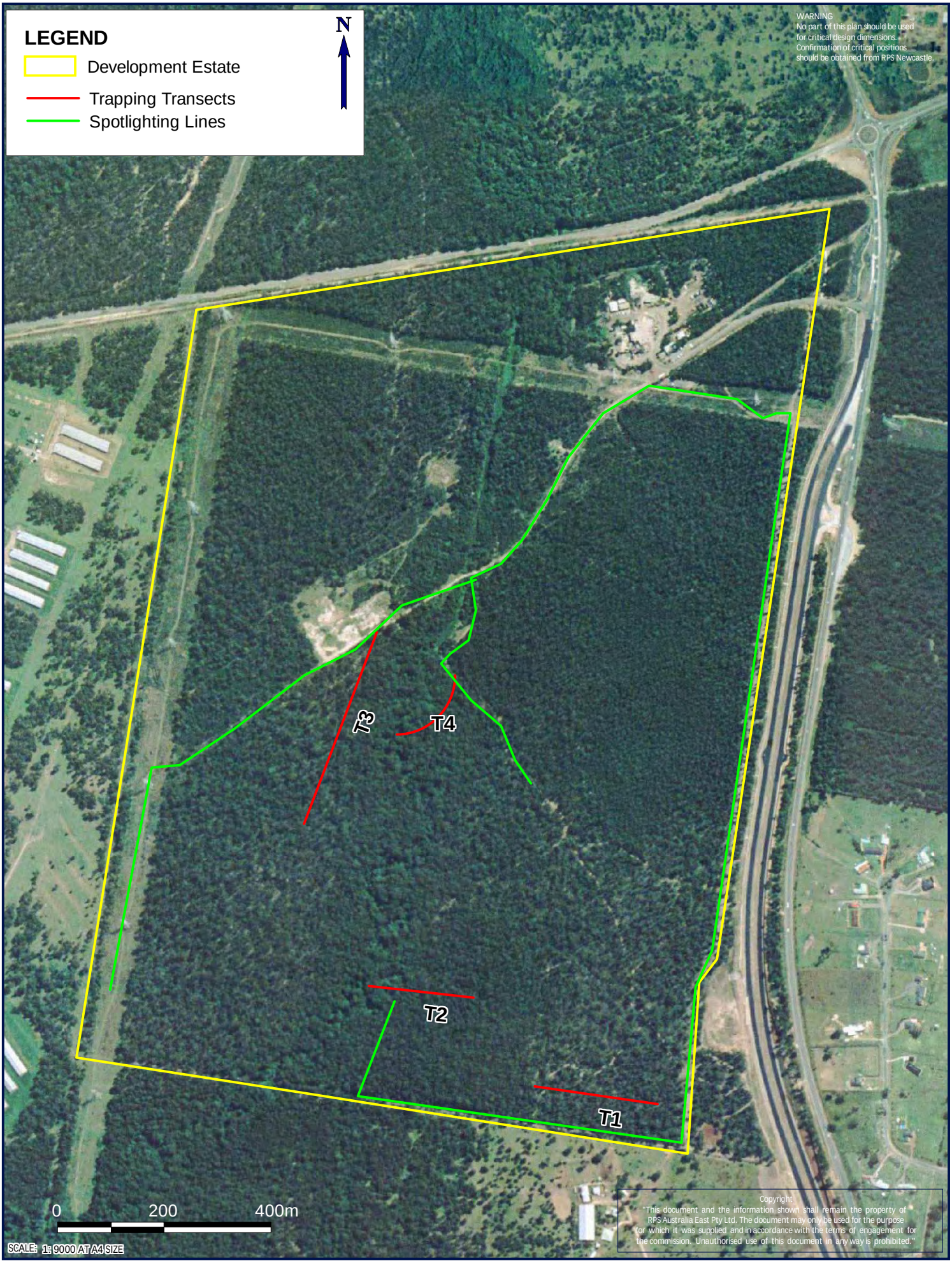
These species, specifically the *Pteropus poliocephalus* (Grey-headed Flying Fox), were surveyed via nocturnal spotlighting and targeted searches for suitable camp and / or day roost locations. Surveys for primary and secondary indications for this species were undertaken during both diurnal and nocturnal surveys.

Herpetofauna

Specific herpetofauna (frog and reptile) searches were carried out at each of the survey points and significant habitat areas present. Diurnal searches were made in areas of appropriate habitat. Such habitat included areas of thicker vegetation, in ground litter, near and under fallen timber, around piles of refuse / dumped rubbish, and wet / damp areas such as drainage lines and areas of poor infiltration capacity and / or periodic inundation.

Reptile searches were largely concentrated to the hottest part of the day (early afternoon). Frog searches were largely concentrated to nocturnal survey periods and/or periods of wet weather. Physical frog searches were augmented by call recognition. Any calls

unable to be clarified in the field were recorded for later comparison with commercially available recordings.



TITLE: FIGURE 3-4 FAUNA SURVEY LOCATIONS

LOCATION: BLACK HILL

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 18/10/2010
PURPOSE: EAR

J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\BH24530-2 Figure 3-4 Fauna Survey Locations B A4

LAYOUT REF:
VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industies Ltd
JOB REF: 24530-2

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3.13 Survey Dates, Type and Prevailing Conditions

The following table depicts the dates, survey type and prevailing weather during the ecological investigations conducted during the survey period.

Table 3-2: Development Estate Survey Dates, Types & Prevailing Weather

DATE	SURVEY TYPE	WEATHER					
		Temperature ^{0}C	*Rain (24 hrs to 9:00am)*	*Sun*		*Moon*	
				Rise	*Set*	*Rise*	*Set*
Vegetation Surveys							
06/09/07	Targeted *Diuris praecox, Caladenia tessellata* and *Microtis angusii* orchid searches	12 – 18	1.2mm	7:05	18:39	3:31	13:13
29/10/07	Quadrat and Transect Survey	20 – 33	0mm	5:58	19:16	23:10	07:50
30/10/07	Threatened Species Search Random Meander Survey Habitat Assessment	14 – 28	0mm	5:57	19:17	-----	8:53
Trapping							
22/10/07	Fauna Trapping, Opportunistic survey, bird survey, diurnal Herpetofauna survey	30 – 33	0mm	6:06	19:10	14:44	3:24
23/10/07		27 – 30	0mm	6:04	19:11	15:51	3:56
24/10/07		21 – 24	0mm	6:03	19:12	17:00	4:26
25/10/07		21 – 24	1-5mm	6:02	19:13	18:11	4:57
26/10/07		24 – 27	1-5mm	6:01	19:14	19:26	5:31
Fauna Surveys							
06/09/07	Diurnal opportunistic	12 – 18	1.2mm	7:05	18:39	3:31	13:13
29/10/07		20 – 33	0mm	5:58	19:16	23:10	07:50
30/10/07		14 – 28	0mm	5:57	19:17	-----	8:53
23/10/07	Bird Surveys	27 – 30	0mm	6:04	19:11	15:51	3:56
07/01/08	Hair Tube Survey	24 – 27	1-5mm	5:53	20:05	4:12	19:22
08/01/08		24 – 27	1-5mm	5:54	20:05	5:08	20:09
09/01/08		27 – 30	0mm	5:55	20:05	6:09	20:50
10/01/08		27 – 30	0mm	5:55	20:05	7:12	21:26
11/01/08		27 – 30	0mm	5:56	20:05	8:16	21:58
12/01/08		30 – 33	0mm	5:57	20:05	9:19	22:28
13/01/08		33 – 36	0mm	5:58	20:05	10:22	22:56
14/01/08		24 – 27	1-5mm	5:59	20:05	11:25	23:25
15/01/08		24 – 27	1-5mm	6:00	20:05	12:29	23:55
16/01/08		30 – 33	0mm	6:01	20:05	13:37	-----
03/03/08	Nocturnal Survey	12 – 24	0mm	6:44	19:27	1:41	16:39
04/03/08		12 – 27	0mm	6:45	19:26	2:42	17:20
05/03/08		12 – 24	0mm	6:45	19:24	3:45	17:55
06/03/08		15 – 27	0mm	6:46	19:23	4:50	18:28

Source:
Australian Government – Geoscience Australia [http://www.ga.gov.au/geodesy/astro/.jsp]
National Rainfall and Temperature Map Archives [http://www.bom.gov.au/silo/products/ClimMaps.shtml]

3.14 Habitat Assessments

An assessment of the relative value of the habitat present on the site was carried out. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region.

Key features assessed for flora habitat included vegetation type and stratification, soil type, depth and drainage, landform pattern, aspect and past disturbance including fire regime. Habitat key features assessed for fauna type at each survey point included hollow bearing tree density, feed tree density, diversity and density of Proteaceae species, Eucalypt diversity, vegetation strata number and density of dead wood debris across the ground as outlined in Table 3-3 below. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna.

Table 3-3: Ecological / Environmental Attributes Collected within Flora Survey Points

Feature	Variables	Value
Hollow Bearing Tree Density	Low Density Moderate Density High Density	Determine the density and distribution of denning and roosting habitat for native fauna species across the site.
Eucalypt diversity	Low Density Moderate Density High Density	Determine the diversity of Eucalypt feeding opportunities for native fauna species across the site.
Allocasuarina sp.	Low Density Moderate Density High Density	Determine the density and distribution of this habitat resource across the site, particularly as a forage plant species for Glossy Black-Cockatoo.
Proteaceae sp.	Low Density Moderate Density High Density	Determine the density and diversity of Proteaceae species across the site, as an indicator of winter foraging resources for threatened arboreal mammals, such as the Squirrel Glider and potentially the Pygmy Possum.
Structural Diversity	Low (1 layer) Moderate (2 layers) High (3+ layers)	A measure of habitat quality across the site, particularly as an indicator of microhabitat diversity and niche opportunity for bird species, potential threatened terrestrial mammals and the prey species of forest owls.
Fallen Timber	Low (few or none) Moderate (scattered) High (intact)	A measure of habitat quality across the site, particularly as an indicator of microhabitat diversity and niche opportunity for bird species, potential threatened terrestrial mammals and the prey species of forest owls.

The assessment was also based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

3.15 Limitations

Limitations associated with the EAR are presented herewith. The limitations have been taken into account throughout this assessment specifically in relation to threatened species assessments, results and conclusions.

In these instances, a precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.

Seasonality

Timing limitations are always encountered during ecological assessment surveys due to the seasonal variations across the broad spectrum of flora and fauna species to be studied. Preliminary surveys were carried out during March, targeted searches for threatened flora and fauna were undertaken during September, November and January. As such there was less survey work undertaken during times when certain migratory bird or bat species would have a higher probability for presence on the site and when some reptile and amphibian species might exhibit greater activity.

Most notably, several threatened flora species, particularly cryptic orchids, should be surveyed within their respective flowering periods. Several of the threatened orchids, which have potential habitat, could not be comprehensively surveyed to provide information on whether they occur within the site. Therefore, these threatened orchids cannot be discounted as occurring within the site.

The flowering and fruiting plant species that attract some nomadic or migratory threatened species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for the above-mentioned species. Again, this has been taken into account in the habitat assessment phase, although ongoing surveys, conducted during a range of seasonal periods, are designed to elucidate any potential significance the Coal & Allied lands might represent for seasonal species.

In addition, the seasonality of the surveys also places limits on the number of flora species identified in the site as the optimum time to survey would be throughout spring and summer when the majority of flora species flower.

Data Availability & Accuracy

The collated threatened flora and fauna species records provided by the NPWS for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. For the purposes of this assessment this information has been considered to have an accuracy of ± 1km.

Threatened flora and fauna records within the region were predominantly sourced from the DECCW Atlas of Wildlife Database. Other sources such as Birdata and HBOC were also utilised. Similar limitations are known to exist with regards to these data sources and their accuracy.

Note: Data recorded by RPS during the survey period, has been undertaken with a Trimble GeoXH GPS unit, which is capable of sub-metre accuracy following post processing.

Access

The survey over Development Estates was somewhat limited by access due to wet weather and track deterioration (some tracks have been severely degraded or remain blocked off by fallen timber). In some areas the topography or density of flora (i.e. *Lantana camara* tangles) restricted access to some parts of the site.

Access issues were particularly applicable to surveys conducted within the Conservation Estates, notably Stockrington lands, due to the steepness of topography and the deterioration of track integrity under poor weather conditions.

Fauna

Fauna survey effort varied according to the standards set within the DECCW Biodiversity Survey Guidelines due to the following reasons:

- Seasonal constraints as outlined above.
- Diurnal Birds - Habitat assessment and previous records and reporting were used to determine the probability of site use. Bird surveys outlined in the aforementioned methods in combination with opportunistic surveys conducted during other fieldwork were considered as representing a wider and more thorough coverage of the site than short periods over limited transects. Survey coverage was determined by stratification units designed to represent other fauna guilds and flora surveys. Surveys for seasonally occurring threatened species, including the *Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater), were mostly limited to incidental observations undertaken during threatened flora surveys. A limited targeted survey period was allocated for the onsite survey of these species; however, adequate assessment of the Development Estate's potential to support these species is contained within habitat assessment of the site.
- Nocturnal Birds – The number of nights surveyed for nocturnal birds was less than required, as a consequence, assessment of development impact was based upon the mobility of local species, local records, habitat opportunities and observed species.
- Herptofauna – Given that surveys did not coincide with heavy rainfall events and high seasonal temperatures, some local frog species may have been inactive during survey events and hence results varied. The same seasonal limitations constrained the extent of reptile activity observed during fauna surveys. However, habitat assessment of the site has carefully considered the likelihood that local species might potentially occur within the site.

Despite the apparent deficiencies, suitable coverage of the site is considered to have been accomplished, particularly as potential occurrences of likely species is assumed (precautionary approach) in light of habitat assessment, previous local records, seasonality deficiencies, known movements of locally occurring threatened species and the combined local knowledge and experience of the authors

4 Results

4.1 Flora

A total of 208 flora species were identified during the survey period over the Black Hill Estate within the quadrats, transects and random meander surveys. Additional orchids have also been added which were detected during the targeted *Diuris praecox* and *Caladenia tessellata* surveys. A complete list of the flora species identified is provided in Appendix 3 of this report.

4.1.1 Vegetation Community Delineation

Vegetation communities have been delineated via the methods outlined within Section 3. Following the initial field surveys and mapping, subsequent statistical analysis was employed to qualify and test the results.

A scree plot, Figure 4-1 below, shows the dissimilarity against groups in which it shows the point of inflection at 0.70 dissimilarity level. Therefore, 15 groups have been recognised by the non-parametric statistical analysis (PATN Ver. 3.11, Belbin 2006). However, the data levels off at 0.72 dissimilarity showing 9 groups. These nine groups are supported by ground truthing with nine vegetation communities being delineated.

Figure 4-2 includes the Dendrogram produced by the PATN program (Ver. 3.11, Belbin 2006), which indicates the floristic relationships between the vegetation communities. A combination of statistical analysis and groundtruthing has delineated nine vegetation communities within both the Conservation Estates and the Development Estates. Extensive survey effort of over 100 quadrats was used within the statistical analyses. A clear delineation is shown between the dry sclerophyll and wet sclerophyll forests within the northern lands. However, several variants of these vegetation communities were delineated at a lower level of dissimilarity and are shown in the Dendrogram of the site Figure 4-2). When taking into consideration the variants there are 15 which correspond to the scree plot. Therefore as a result of groundtruthing and statistical analysis 9 vegetation communities have been delineated within the Northern Lands, with some communities containing several variants. These variants are described within the description of the individual communities. It must be noted that the variants are not defined vegetation communities in their own right but floristic variation does occur throughout the community. These have not been mapped due to the time constraints imposed on this project and in any case are not necessary as they do not assist the assessment of conservation significance of any of these communities to any further significant degree.

The PATN analysis did not delineate between two the communities of Swamp Oak Rushland Forest or Swamp Mahogany Paperbark Forest and this is due to low sampling in these communities (1 quadrat each) as these communities occurred in Tank Paddock in small areas (<1ha).

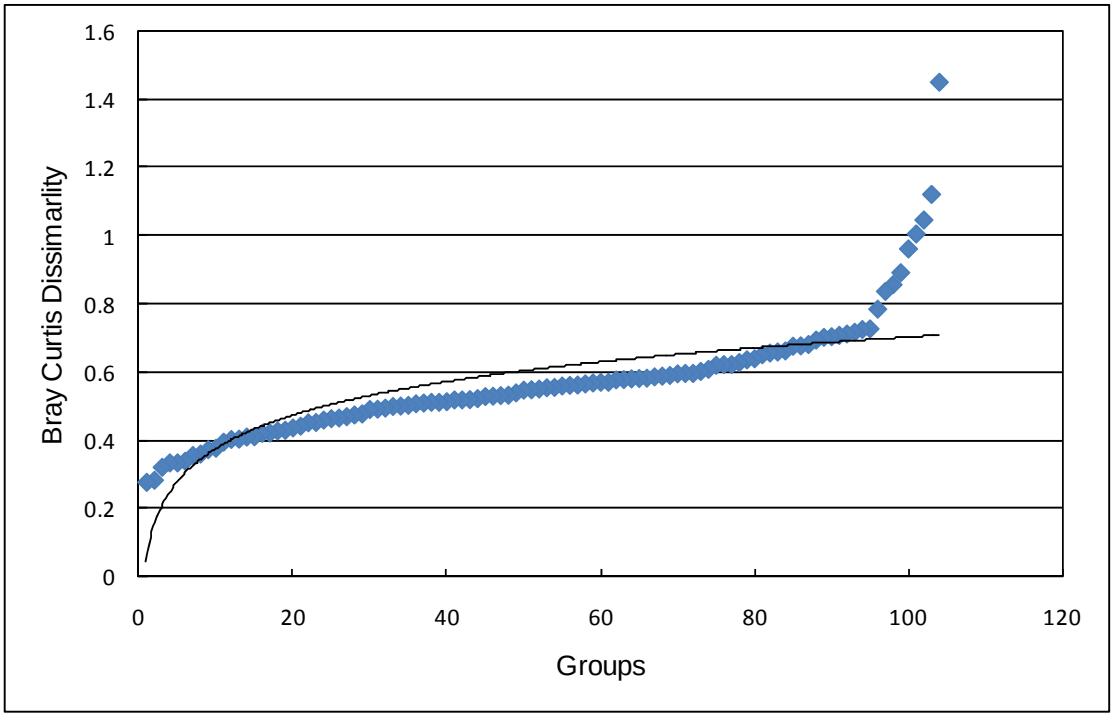


Figure 4-1: Scree Plot of Bray Curtis Association Measure Results

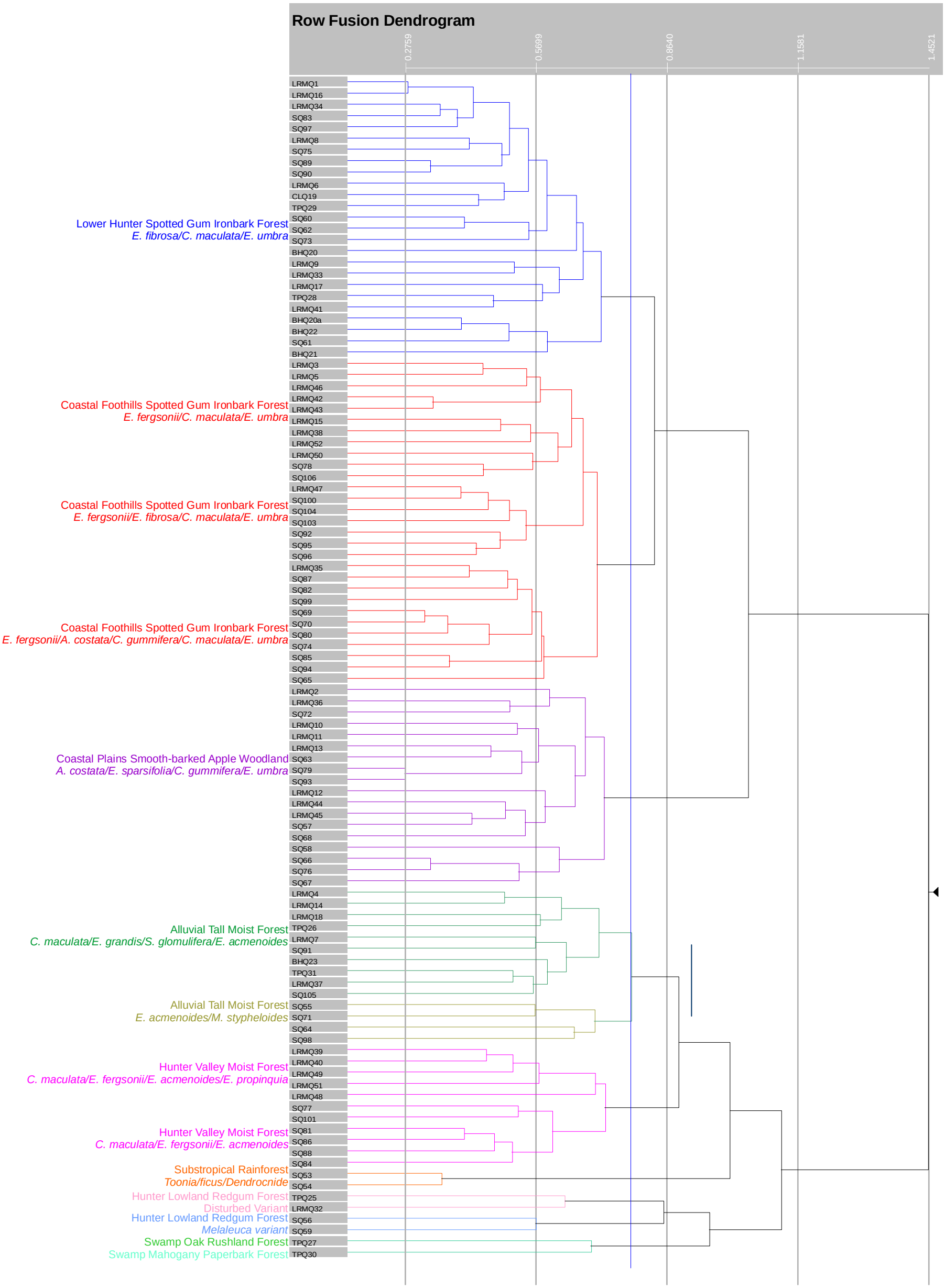


Figure 4-2: Dendogram showing vegetation communities and dissimilarity association for the Northern Lands

4.1.2 Description of Vegetation Communities

A description of each community and classification into the regional vegetation classification, LHCCREMS has been undertaken. The following three vegetation communities were delineated within Black Hill Estate as shown in Figure 4-3 and listed below. A selection of photographs depicting vegetation communities on site is available in Appendix 5.

(1) Lower Hunter Spotted Gum Ironbark Forest (EEC – Lower Hunter Spotted Gum Ironbark Forest);

(2) Alluvial Tall Moist Forest; and

(3) Weeds and Cleared Areas.

1 Lower Hunter Spotted Gum Ironbark Forest (EEC)

This community occupies the majority of the site and covers approximately 132.92 ha. This vegetation community is commensurate with MU 17 Lower Hunter Spotted Gum – Ironbark Forest as described by LHCCREMS (NPWS 2000; House 2003). This community varied in some areas with a dense shrub layer of *Melaleuca nodosa* in the north eastern portion of the site and other areas containing a shrub layer of *Callistemon rigidus, Daviesia ulicifolia* and *Bursaria spinosa*. The remaining areas of the site have a grassy understorey dominated by *Themeda australis, Entolasia stricta, Imperata cylindrica* and *Joycea pallida.* The ROTAP species *Macrozamia flexuosa* was located within this vegetation community. The paperbark *Melaleuca decora* also occurred within the site in small isolated patches which adjoined moister drainage lines. The occurrence within the south eastern portion of the Development Estates contained scattered individuals of *Angophora costata* and this often made delineation difficult, however the shrub layer and understorey did not differ from the remainder of the site. In addition, the quadrats performed at Black Hill clustered with other quadrats which were performed within LHSGIF. Thus, it is considered that this community is LHSGIF.

<u>*Upper Stratum*</u> – 16 m to 22 m with a PFC of 30% to 50%, the dominant species being *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Eucalyptus punctata* (Grey Gum), *Eucalyptus globoidea* (White Stringybark) and *Eucalyptus umbra* subsp. *umbra* (Broad-leaved Mahogany).

<u>*Mid Stratum 1*</u> – 6 m to 12 m with a PFC of 20% to 40%, the dominant species being *Allocasuarina torulosa* (Forest Oak), *Melaleuca nodosa* (Ball Honeymyrtle), and *Melaleuca decora.*

<u>*Mid Stratum 2*</u> – 2 m to 6 m with a PFC of 20% to 70%, the dominant species being *Melaleuca nodosa* (Honeymyrtle), *Callistemon rigidus* (Stiff Bottlebrush), *Daviesia ulicifolia* (Gorse Bitter Pea), *Bursaria spinosa* (Blackthorn) and *Persoonia linearis* (Narrow-leaved Geebung).

Lower Stratum – 0.5 m to 2 m with a PFC of 80% to 90%, the dominant species being *Xanthorrhoea macronema* (Grass Tree), *Lepidosperma laterale* (Variable Sword Sedge), *Microlena stipoides* var. *stipoides* (Weeping Rice Grass), *Lomandra longifolia* (Mat Grass), *Joycea pallidea* (Silver-top Wallaby Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic) and *Aristida vagans* (Three-awned Spear Grass).

2 Alluvial Tall Moist Forest

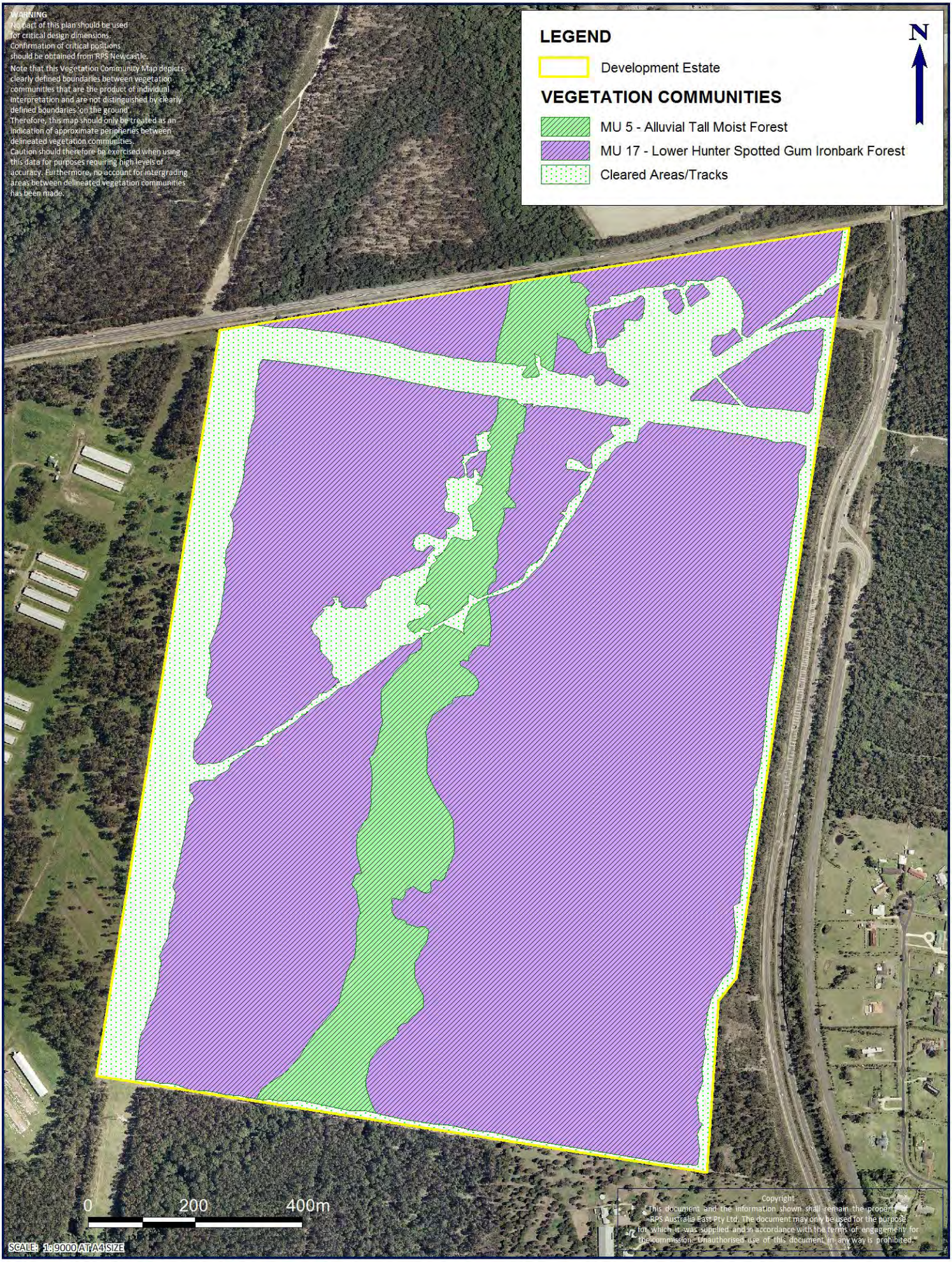
This vegetation community occurs along Viney Creek which runs in a north south direction in the middle of the site. This community has severe infestations of weeds which have been dispersed from surrounding rural lands. The main weed present within the creekline is *Lantana camara* (Lantana). However there is still a wide diversity of natives with some *Eucalyptus grandis* trees being emergent within the canopy to a height of 26m. This vegetation community covers approximately 17.61 ha and is commensurate with MU 5 Alluvial Tall Moist as described by LHCCREMS (NPWS 2000; House 2003). Variations of this community occurred within the Black Hill Development Estate. In some portions of the community *Eucalyptus grandis* was dominant while in other portions the ironbark *Eucalyptus siderophloia* was dominant. The broad leaf variant (as described in the ATMF description in the Conservation Estate appendix) is present within the Black Hill Development Estate.

Upper Stratum – 18 to 25 m with a Projected Foliage Cover (PFC) of 20% to 30%, the dominant species being *Eucalyptus grandis* (Flooded Gum), *Eucalyptus siderophloia* (Northern Grey Ironbark), *Syncarpia glomulifera* (Turpentine) and *Eucalyptus acmenoides* (White Mahogany).

Mid Stratum 1 – 6 m to 10 m with a PFC of 30% to 40%, the dominant species being, *Melaleuca styphelioides* (Prickly-leaved Melaleuca), *Cryptocarya microneura* and *Callistemon salignus* (Willow Bottlebrush).

Mid Stratum 2 – 2 m to 6 m with a PFC of 30% to 100%, the dominant species being, *Backhousia myrtifolia* (Grey Myrtle), *Commersonia fraseri* (Brush Kurrajong), *Acmena smithii* (Lilly Pilly), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree) and *Lantana camara* (Lantana).

Lower Stratum – 0.3 to 1.5m with a PFC of 20% to 30%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Carex appressa*, *Adiantum aethiopicum* (Common Maidenhair), *Blechnum cartilagineum*, *Carex longebrachiata*, *Lomandra longifolia* (Spiky-headed Mat-rush), *Entolasia marginata* (Bordered Panic), *Doodia apsera* (Rasp Fern), *Hydrocotyle peduncularis*, *Dichondra repens* (Kidney Weed), *Oplismenus aemulus* (Basket Grass), *Parsonsia straminea* (Monkey Rope) and *Cissus antarctica* (Native Grape).



TITLE: FIGURE 4-3 VEGETATION MAP | LOCATION: BLACK HILL | DATUM: N/A | PROJECTION: MGA ZONE 56 (GDA 94) | DATE: 18/10/2010 | PURPOSE: EAR | LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works \Drafting\Ecology\Northern Lands\BH/ 24530-2 Figure 4-3 Vegetation Map B A4 | VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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RPS

3 Weeds and Cleared Areas

This vegetation community occurs below the electricity easements and a central portion of the site which was the location of the Ironbark Coal Mine. This community encompasses approximately 32.97 ha and is not commensurate with any vegetation communities that have been described by LHCCREMS (NPWS 2000; House 2003). These cleared areas are characterised by disturbed substrates and high levels of light, which provide opportunities for exotic weeds and colonists from adjacent native vegetation communities. These areas are highly disturbed and have high weed incursions. However, there are dense patches of both Melaleucas and Callistemon species within the electricity easements.

Upper Stratum – 4 to 10 m with a Projected Foliage Cover (PFC) of 10% to 30%, the dominant species being *Corymbia maculata* (Spotted Gum), *Melaleuca decora*, and *Melaleuca nodosa* (Ball Honeymyrtle).

Mid Stratum – 1.5 to 2 m with PFC of 20 to 30%, the dominant species being *Pteridium esculentum* (Bracken Fern), *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle), *Lantana camara* (Lantana), *Acacia elongata*, *Callistemon linearis*, *Callistemon rigidus* (Stiff Bottlebrush) and *Pultenaea cunninghamii*.

Lower Stratum – 0.5 m to 1 m with a PFC of 80% to 90%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Cynodon dactylon* (Common Couch), *Hydrocotyle bonariensis* (Pennywort), *Chloris gayana* (Rhodes Grass), *Verbena bonariensis* (Purple Top), *Stenotaphrum secundatum* (Buffalo Grass), *Richardia brasiliensis* (White Eye), *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed), *Plantago lanceolata* (Ribwort), *Bidens pilosa* (Farmer's Friends), *Trifolium repens* (White Clover) *Trifolium dubium* and *Sida rhombifolia* (Paddy's Lucerne).

4.1.3 Conservation Status of Vegetation Communities

One EEC that is listed under the *TSC Act* occurs within delineated vegetation communities extant on the Black Hill site. This community is Lower Hunter Spotted Gum Ironbark Forest which is commensurate with 'Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion'.

4.1.4 Regionally Significant Vegetation Communities

Newcastle City Council does not at present have any flora and fauna guidelines so the guidelines for Lake Macquarie Council were used to identify any regionally significant vegetation communities in the area.

The following vegetation communities, which occur within the development estate, are considered to be regionally significant by Lake Macquarie Flora and Fauna Guidelines within the Lake Macquarie LGA and Lower Hunter and Central Coast Regional Biodiversity Strategy (Payne 1998):

- Lower Hunter Spotted Gum Ironbark Forest (EEC) and

- Alluvial Tall Moist Forest

4.1.5 Regionally Significant Flora Species

One ROTAP listed species, *Macrozamia flexuosa,* was recorded within the Lower Hunter Spotted Gum Ironbark Forest within the south east of the site (Briggs and Leigh, 1996). This species has been recorded from Bulahdelah to Lake Macquarie and occurs in several conservation reserves including Glenrock SRA (Bell 1998a), Lake Macquarie SRA and Pulbah Island NR (Bell 1998b), Werakata National Park (Bell 2001a), and Karuah and Wallaroo Nature Reserves (Bell 2002). A large population of this species has been located at the Hunter Economic Zone in Kurri Kurri (Bell, 2004b).

Newcastle City Council does not at present have any flora and fauna guidelines hence to ensure a holistic assessment the guidelines for Lake Macquarie Council were used to identify any regionally significant flora in the area. Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant flora species and *Eucalyptus grandis* (Flooded Gum) is listed as being significant as the southern limit is Port Stephens. *Melaleuca decora* is also listed as it is very rare within the Lake Macquarie LGA. It is expected that these species are similarly regionally significant in the Newcastle LGA.

4.1.6 Desktop Assessment - Threatened Flora Search Results

The results of this search indicated numerous threatened flora species have been previously recorded within the locality and/ or have potential habitat within the site. The following have been recorded within 10 km (DECCW Wildlife Atlas 2010) of the site:

- *Callistemon linearifolius* (Netted Bottle Brush);
- *Eucalyptus parramattensis* subsp. *decadens*;
- *Grevillea parviflora* subsp *parviflora* (Little-flower Grevillea);
- *Rulingia prostrata*
- *Rutidosis heterogama* (Heath Wrinklewort); and
- *Tetratheca juncea* (Black-eyed Susan)
- *Zanichellia palustris*.

In addition, to the above threatened flora species recorded on the DECCW Wildlife Atlas, it was considered the following species have potential habitat or have been recorded within the vicinity of the site and should be considered within this assessment:

- *Acacia bynoeana*;
- *Angophora inopina*;
- *Arthropteris palisotii*
- *Caladenia tessellata* (Thick Lip Spider Orchid);
- *Cynanchum elegans*;
- *Dendrobium melaleucaphilum* (Spider Orchid);
- *Diuris praecox* (Rough Double Tail);

- *Eucalyptus camfieldii*;
- *Eucalyptus glaucina;*
- *Melaleuca biconvexa* (Biconvex Paperbark); and
- *Syzygium paniculatum* (Magenta Lilly Pilly).

4.1.7 Threatened Flora Species with potential to occur

Of the species identified during the desktop search, the following 10 threatened flora species have potential habitat within the Black Hill Development Estate:

- *Acacia bynoeana* – Sub-optimal habitat within disturbed areas under the electricity easements. However this species preferred habitat is open woodland on sandy soils. This species closest record is within the Lake Macquarie SCA to the south west of the site;
- *Caladenia tessellata* – Potential habitat within the dry sclerophyll forests within the site;
- *Callistemon linearifolius* – A small shrub that has potential habitat within the drainage lines and the Lower Hunter Spotted Gum Ironbark vegetation community within the development estate;
- *Dendrobium melaleucaphilum* – Epiphytic orchid mostly found on *Melaleuca styphelioides*, habitat within the Alluvial Tall Moist Forest on the site;
- *Diuris praecox* – cryptic orchid with potential habitat within the Lower Hunter Spotted Gum Ironbark vegetation community within the site;
- *Grevillea parviflora* subsp. *parviflora* – a shrub, potential habitat within the Lower Hunter Spotted Gum Ironbark vegetation community within the site;
- *Melaleuca biconvexa* – Shrub to small tree found in low-lying swamp areas, marginal habitat within the wet sclerophyll vegetation communities within the site;
- *Microtis angusii* – Cryptic orchid found in disturbed sites in Sydney. A species which is considered to have affinities to this species but remains undescribed was located at Chain Valley Bay near Wyong on the Central Coast. Thus, it is considered that this undescribed species may have sub-optimal habitat within the disturbed sites within the site;
- *Rutidosis heterogama* – A small shrub, potential habitat within the Lower Hunter Spotted Gum Ironbark vegetation community within the site; and
- *Syzygium paniculatum* – Shrub to small tree found in rainforests or riparian vegetation, potential habitat within the wet sclerophyll vegetation communities within the site.

4.1.8 Targeted Threatened Flora Species Survey Results

No threatened flora species were located within the Black Hill site. However, one ROTAP listed species (*Macrozamia flexuosa)* was located within the site. DECCW previously recorded *Callistemon linearifolius* within the north eastern portion of the site. Several cryptic species are known to occur within the region as discussed below.

***Diuris praecox* (Newcastle Doubletail)**
Targeted searches for *Diuris praecox* were conducted throughout the Development Estate during the flowering period for this species. No individuals of this species were located during any of the targeted searches.

Potential habitat exists for this species within Lower Hunter Spotted Gum Ironbark vegetation community within the site. Notably there are also large areas of this community delineated within the Conservation Estates.

***Callistemon linearifolius* (Netted Bottlebrush)**
This species has been recorded by DECCW Atlas in 2004 and 2005 in the north western and north eastern portions of the site. DECCW database atlas records are accurate to ± 1 km and therefore it is difficult to predict if the development may impact upon this species. Several *Callistemon rigidus* specimens were identified in the vicinity of these records and this species is similar to *Callistemon linearifolius.* However, careful checking of key indicators and descriptors for this species, has noted that there were prominent oil dots and no visible net veins present on the leaves of these plants located within the Development Estate thus concluding that these species were *Callistemon rigidus*. A large population of *Callistemon linearifolius* was detected within the Conservation Estates to the south west of the Black Hill site (Appendix 2).

***Caladenia tessellata* (Thick Lip Spider Orchid)**
This terrestrial orchid species is known to occur within sclerophyllous woodland on clay loam and sandy soils. This species was targeted during the *Diuris praecox* surveys and was not detected.

Potential habitats for *Caladenia tessellata* include the Lower Hunter Spotted Gum-Ironbark Forest vegetation community (approximately 132.92ha) within the Development Estate. However, some of the areas within this vegetation community contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid and therefore the area of habitat may be an over estimation. Notably there are large areas of habitat for this species within the Conservation Estates.

Other Cryptic orchids
No threatened cryptic orchids were located during the targeted surveys within the Development Estate. A range of orchid genuses encompassing 10 species were observed within the site, including *Acianthus, Caladenia, Calochilus, Dipodium, Microtis, Prasophyllum* and *Pterostylis*. Those threatened genuses that are considered most likely to have habitat opportunities within the Development Estate, include *Diuris* sp*.,* and *Caladenia* sp*.* Although these species cannot be entirely discounted as occurring within the development estate, large areas of potential habitat are also present within the Conservation Estates that are to be set aside for conservation.

4.1.9 Groundwater Dependent Ecosystems

GDEs is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Identification of GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depressions, swamps and creeklines, where groundwater comes up to the surface.

Matthei (1995) has mapped the entire Black Hill Development Estate as the residual soil of the Beresfield soil landscape. These residual soils are comprised of clay soil overlying weathered rock and are unlikely to contain groundwater. Identification of GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depression, swamps and creeklines, where groundwater comes up to the surface.

The Alluvial Tall Moist Forest on the Black Hill Development Estate is the only vegetation community which could have the potential to be identified as GDEs. Identification of GDEs depends upon the location of the vegetation communities in relation to groundwater.

It is considered that as the ATMF occurs on residual soils and the presence of this community is most likely to be a result of surface runoff rather than groundwater dependence. In conclusion, none of the vegetation communities within the Black Hill Development Estate have been classed as GDEs, with all the ecosystems generally reliant on surface water runoff for their water requirements.

GDE's have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types Table 4-1 below outlines the GDE types, classes and sub-classes as per DLWC (2006) which occur within the Black Hill Development Estate. Refer to Figure 4-3: Vegetation Map for the extent of this community on site.

Table 4-1: GDE's Types and Classes for Black Hill Development Estate

Vegetation Community at Black Hill	GDE TYPE	Class	Description of Class	Habitat
Alluvial Tall Moist Forest (northern occurrences)	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial

4.2 Fauna

The results of fauna survey work carried out on the site are presented in the following section. A comprehensive list of species expected and recorded during the survey period is presented in Appendix 4. Threatened species recorded during the survey period are depicted in Figure 4-4.

4.2.1 NPWS Threatened Species Database Search Results

The results of the above search indicated that 59 threatened fauna species have been previously recorded within 10km (DECCW Wildlife Atlas 2010) of the Development Estate. A total of 20 of these species are highly unlikely to occur within the Development Estate due to the absence of suitable habitat. From the remaining 39 species, five were recorded during fauna surveys (indicated by an asterisk '*' in the following list). For a number of these species no suitable habitat occurs within the site, but discussion is added below with regard to the potential for these species to occur in line with the precautionary approach incorporated into this EAR assessment process.

Litoria aurea	Green and Golden Bell Frog
Litoria brevipalmata	Green-thighed Frog
Varanus rosenbergi	Heath Monitor
Botaurus poiciloptilus	Australasian Bittern
Lophoictinia isura	Square-tailed Kite
Callocephalon fimbriatum	Gang-Gang Cockatoo
Calyptorhynchus lathami	Glossy Black-Cockatoo
Melanodryas cucullata	Hooded Robin
Stagonopleura guttata	Diamond Firetail
Pomatostomus temporalis	Grey-crowned Babbler
Chthonicola sagittatus	Speckled Warbler
Climacteris picumnus	Brown Treecreeper
Melithreptus gularis	Black-chinned Honeyeater
Xanthomyza phrygia	Regent Honeyeater
Lathamus discolor	Swift Parrot
Neophema pulchella	Turquoise Parrot
Glossopsitta pusilla	Little Lorikeet*
Ninox connivens	Barking Owl
Ninox strenua	Powerful Owl*
Tyto novaehollandiae	Masked Owl*
Tyto tenebricosa	Sooty Owl
Ptilinopus magnificus	Wompoo Fruit-Dove
Ptilinopus regina	Rose-crowned Fruit-Dove
Ptilinopus superbus	Superb Fruit-Dove
Dasyurus maculatus	Spotted-tailed Quoll
Phascogale tapoatafa	Brush-tailed Phascogale
Petaurus australis	Yellow-bellied Glider
Petaurus norfolcensis	Squirrel Glider
Phascolarctos cinereus	Koala
Pteropus poliocephalus	Grey-headed Flying-fox*
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat
Miniopterus australis	Little Bentwing-bat*
Mormopterus norfolkensis	Eastern Freetail-bat
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Falsistrellus tasmaniensis	Eastern False Pipistrelle
Chalinolobus dwyeri	Large-eared Pied Bat
Myotis adversus	Large-footed Myotis

Scoteanax rueppellii	Greater Broad-nosed Bat
Vespadelus troughtoni	Eastern Cave Bat

In addition to the above threatened species a further 20 threatened wetland, estuarine and inland fauna species have been recorded within a 10 km radius of the site. These species have appeared in wider locality searches as consequence of the site's proximity to estuarine and wetland habitats and rare local records of inland species. These species have not been included within the above 10 km threatened species list, as potential impacts within the site will not include the inland, wetland and estuarine habitats in which they occur and these habitats do not occur on site

Anseranas semipalmata	Magpie Goose
Stictonetta naevosa	Freckled Duck
Charadrius leschenaultia	Greater Sand-plover
Calidris tenuirostris	Great Knot
Chelodina mydas	Green Turtle
Charadrius mongolus	Lesser Sand-plover
Pterodroma leucoptera	Gould's Petrel
Pterodroma solandri	Providence Petrel
Sterna albifrons	Little Tern
Haematopus longirostris	Pied Oystercatcher
Irediparra gallinaceae	Comb-crested Jacana
Pandion cristatus	Osprey
Hamirostra melanosternon	Black-breasted Buzzard
Ephippiorhynchus asiaticus	Black-necked Stork
Ixobrychus flavicollis	Black Bittern
Limicola falcinellus	Broad-billed Sandpiper
Limosa limosa	Black-tailed Godwit
Oxyura australis	Blue-billed Duck
Rostratula australis	Australian Painted Snipe
Xenus cinerius	Terek Sandpiper

The majority of the site is characterised by open forest habitat offering opportunities for common native fauna species including a number of threatened species as listed above. Generally there is a paucity of hollow-bearing trees within the site's dry forest habitats, due to a relatively young cohort of canopy trees, although it is likely that these may contain small hollows, which may be used by hollow-dwelling microchiropteran bats for roosting purposes.

The canopy would provide foraging habitat for threatened insectivorous bat species during the warmer months and there is sufficient diversity within canopy tree species to provide continuous blossom resources for common and threatened nectivorous fauna, including flying-foxes, birds and gliders, throughout the year. There are hollows within the site's riparian forest habitats of sufficient size to represent potential nesting sites for Glossy Black-Cockatoos. However the site has only sparse densities of a single *Allocasuarina* species, being *Allocasuarina torulosa*, which is the almost exclusive feed tree genus for these cockatoos. The riparian forested areas of the site also contain hollows that are of

sufficient size to represent nesting and roosting sites for forest owl species and these habitats provide suitable foraging habitat for Powerful, Barking, Sooty and Masked Owls occurring in the area. *Ninox strenua* (Powerful Owl) was observed on the site within riparian forest vegetation and was heard calling from within this habitat on two subsequent nights. A call consistent with *Tyto novaehollandiae* (Masked Owl) was heard on one night during owl call playback surveys.

Despite the occurrence of Koala feed tree species including *Eucalyptus punctata* (Grey Gum) *and Eucalyptus grandis* (Flooded Gum) within the site, no direct observations of Koalas or secondary evidence suggesting that Koalas might have used the site recently were noted within the site. Furthermore, records for Koalas are limited to relatively distant off site areas to the south and southwest of the site and there are no recent records of this species within the site or its vicinity.

Although a woodland and open forest species within its range and the occurrence of records from the western vicinity of the site, habitat present is considered to be too closed to be suitable for the Grey-crowned Babbler. No observations of this conspicuous species were made during fauna surveys within the site.

Eucalyptus species within the site include the winter-flowering *Corymbia maculata* (Spotted Gum). This species is widespread across the site within the LHSGIF. Throughout winter months these stands may represent foraging resources for the nomadic *Lathamus discolor* (Swift Parrot) due to their wide ranging nomadic habits and to a lesser extent *Xanthomyza phyrgia* (Regent Honeyeater), which is more usually recorded in the Cessnock and LMCC LGAs in the Lower Hunter Region.

4.2.2 Regionally Significant Fauna Species

Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant fauna species occurring across Lower Hunter LGA's, of which five were identified within the Development Estate, and are listed as follows:

Falcunculus frontatus	Crested Shrike-tit
Petaurus breviceps	Sugar Glider
Macropus rufogriseus	Red-necked Wallaby
Amphibolurus muricatus	Jacky Lizard
Lymnodynastes tasmaniensis	Spotted Grass Frog

4.2.3 Terrestrial Mammals

Mammals recorded within the site encompassed species from terrestrial, arboreal and aerial guilds. Terrestrial fauna survey captures were dominated by *Antechinus stuartii* (Brown Antechinus), particularly where understorey vegetation densities were higher within open forest habitats. *Rattus fuscipes* (Bush Rat) was found to occur within the main drainage line that transects the site. *Perameles nasuta* (Long-nosed Bandicoot) was observed foraging in the understorey of riparian vegetation communities during nocturnal surveys. In addition to these small native terrestrial mammals, foxes and secondary fox

indications, such as scent marking and scats, were encountered throughout the site, but generally along track lines.

Wallabia bicolour (Swamp Wallaby) and *Macropus rufogriseus* (Red-necked Wallaby) were observed across the site during diurnal and nocturnal surveys. Grazing opportunities occur across the Black Hill Development Estate for these species.

4.2.4 Arboreal Mammals

Pseudocheirus peregrinus (Ring-tail Possum) and *Trichosurus vulpecula* (Common Brush-tail Possum) were observed during arboreal fauna and nocturnal surveys on several occasions within open forest habitat with moderate understorey. *Petaurus breviceps* (Sugar Glider) was observed in open forest habitat drinking sap from *Acacia irrorata* (Green Wattle).

4.2.5 Bats

A number of Microchiropteran bat species were detected within the site during nocturnal surveys via ultrasonic detection with a definite – probable confidence level, including *Miniopterus australis* (Little Bentwing-bat), *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat) and *Vespadelus vulturnus* (Little Forest Bat). Note: *Miniopterus australis* is listed as Vulnerable under the *TSC Act 1995*.

Pteropus poliocephalus (Grey-headed Flying Fox) was observed foraging and was heard calling within the Development Estate during nocturnal survey work. Habitat occurs across the site in the form of flowering sclerophyllous tree species with the winter-flowering species *Corymbia maculata* (Spotted Gum) being of note during the survey period.

4.2.6 Avifauna

There are a range of habitat opportunities for different avifauna guilds within the Black Hill Development Estate encompassing cleared open areas through to dry sclerophyll open forests and wet sclerophyll forests. Most of the lands are wooded, apart from limited areas that have been cleared for power infrastructure easements or previous land uses and a range of common forest bird species were noted during fauna surveys.

Observed forest bird species encompassed a number of groups with those species recorded including, Whistlers and Thrushes, Robins, Flycatchers, Fairy-wrens, Scrub-wrens, Thornbills, Whipbirds, Cuckoos, Finches, Butcherbirds and birds of prey amongst others. Within these bird groups, species with specific preferences for wet or dry forest habitats were often encompassed, such as Golden Whistler and Rufous Whistler, Rufous Fantail and Grey Fantail and Lewin's Honeyeater and Yellow-faced Honeyeater.

The canopy of the site's wooded habitats contains a diversity of tree species that together offer a year round continuity in blossom resources for a range of nectivorous bird species such as honeyeaters and lorikeets. The canopy also represents abundant foraging opportunities for those birds, which hunt the invertebrate fauna that foliage and flowering

trees attract. Understorey strata density varies across the site with the greatest complexity occurring within the riparian corridor and open forest areas containing dense understorey strata. These habitats provide cover, foraging and nesting opportunities for small bird species occurring within these habitats and adjacent more open wooded areas. Some areas of understorey strata within dry forest habitats, particularly to the west of the riparian corridor, contain more open understorey strata representing less diverse habitat opportunities for small bird species.

Despite the presence of mesic vegetation in the riparian corridor, this vegetation only occurs as understorey elements with the canopy being dominated by *Eucalyptus* species. These wet sclerophyll understorey strata have not developed into extensive closed canopy communities. Therefore, these habitats do not provide a wide range of fruiting plant species as required by strictly frugivorous bird species, including threatened Fruit-dove species that occur on rare occasions within the Lower Hunter Region. However, within the riparian corridor there is abundant habitat for those species commonly found in wet sclerophyll forest. *Falcunculus frontatus* (Crested Shrike-tit) was observed in riparian vegetation and this species is often an indicator of higher than average habitat quality.

There are no significant wetland habitats within the site and as such no waterbird species were observed. However, reedbeds occurring where the forest canopy does not shade the creek provide potential habitat for rail and crake species.

Open cleared areas within power infrastructure easements are overgrown with grasses and currently provide foraging opportunities for small bird species. Where open areas occur within wooded habitats common open forest birds such as Eastern Rosellas, Noisy Miners, Grey and Pied Butcherbirds occur. The site provides abundant foraging opportunities for canopy specialists like the White-throated Gerygone, Spotted and Striated Pardalotes and Mistletoebirds.

Throughout the open forest habitats there is only a very sparse presence of *Allocasuarina* spp. (She Oaks), which are the dominant food resource for *Calyptorhynchus lathami* (Glossy Black-Cockatoo). No chewed *Allocasuarina torulosa* (Forest She-oak) nuts were noted within the site to indicate the recent presence of Glossy Black-Cockatoos.

Extensive wooded habitats within the site, containing moderate to high levels of understorey structural diversity and low to moderate densities of high hollow-bearing trees, support populations of terrestrial and arboreal mammal species. These habitat attributes are important features for the foraging purposes of forest owl species, particularly *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl), in relation to the habitats contained within the Development Estate. A Masked Owl was heard calling during owl call back surveys and a Powerful Owl was recorded on three nights during nocturnal surveys. In addition to these records there are records for both of these species elsewhere in the locality although it is considered that the site is not of sufficient size to support these species in isolation from surrounding habitat. There are hollows of sufficient size within the Development Estate to represent potential breeding opportunities for these species.

Swift Parrot Target Survey Results

The widespread occurrence of *Corymbia maculata* (Spotted Gum) across large areas of both proposed Development and Conservation Estates suggests that these lands have the potential to attract Swift Parrots during those seasons when Spotted Gum is an important winter flowering species within the central to lower Hunter Valley. However, targeted survey during 2008 over the Development Estate did not result in any Swift Parrot observations.

4.2.7 Amphibians

Three common species of frog were identified within the Development Estate. *Limnodynastes tasmaniensis* (Spotted Marsh Frog), *Litoria fallax* (Eastern Dwarf Tree Frog) and *Uperoleia laevigata* (Smooth Toadlet), were heard calling across the site within dams, ephemeral ponds and creeks. Although only a relatively small number of frogs were observed within the site, onsite habitat provides opportunities to support a wider suite of common frog species.

Although a number of threatened frog species are known to occur within the region, in particular those belonging to the Genus *Crinia*, *Mixophyes*, *Pseudophryne*, *Litoria* and *Heleioporus*, habitat within the site are not suited to these threatened species. *Mixophyes* spp. occur in montane creeklines, *Pseudophryne australis* and *Heleioporus australiacus* occur within Sydney Sandstone habitats to the south of the Hunter and regionally *Crinia tinnula* occurs in swamp woodland and swamp forest communities around Port Stephens and Lake Macquarie. *Litoria brevipalmata* has been recorded on the valley floor in the Cessnock LGA, but onsite habitat is inconsistent with those areas where it has been regionally recorded.

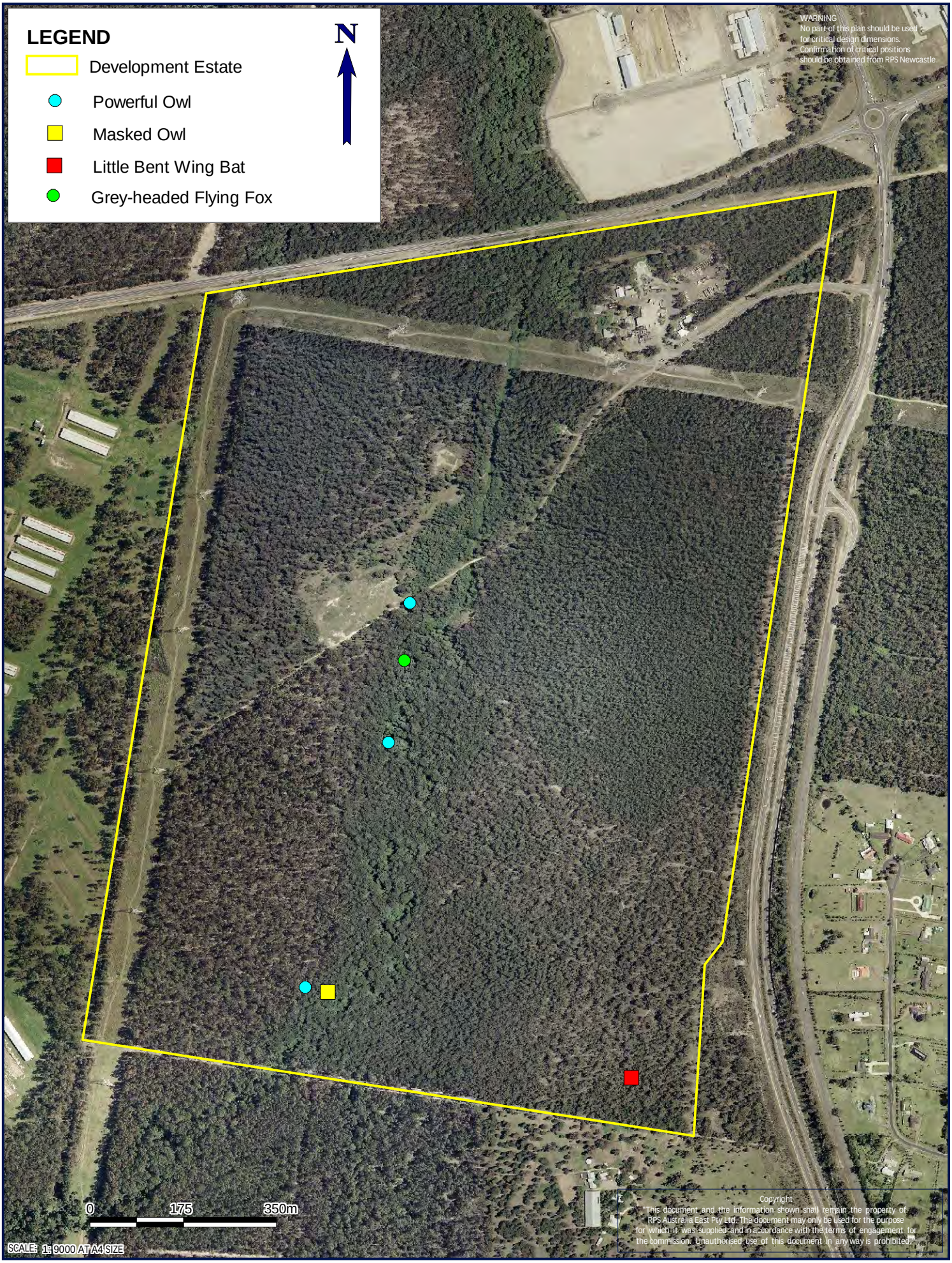
In a historical context habitat attributes that occur within the site, such as creekline and dam edge vegetation, were once recognised as suitable habitat for *Litoria aurea* (Green and Golden Bell Frog). During the 1960's and early 1970's this species was a common frog species frequently encountered in association with *Typha orientalis* (Cumbungi) (RPS ecologist pers. obs.). However, this species was not observed within these habitat types onsite and this species is now more reliably observed within the Lower Hunter River floodplain in association with near estuarine wetland habitats.

4.2.8 Reptiles

The most commonly encountered reptiles within the Development Estate were common skink species occurring within ground debris, particularly *Lampropholis delicata* (Grass Skink), which was observed across all wooded habitats within the site. *Saiphos equalis* (Three-toed Skink) was found sheltering under dead vegetation in open forest habitats. *Ctenotus robustus* (Striped Skink) was found sheltering below dead vegetation within open forest habitat.

One species of dragon lizard was observed within the site. *Amphibolurus muricatus* (Jacky Lizard) was observed in open forest habitat and *Varanus varius* (Lace Monitor) was also observed in open forest habitat within the site.

Two individuals of a single snake species, being *Hemiaspis signata* (Black-bellied Swamp Snake), were observed within open forest habitat during nocturnal fauna surveys.



TITLE: FIGURE 4-4 THREATENED FAUNA SPECIES RECORDS

LOCATION: BLACK HILL

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 19/10/2010
PURPOSE: EAR

J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\BH\24530-2 Figure 4-4 Threatened Fauna Species Records C A4
LAYOUT REF:
VERSION (PLAN BY): C (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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4.3 Habitat Survey

4.3.1 Flora Habitat

The vegetation communities present throughout the site offer a number of suitable habitat types for a moderate array of native flora species. A number of geomorphological factors contribute to those vegetation communities present within the Black Hill Development Estate. These factors include the geology, soils, elevation, topography and rainfall patterns. The geomorphological influences underlying the site provide suitable conditions for two native vegetation communities, being Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) and Alluvial Tall Moist Forest (ATMF). Apart from these naturally occurring vegetation communities there are areas within the site that have been cleared to facilitate energy infrastructure and its associated maintenance accessibility. These cleared areas are characterised by disturbed substrates and high levels of light, which provide opportunities for exotic weeds and colonists from adjacent native vegetation communities. LHSGIF within the site is of significance as this vegetation community is listed as an Endangered Ecological Communities (EEC) under the *TSC Act 1995*. ATMF is recognised in *Lower Hunter and Central Coast Regional Biodiversity Strategy* (Payne 1998) as a vegetation community of Regional Significance.

A number of threatened flora species are known to occur locally within LHSGIF and ATMF. LHSGIF elsewhere within the region is known to contain *Grevillea parviflora* subsp. *parviflora*, *Callistemon linearifolius*, *Rutidosis heterogama* and in some cases *Tetratheca juncea*. Threatened flora species known to be associated with ATMF are *Melaleuca biconvexa*, *Dendrobium melaleucaphilum* and *Syzygium paniculatum*.

A number of ROTAP listed flora are known to occur within LHSGIF, including *Grevillea montana*, *Macrozamia flexuosa* and *Eucalyptus fergusonii* subsp. *fergusonii.* ATMF in the region is known to contain the ROTAP listed *Callistemon shiressii*. Furthermore, at least one Regionally Significant plant species, being *Grevillea humilis* has been noted as occurring within the wider locality of the site in other vegetation communities associated with LHSGIF.

The condition of the vegetation communities varies across the site with areas exhibiting increased degradation with increased proximity to tracks and infrastructure easements. ATMF lies within the riparian corridor traversing the site from south to north and offers opportunities for mesic vegetation, including serious introduced weeds like *Lantana camara* (Lantana).

Other than those opportunities for weeds occurring within cleared easements, vegetation community disturbances within the site are limited to edge effects associated with access tracks and small occasional incidences of rubbish dumping. Rubbish dumping is largely confined to access tracks on the eastern side of the site.

4.3.2 Fauna Habitat

Fauna potentially occurring within the site varies with respect to vegetation quality, density and community form. The site encompasses vegetation communities ranging from wet to dry sclerophyll vegetation associations. The variation in vegetation within the site provides habitat for a diversity of common fauna species and opportunities for a low to moderate number of threatened fauna species.

Eucalypt and other dominant tree flowering times have potential to supply nectar and foraging opportunities for a diversity of species throughout the majority of the year. Dominant tree species and flowering periods are contained in Table 4-2 below.

Table 4-2: Dominant Tree Species and Flowering Period

Dominant Tree Species	TSC listed	EPBC listed	Habitats (but not confined to) Map units REMS	Potential Threatened Fauna Species that May be attracted by Blossom	Flowering Period (Best time to Survey) in Months of the Year											
					J	F	M	A	M	J	J	A	S	O	N	D
Angophora costata Smooth-barked Apple	NA	NA	17	Micro bats (insects), gliders.	■	■								■	■	■
Corymbia maculata Spotted Gum	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	■				■	■	■	■	■	■	■	■
Eucalyptus acmenoides White Mahogany	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders	■										■	■
Eucalyptus capitellata Brown Stringybark	NA	NA		Micro bats (insects), Flying Foxes, Gliders	■	■					■	■	■			■
Eucalyptus fibrosa Broad Leaf Ironbark	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot			■	■	■	■	■	■	■	■	■	
Eucalyptus globoidea White Stringybark	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot				■	■	■	■					
Eucalyptus grandis Flooded Gum	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot				■	■	■	■	■				
Eucalyptus paniculata Grey Ironbark	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	■				■	■	■	■	■	■	■	■
Eucalyptus punctata Grey Gum	NA	NA	5 & 15	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater	■	■	■	■								■

Dark shading represents core flowering times for canopy trees as reported in the literature and light shading represents those times when flowering has been noted by RPS ecologists outside these core flowering periods.

Note: The cleared areas occurring within the site are considered to be insignificant in terms of providing habitat for native fauna species aside from providing foraging habitat along the ecotone between cleared and forested areas (such as for hunting bats).

Terrestrial Mammals

Open Forest communities within the site provide suitable habitat for a number of terrestrial mammals, including small marsupials and rodents. Within LHSGIF understorey complexity is variable with the most suitable opportunities where understorey densities are highest. General densities of understorey vegetation within the site vary from low to moderately high. Patchy areas of *Melaleuca nodosa* and other understorey shrubs throughout the site offer shelter and foraging habitat for this fauna guild.

ATMF within the site has a complex understorey of ground cover species, vine thickets and dense areas of *Lantana camara*. The moderate density of understorey vegetation provides habitat opportunities for terrestrial mammals including marsupial and rodent species guilds. Understorey vegetation provides habitat opportunities for bandicoot species.

Trends observed from the trapping surveys indicate that small mammals such as *Antechinus* and Native Rats are present, but not in high densities due to only a moderate complexity of understorey strata.

Arboreal Mammals

Dry forest within the site exhibits a narrow spread of age cohort of canopy tree species, suggesting that the site has been cleared in the past. The site has a history of mining and vegetation appears to be recovering from previous land-use practices. This has important implications for potential roosting habitat for arboreal mammal species. Age classes of canopy trees throughout the site's LHSGIF are largely of a young maturing class that is not of sufficient maturity to develop hollows. Arboreal mammal populations within the site are therefore expected to be very sparse within LHSGIF due to the general lack of roosting habitat. Elsewhere within the site along the riparian corridor there are large mature individuals of *E. grandis, E. acmenoides and E. paniculata*, although these trees do not exhibit a high incidence of hollows.

The low incidence of arboreal mammal habitat and the paucity of this fauna guild during targeted trapping somewhat limits the site's suitability for Forest Owl species that may occur locally as some forest owl species are dependent upon arboreal mammals as a primary prey group.

Areas of open cleared land with a low diversity and density of *Eucalyptus* species hold limited habitat for arboreal species.

Bats

The wooded and adjacent open areas within the site provide extensive insectivorous foraging habitat for microchiropteran bat species. The mix of dominant tree species has the potential to provide a continuous supply of nectar throughout the year, thus attracting insect populations for a range of microchiropteran bats that occur within the locality.

Although there is a relatively low incidence of hollow bearing trees within the site, it is likely that canopy trees would contain at least a sparse incidence of small hollows, which are utilised by some Microchiropteran bats. Furthermore, the site is continuous with

habitat to the west and there are unbroken linkages to forests spilling off the Sugarloaf Range to the south, which would enable species occurring in the wider locality to utilise foraging habitat within the site without having to traverse vast areas of cleared land.

Canopy trees within the site also offer blossom foraging opportunities for Grey-headed Flying-foxes. This species travels widely to access foraging resources and there are abundant blossom resources within the site for this species to utilise.

Frogs

The permanent watercourse of Viney Creek contains large pools and traverses the site from south to north. Wide slow flowing reaches of the creek that pass through dry forest have extensive reed beds. The diversity of micro-habitats within the creekline with an abundance of associated vegetation provides diverse breeding, shelter and foraging habitats for a number of common frog species. Although abundant riparian habitat occurs within the site, the habitat is not consistent with that which might support threatened species that occur within the region. Adjacent wooded habitats are likely to provide foraging and shelter opportunities for a variety of tree dwelling and terrestrial frog species.

Reptiles

Habitat within the site has potential for representing significant shelter and foraging opportunities for a diversity of reptile species. This can be attributed to the complexity of understorey strata and the moderate – high incidence of forest debris in the ground cover layer.

Watercourses are likely to provide year round habitat, where creeklines and drainage lines with ephemeral ponds within the site provide intermittent foraging opportunities for common snake and turtle species. Wooded areas are likely to represent habitat for common lizard and snake species.

Avifauna

The wooded areas provide suitable foraging resources (e.g. Invertebrate habitat and blossom) and nesting and roosting opportunities for a variety of sedentary and migratory birds. Hollow-bearing trees, occurring largely within the riparian corridor, may provide nesting habitat for hollow dependant birds such as Forest Owls, Treecreepers, Parrots, Kingfishers and Woodswallows.

Dry forest areas within the site are continuous with the extensive forests and woodlands of the Sugarloaf Range to the south. As such, there is opportunity for nomadic blossom species, including threatened species, to use the site as part of seasonal foraging movements in response to widespread local blossoming events. Understorey habitat opportunities for small avian species within the site's dry forest areas range from low, where the forest's understorey strata is open, to high, where understory density is high due to more complex shrubby understorey vegetation. The juxtaposition of both dry and wet forest types within the site allow both wet and dry forest bird groups to occur within the site and increases avian diversity potential in the ecotone areas where these communities overlap.

The riparian corridor provides roosting, nesting and foraging opportunities for Forest Owl species and its proximity to extensive dry forest habitats within and outside the site offers these species abundant hunting opportunities within open forest and woodland areas. Although the site provides potential habitat opportunities for Forest Owl species, the general low habitat potential for arboreal mammals within the site's dry forest areas, due to a low incidence of hollow-bearing trees, may somewhat compromise the site's potential for supporting these species.

4.4 Habitat Mapping

Habitat mapping (Figure 4-5) has been undertaken based on the results of field assessment coupled with the results of floristic investigations and RPS Ecology staff combined observations and experience. To optimise the habitat mapping for display and analysis, habitat quality has been divided into the five categories outlined below, based on the habitat assessment elements discussed previously. The habitat assessment elements are; hollow bearing tree density, Eucalypt diversity, Allocasuarina species density, Proteaceae species density, structural diversity and fallen timber density.
Note: The habitat quality has been delineated with reference to but does not follow the delineated vegetation community boundaries.

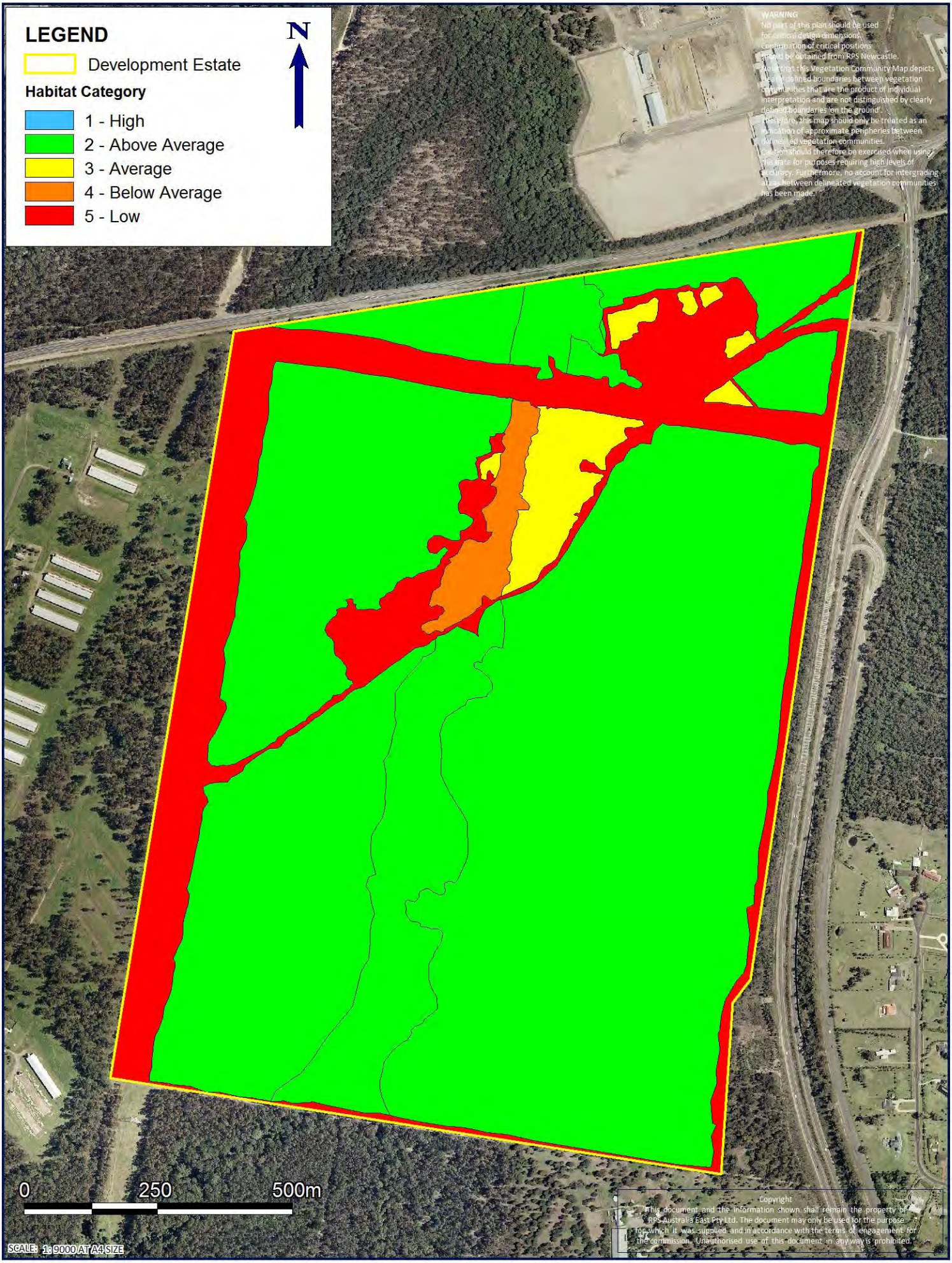
High – Quality habitat with native flora showing no significant disturbance with old growth elements, intact understorey and year round foraging opportunities preferable to significant and threatened fauna species that includes forest owls, arboreal mammals and avifauna (includes EEC with no weed incursion and areas perceived to have regionally unique floristic representations or fauna habitat).

Above average – Quality habitat with native flora showing little to no disturbance with moderate levels of key elements. These areas are likely to be utilised by native fauna species, including threatened species, as part of a larger home range (includes EEC with minor weed incursion).

Average quality – Habitat with dominant native community with low to moderate disturbance levels within elements, and includes areas of recent fire disturbance where understorey diversity is low with long term natural regeneration likely (also includes EEC with moderate weed incursion).

Below average – Habitat representing a native vegetation community with high weed incursion and other disturbances and low level of foraging opportunities (includes EEC with severe weed incursion and disused tracks with signs of native regeneration).

Low – Cleared land dominated by exotic flora species and representing preferred habitat for exotic fauna species (includes highly disturbed and frequently used tracks).



TITLE: FIGURE 4-5 HABITAT CONDITION MAP

LOCATION: BLACK HILL

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 19/10/2010
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Draft..\Eco\Northern Lands\BH\24530-2 Figure 4-4 Threatened Fauna Species Records C A4
VERSION (PLAN BY): C (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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5 Development & Conservation Outcomes

The Lower Hunter Region's vegetation is of bio-geographic significance as it supports a transition between the northern and southern plant and animal assemblages. This north-south link is not evident elsewhere in the Hunter Valley. The Region also forms an east-west migratory pathway and a drought refuge for inland species.

The preservation of large vegetated areas that are linked to other similar areas has been recognised as fundamentally important to achieving long term regional biodiversity outcomes in the Lower Hunter region. The two most valued of these areas in the Lower Hunter contain large land areas owned and controlled by Coal & Allied. Firstly, the green corridor that links the Watagans and Yengo National Parks with the coastal plains of the Tomago Sandbeds, Stockton Bight and Port Stephens. Secondly, the Wallarah Peninsula lands provide a regionally significant break between urban areas, and contain areas of high biodiversity, scenic amenity and heritage value.

The Coal & Allied lands to be dedicated form large vegetated areas in their own right, and complete linkages of identified regional corridors in key areas.

In addition to their important strategic location in a wider landscape context, the Conservation Estates contain valuable biodiversity resources. They contain and will conserve a range of important vegetation communities, including areas of Endangered Ecological Communities (EEC) and other vegetation types that have been depleted in the region. Several threatened plant species have been recorded within the Conservation Estates, including *Arthropteris palisotii, Tetratheca juncea* (Black-eyed Susan), *Grevillea parviflora* subsp. *parviflora*, *Eucalyptus nicholii, Rutidosis heterogama, Syzygium paniculatum* and *Callistemon linearifolius*. Two of the threatened flora species recorded in the Conservation Estates are considered to be planted specimens and not naturally occurring, being *Eucalyptus nicholii* and *Syzygium paniculatum*, although *S. paniculatum* may have been transported to its position in a disturbed area by natural means. In addition to these threatened species two rare (ROTAP) species *Callistemon shiressii* and *Eucalyptus fergusonii* subsp. *dorsiventralis* were also identified within the Conservation Estates. Refer to Table 5-1: Vegetation Removal / Retention for a complete breakdown of the vegetation retention and removal within both the Development Estates and the Conservation Estates.

The diverse nature of both the landform settings, varying from coastal ranges forests and woodlands to coastal heath to wetlands, provides a diverse array of habitats and resources for native fauna. The Conservation Estates are known to contain important populations of numerous threatened fauna species, including birds, mammals and herpetofauna. The conservation of these lands will provide secure regional biodiversity gene pools, and also through linkages facilitate valuable genetic material exchange and other key processes associated with sustainable ecological population dynamics. Refer to Table 5-2: Habitat Removal / Retention.

In summary, the Coal & Allied conservation dedications provide outcomes that contribute to meeting the Environmental Protection goals outlined in the Sustainability Criteria contained within the Lower Hunter Regional Strategy. Such goals include:

- Outcomes consistent with the Lower Hunter Regional Conservation Plan;
- Maintains/improves areas of regionally significant biodiversity;Maintains environmental areas for air & water quality; and
- Protects areas of Aboriginal cultural heritage value and historical heritage value.

These outcomes:

- Conserve in perpetuity key strategic parcels of land that complete long sought after regional biodiversity conservation corridors and buffer areas;
- Provide large intact areas of conserved habitat that will function as regional biodiversity gene pools;
- Protect an important array of vegetation communities, flora and fauna species, and natural landscape assets, including threatened species and EEC's;
- Contribute significantly to the successful implementation of the Lower Hunter Regional Conservation Plan; and
- Achieve additional conservation benefits within Development Estates via appropriate urban design and management practices.

The following Table 5-1: Vegetation Removal / Retention depicts the vegetation removal and retention associated with the proposal. The following headings have been utilised within the Vegetation Removal Tables.

'Vegetation Community' – Name of Vegetation Community which may be impacted upon by the proposal.

'TSC Act' – Provides the status of the species / community / population described with relation to the *TSC Act.*

'Potential KTP' – Lists the Key Threatening Processes (KTP), which are listed within the *TSC Act*, that have the potential to occur as a consequence of the proposal. Descriptions of potential KTP's and the likelihood of their occurrence within the proposal are presented in Section 6. These are as follows:

(1) Loss of Hollow-bearing trees;

(2) Clearing of native vegetation;

(3) Human-caused climate change;

(4) Infection of native plants by Phytophthora cinnamomi;

(5) Invasion of native plant communities by exotic perennial grasses;

(6) Removal of dead wood and dead trees;

(7) Predation by the Feral Cat;

(8) Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;

(9) *Lantana camara*; and

(10) Predation by the European Fox.

'Area in Development Estate (Ha / %)' – Displays the area of vegetation that will be removed within the Development Estate and the percentage of this vegetation type to be removed within the Northern Lands.

'Area Conservation Land (Ha / %)' – Displays the area of vegetation that will be conserved for each of the delineated vegetation communities within the Conservation Estates.

'Total Area' – Represents the total area of each vegetation community within the site, thus the sum of the preceding two columns.

'Comments' – Provides a brief discussion on the key characteristic of the vegetation where relevant.

Table 5-1: Vegetation Removal / Retention

Vegetation Community	1. TSC Act 2. EPBC Act 3. Other	Potential KTP	Vegetation Outcome (ha)			
			Area in Minmi Link Rd Development Estate	Area in Minmi Link Rd Conservation Estate	Area in Black Hill Development Estate	Area in Black Hill Conservation Estate
Alluvial Tall Moist Forest		1-10	30.83	129.88	17.61	36.22
Coastal Foothills Spotted Gum-Ironbark Forest		1-7, 9, 10	169.42	859.01	0	188.39
Coastal Plains Smooth-Barked Apple Woodland		1-7, 9, 10	22.98	160.58	0	44.03
Dam		8	1.30	0.43	0	0
Freshwater Wetland Complex	**1. EEC - FRESHWATER WETLANDS**	1-7, 9	0.37	0	0	11.89
Hunter Lowland Redgum Forest	**1. EEC - HLRF**	1-10	0.39	11.80	0	2.28
Hunter Valley Moist Forest		1-10	21.94	66.87	0	62.54
Lower Hunter Spotted Gum Ironbark Forest	**1. EEC - LHSGIF**	1-7, 9,10	136.80	181.66	132.92	131.46
Sub-tropical Rainforest	**1.EEC - LOWLAND RAINFOREST**	1-10	0	11.53	0	9.99
Swamp Mahogany – Paperbark Forest	**1. EEC - SSF**	1-10	0	0	0	0.23
Swamp Oak Rushland Forest	**1. EEC - SOFF**	5, 7-10,	0	0	0	0.57
Weeds And Cleared Areas		3-10	140.37	139.24	32.97	56.76

Table 5-2: Habitat Removal / Retention

Habitat	Habitat Outcome (ha)			
	Area in Minmi Link Rd Development Estate	Area in Minmi Link Rd Conservation Estate	Area in Black Hill Development Estate	Area in Black Hill Conservation Estate
1 – High	84	211.15	0	174.87
2 – Above Ave	230	1133.18	147	265.74
3 – Average	67.4	82.91	3.5	47.69
4 – Below Ave	13	1.88	33	0.32
5 – Low	130	131.88	0	55.82

6 Environmental Impact Assessment

6.1 Identification of Threatened Species, Populations and Ecological Communities

Those threatened flora and fauna species (listed under the *TSC Act, 1995*) that have been gazetted / recorded from within the vicinity of the site have been considered within this assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the overall proposal. This assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the overall proposal.

Those species / communities that have been identified as having either a moderate level of impact (or greater) as a result of the proposed Development Estate or that have been recorded within the site during field investigations have been subject to further assessment within Section 6.2 herewith.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat Description and Known Populations' or **'Habitat Description and Known Stands / Populations'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Chance of Occurrence within Site'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impact within Development Estate'– Assesses the likely level / significance of impacts to each species / community / population that would result from the proposed Development Estate, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of construction works, proposed remediation works etc. All impact assessment is undertaken with due consideration to the offset related to the Conservation Estates forming part of the proposal

Table 6-1: Threatened Species Assessment

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Plants			
Acacia bynoeana Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to the Southern Highlands. Within the Hunter Sub-bioregion it has been found in several locations within the Cessnock LGA where it has been found growing in Kurri Sand Swamp Woodland (KSSW). Has also been recently recorded as isolated populations within Yellow Bloodwood Woodland and Blue-leaved Stringybark Woodland near Ellalong. Locally, it is known to occur with Coastal Plains Scribbly Gum Woodland.	**Low** The survey did not record this species within the proposed development area. Habitat within the Development Estate can be considered sub-optimal at best, as this species prefers woodland habitats. Thus it is unlikely that this species will occur due to the lack of suitable habitat.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat within the Development Estate and thus unlikely to be effected by the proposal.
Arthropteris palisotii Lesser Creeping Fern (E)	Occurs in North-eastern NSW and also in Queensland. The Lesser Creeping Fern grows on trees. Its creeping stem is branched and wiry and covered with dark scales. Spores are borne on the underside of the leaflets in circular clumps. Occurs in rainforest, mainly on tree trunks.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** It is considered that better habitat is present within the Subtropical Rainforest which will be conserved as part of the Conservation Estates at Stockrington to the south west of the site will be conserved within the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the site.
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Callistemon linearifolius (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Significant populations recently found within the Lower Hunter, including Werakata National Park. Re-sprouting/juvenile specimens difficult to distinguish from other *Callistemon* species such as *C. rigidus* or *C. linearis* without the aid of flowering parts. Locally this species has been recorded where dry forest habitats interface with salt tolerant vegetation communities, such as Swamp Oak Rushland Forest and Riparian Melaleuca forest.	**Moderate** The survey did not record this species within the proposed development area. However a NPWS Database record does occur for this species within the site. The areas in which this species was located was surveyed and *Callistemon rigidus* was located, this species is similar to *Callistemon linearifolius* however close inspection of several of this species found that oil dots were distinct on the back of the leaves and no net veins were present on any of the plants, thus concluding that these species were *Callistemon rigidus*. A large population of at least 200 specimens were located within the Conservation Estates to the south west of the site.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of a large population of this species and large areas of potential habitat for this species within the Tank Paddock and proposed Conservation Estates. However since a DECCWW record was identified within the site this species will be further assessed in Section 5.2 below.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Caladenia tessellata (E, V*)	A small terrestrial orchid, which regrows its single leaf on an annual basis. It is known to occur in grassy woodland and locally it has potential to occur within Coastal Plains Scribbly Gum Woodland. It has been recorded within Munmorah State Recreation Area to the south of the site.	**Moderate** Flora surveys were conducted within the flowering season for this species and it was not recorded within the Development Estate. However, habitat assessment suggests that there is potential for this species to occur in habitats with a heathy to grassy understorey of which those in the best condition occur within the Conservation Estates. Habitat does exist within the Development Estate within the grassy areas located in the western portions of the Development Estate. Potential habitats within the Development Estate for *Caladenia tessellata* include dry sclerophyll forests of Lower Hunter Spotted Gum-Ironbark Forest. However, some of the habitat with LHSGIF contains sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid. Due to the cryptic nature of this species, it is relatively difficult to locate in the field and as such its presence within the Development Estate cannot be discounted	**Low** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat (approx 545ha) for this species will be conserved within the Conservation Estates as part of the current proposal.
Cryptostylis hunteriana Leafless Tongue Orchid (V, V*)	A cryptic Saprophytic orchid species that flowers between December and February. Distribution limits N-Gibraltar Range S- south of Eden. Grows in a variety of habitats from tall open forests to swamp heath on sandy soils	**Low** The habitats within the Black Hill Development Estate (Lower Hunter Spotted Gum Ironbark Forest and Alluvial Tall Moist Forest) are not considered to be suitable for the species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Cynanchum elegans White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast south to Wollongong usually in dry, littoral or subtropical rainforest and occasionally Melaleuca scrub or woodland. A climbing or twining plant species that flowers from August to May with peak flowering in November. One record within the Atlas of NSW Wildlife data occurs within the Lower Hunter Region and Central Coast at Green Point to the north of Belmont.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** It is considered that better habitat is present within the Subtropical Rainforest which will be conserved as part of the Conservation Estates at Stockrington to the south west of the site will be conserved within the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the site.
Dendrobium melaleucaphilum (E)	Epiphytic orchid growing mostly growing on *Melaleuca styphelioides*, but occasionally on rainforest trees or rocks. Extends from south of the Blue Mountains to Queensland. Preferred habitat is coastal swamp forests.	**Low – Moderate** Although the favoured host plant for this orchid, *Melaleuca styphelioides*, for this orchid was recorded within the site during flora surveys, there are no known records for this orchid species in the Newcastle area and it was not recorded during flora surveys. The majority of the habitat of Alluvial Tall Moist Forest will be conserved within the site as part of the proposal. Nevertheless due to the occurrence of potential habitat its presence within the site cannot be totally discounted.	**Low** Unlikely to be adversely affected by the current proposal as the majority of the habitat will be conserved both within the Development Estate and within the Conservation Estates.
Diuris praecox (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes. This species has been recorded at a number of dry forest locations to the southeast of Lake Macquarie.	**Moderate** There is opportunity for this species to occur within open forest habitats of Lower Hunter Spotted Gum Ironbark Forest within the site. However targeted searches within the flowering period of this species failed to locate any specimens. Due to the cryptic nature of this species, it is relatively difficult to locate in the field and as such its presence within the site cannot be discounted.	**Low** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat (approx 545ha) for this species will be conserved within the Conservation Estates as part of the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Eucalyptus camfieldii Camfield's Stringybark (V, V*)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often restricted drainage. Records from the Hunter Sub-bioregion are largely in near-coastal areas from the Port Stephens LGA to the Central Coast. An isolated stand of trees consistent with this species has been recorded near Kurri Kurri (K. Hill pers. comm.). A local record to the east of the site is reported in the Atlas of NSW Wildlife data.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Eucalyptus glaucina (V, V*)	Red Gum species that grows in grassy woodland on deep, fertile and moist soils. Recorded within Hunter Lowland Redgum Forest and Central Hunter Ironbark Spotted Gum Grey Box Forest communities in the lower Central Hunter. Interbreeding known to occur between this species and *E. tereticornis*.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species within the Tank Paddock proposed Conservation Estates.
Eucalyptus parramattensis ssp. decadens Drooping Red Gum (V, V*)	Red Gum species that grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Locally, this species occurs almost exclusively in association with Kurri Sand Swamp Woodland (KSSW) and ecotonal areas, but a small disjunct stand of stunted individuals have been recently recorded within coastal heath in the Lake Macquarie LGA (RPS pers. obs.).	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Grevillea parviflora subsp. parviflora (V, V)*	Occurs in light, clayey soils in woodlands. Most plants appear capable of suckering from a rootstock. Relatively widespread within the Cessnock LGA. Occurs within Werakata National Park. Much confusion surrounds the taxonomy of this species and other similar *Grevillea* taxa (S. Bell *pers. comm.*), and a NPWS-funded study of the species is currently in progress.	**Moderate** The survey was unable to locate this species within the proposed Development Estate. The site has potential suitable habitat for this species in the form of Lower Hunter Spotted Gum Ironbark Forest. Surveys failed to locate this species within the site.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species within the Tank Paddock proposed Conservation Estates.
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas from Jervis Bay to Port Macquarie. Records in the Hunter Region are confined to western Lake Macquarie (Atlas of NSW Wildlife data).	**Low** The closest records for this species occur to the west of Lake Macquarie and this species was not recorded during flora surveys conducted within the site. However, potential habitat exists in the Alluvial Tall Moist Forest vegetation community within the site.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species within the Tank Paddock proposed Conservation Estates.
Microtis angusii Angus's Onion Orchid (E, E*)	Record from the Terry Hill's district of Sydney. Occurs upon disturbed soil horizons that were originally ridgetop lateritic soils supporting a distinctive open to low open forest community, Duffy's Forest Vegetation Community, which is listed as an EEC. Suspected occurrences in the southern Lake Macquarie hinterland are derived from a tentative record by Bell (1998) in the Lake Macquarie State Recreation area, which occurs to the south of Gwandalan.	**Low - Moderate** The presence of records within the central coast area and the occurrence of habitat as described from other locations where this species has been recorded suggests that this species may have sub-optimal habitat within both the Conservation Estates and the Development Estate within the site.	**Low** Considered unlikely to be adversely affected by the current proposal due to suitable habitat existing within the Conservation Estates.
Rulingia prostrata Dwarf Kerrawang (E, E*)	A prostrate shrub forming mats greater than 1m in width and occurring within heath, dry sclerophyll and coastal sands around Tomago.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development. Marginal sub-optimal habitat is present within the Freshwater Wetlands vegetation community within the Conservation Estates.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Rutidosis heterogama (V, V*)	Small Asteraceous herb occurring in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Cessnock LGA. This species is also noted as occurring within coastal heathland habitats between Wyong and Evans Head on sandy substrates or moist areas within open forest.	**Moderate** The targeted survey did not detect this species within the proposed Development Estate. Potentially suitable habitat exists within the Lower Hunter Spotted Gum Ironbark forest community. However a small population of this species was located within the Lower Hunter Spotted Gum vegetation community in the western portion of the Conservation Estates.	**Low** Considered unlikely to be adversely affected by the current proposal due to suitable habitat existing within the Tank Paddock Conservation Estates.
Syzygium paniculatum Magenta Lilly Pilly (V, V*)	A shrub to small tree found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay. Hunter Region records confined to the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	**Low** The survey did not record this species within the proposed development area. The site contains sub-optimal potential habitat for this species.	**Low** It is considered that better habitat is present within the Subtropical Rainforest which will be conserved as part of the Conservation Estates at Stockrington to the south west of the site will be conserved within the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the site.
Tetratheca juncea Black-eyed Susan (V, V*)	Occurs in a variety of forested and heathy habitats. Locally found in Open Forests and Woodlands with dense, undisturbed understorey, often in association with *Angophora costata* / *Corymbia gummifera* on slopes with south-easterly aspects. A number of records exist from the local area including several records from the proposed Conservation Estates within the Tank Paddock site (Atlas of NSW Wildlife data).	**Low** This species was not recorded within the proposed Black Hill Development Estate. The site lacks Coastal Plains Smooth-barked Apple Woodland considered to be suitable habitat, therefore the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.
Zannichellia palustris (E)	A submerged monoecious weakly rhizomatous aquatic annual or perennial plant. Within Australia it is known only from the Murray River estuary in South Australia and the Lower Hunter region in NSW. This species occurs in fresh to brackish, still to slow moving waters. *Z. palustris* has been collected from Ironbark Creek (Shortland), Black Creek (Cessnock), Kooragang Island and from near Belmont. None of the known sites of this species are formally protected and none are managed in any way for the conservation of the species. This species is ROTAP-coded 3R+, indicating that the species occurs overseas.	**Low** The survey did not record this species within the proposed development area. No habitat for this species is present within the Black Hill Development Estate.	**Low** It is considered that potential habitat for this species exists within the Freshwater Wetlands located within Tank Paddock to the south east of the site. Tank Paddock will be conserved as part of the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the site.
Herpetofauna			
Litoria aurea Green and Golden Bell Frog (E, V*)	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites. Previously widespread within the Sydney Basin Bio-region, but now sparsely distributed within the Lower Hunter and Central Coast areas.	**Low** The survey did not record this species within the proposed Development Estate, although there is a historical record (1984) less than 1 km to the southeast of the site on the edge of the Hexham Floodplain. Whilst there is some limited habitat in the form of cumbungi patches along watercourses within the site, which might have represented potential habitat in its former historical range, this species only persists in the locality within sites exhibiting a saline influence, such as lands proximate to the Hunter River Estuary.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Litoria brevipalmata Green-thighed Tree Frog (V)	Occurs in isolated localities from the NSW Central coast to south-east Queensland. They occur in a range of habitats from rainforest and moist Eucalypt forest to dry eucalypt forest and heath. Breeding occurs following heavy rainfall events in late spring and summer, with frogs congregating around large, temporary pools where males generally only call for one or two nights. This species has been recorded from only one location in the Hunter River catchment, being along creekline habitat within the HEZ study area (Harper Somers O'Sullivan 2004a). Populations of this species are also known to exist regionally within the Watagan National Park (Ehmann, 1997) and Cooranbong (Atlas of NSW Wildlife data).	**Low – Moderate** This species was not recorded within the site during fauna surveys. Although riparian habitats within the site appear to offer opportunities for this species, there are no records for this species within the locality of the Development Estate. However, due to records associated with dry sclerophyll forests elsewhere in the Lower Hunter Valley (14 km to the west) its presence within the site cannot be entirely discounted.	**Low** Considered unlikely to be adversely affected by the proposal, due to more extensive areas of habitat retained as Conservation Estates with the proposal.
Varanus rosenbergi Heath Monitor (V)	Inhabits a range of habitats, including coastal heaths, woodland and sclerophyll forests. It shelters in self-made burrows or in hollow logs and rock crevices and is known to be semi-arboreal. Its range extends from southern Western Australia through South Australia. The Victorian and NSW populations are isolated from these western populations and from each other. Within NSW, populations are known from the Canberra region north to Wondabyne.	**Low** The survey did not record this species within the proposed Development Estate. Unlikely to occur due to its more southerly occurrence.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.
Avifauna			
Botaurus poiciloptilus Australian Bittern (V)	The Australasian Bittern is confined to Australia and New Zealand. Within Australia this species occurs in the southeast and southwest with the occasional vagrant in the northwest of Australia. It favours permanent fresh-waters dominated by sedges, rushes, reeds or cutting grasses (e.g. Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea and Gahnia). Feeds on insects, small fish, eels, frogs and other aquatic life, sometimes in rice fields. It is partly nocturnal in habits, and, keeping as it does to the depths of reedy swamps, is seldom seen during the day. There is an anecdotal record for this species within the proposed Conservation Estates of Tank Paddock.	**Low** The survey did not record this species within the proposed Development Estate. Habitat within the proposed Development Estate lands is considered unsuitable for this species due to the lack of open permanent wetlands with emergent sedges and rushes.	**Low** The occurrence of this species within the site is unlikely; however, habitats within which this species might potentially occur will be retained as Conservation Estates within the Tank Paddock site under the proposal.
Lophoictinia isura Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Records exist from the Cessnock and Maitland LGA's and there are records for this species from Cooranbong in the southwest of the Lake Macquarie LGA (Atlas of NSW Wildlife data; HBOC records). Records for this species within the Lower Hunter are generally limited to Autumn.	**Low – Moderate** Due to the generalist habitat requirements of this species, it could potentially use habitat within the Development Estate on a seasonal basis as part of a wider foraging range. Records in the Hunter Sub-bioregion are generally sparse. Although a historical record occurs < 4 km to the east, it is considered difficult to locate during targeted surveys and the site is not regarded as regionally or locally important to this species, owing to its moderate habitat complexity.	**Low** Given that those areas most suitable as hunting habitat for this species will be retained within proposed conservation areas it is unlikely that the proposal will represent a significant threat to this species.
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Occurs in forests and woodlands where it forages on the seed capsules of Eucalypts. Sedentary, seasonally nomadic or part-migratory, this species shows a general trend to leave highland habitats in winter for more lowland districts. Requires large Eucalypt tree hollows for nesting. Records exist from the Watagan Mountains and adjacent lowlands and foot hills, including one record approximately 1km north of the site (Atlas of NSW Wildlife data).	**Moderate** Local records for this species occur to the north of the site within similar habitat to that occurring within the Development Estate. Within the Lower Hunter Valley this species largely occurs within adjacent ranges, but sometimes moves seasonally into more lowland habitats where *Eucalyptus* feed trees occur. Due to the occurrence of suitable habitat and records within the vicinity this species may use habitat within the Development Estate on at least an intermittent basis. This species was observed within the Stockrington Conservation Estate.	**Low** Given that those areas most suitable as foraging habitat for this species will be retained within proposed conservation areas at Stockrington and Tank Paddock it is unlikely that the current proposal will represent a significant threat to this species.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones. Requires large Eucalypt tree hollows for nesting. Records within the Hunter Sub-bioregion predominantly from relatively undisturbed forested areas on the ranges such as the Watagan Forests, with isolated records from the valley floor remnants.	**Low – Moderate** This species was not recorded within the site during fauna surveys. Although there are hollow-bearing trees of sufficient size within site to provide breeding opportunities for this species, *Allocasuarina* tree species, which make up the bulk of this species foraging requirements occur sparsely within the site. Therefore this species is unlikely to occur within the Development Estate on a more than a rare occurrence.	**Low** The area of potential habitat that will be affected under the current proposal is small in comparison to the area of potential habitat being conserved within the proposed Conservation Estates within Stockrington and Tank Paddock lands. Therefore it is unlikely that the current proposal will represent a significant threat to this species.
Melanodryas cucullata subsp cucullata Hooded Robin (V)	Ranges from about Mundubbera, Qld, to the Spencer Gulf, SA, intergrading with other subspecies through the northern Murray-Darling Basin (Garnett *et al*, 2000). They occupy drier Eucalypt forest, woodland and scrub as well as grasses and low shrubs. The species is a quiet, shy and largely sedentary bird, most often observed in pairs or small groups. The size of territories throughout Australia has been estimated to be between 5 to 50 hectares. Established pairs keep to their territory year round, banding into family groups only briefly after breeding. (Schodde and Tidemann, 1986).	**Low** This species was not recorded within the site during fauna surveys. Although a record for this species occurs within the site (Atlas of NSW Wildlife data), habitat within the site is not considered suitable for this species and occurs outside its current known distribution within the Hunter Valley. Therefore chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.
Stagonopleura guttata Diamond Firetail (V)	Small Finch occupying open woodlands / forests and associated habitats with grassy understorey. Generally found west of the Divide or in drier semi-coastal areas such as the upper Hunter Valley. Appears unable to persist in remnants less than 200ha. Local records for this species are rare, but it has been recorded in the Cessnock LGA during sustained dry periods.	**Low** This species was not recorded within the Development Estate during fauna surveys. Despite the occurrence of a record 1.2 km to the north (Atlas of NSW Wildlife data), within the Hunter Region this species occurs sparsely across the western to Central Hunter, and as such it is unlikely to occur in the Lower Hunter on more than a rare occasion.	**Low** Considered unlikely to be adversely affected by the proposal due to the Development Estate occurring outside of its normal known range.
Pomatostomus temporalis temporalis Grey-crowned Babbler (V)	Ranges from SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. The Grey-crowned Babbler inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. Also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Forages mainly on insects and spiders in leaf litter and soil, but also venturing into vegetation. Within the Lower Hunter Valley, this species is known from Werakata National Park (University of Newcastle 2001). It has been recorded in Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2005; authors pers. obs.).	**Moderate** This species was not recorded within the site during fauna surveys although this species has been recorded in more open habitat to the west of the Development Estate. Although the site is dominated by eucalypt forests and lacks this species' preferred open woodland habitat there are some more open areas within the site, which might be suited to this species. Therefore the chance of occurrence is considered moderate.	**Low** The occurrence of this species within the site is unlikely; however, habitats within which this species might potentially occur will be retained within areas dedicated to Conservation Estates within the Tank Paddock site under the proposal.
Chthonicola sagittatus Speckled Warbler (V)	Occurs in South-Eastern Australia, from South-West Victoria through eastern New South Wales to Central Queensland, mostly on the western slopes and tablelands of the Great Dividing Range, and in the drier areas of coast. Lives in a wide range of Eucalypt dominated vegetation that has a grassy and shrubby understorey often on rocky ridges or gullies (Garnett *et al*, 2000). Within the Lower Hunter Valley, this species is known from Werakata National Park, the HEZ, Elderslie and North Rothbury (Harper Somers O'Sullivan 2004). Records also exist from Wollemi, Goulburn River, Dharug and Yengo National Parks (Atlas of NSW Wildlife).	**Low** This species was not recorded within the site during fauna surveys. Habitat within the site is considered sub-optimal for this species, and Lower Hunter records for this species do not occur further east than the Sugarloaf Range. Records occur within the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data).	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the Development Estate. Habitat will retained within the proposed Conservation Estates at Stockrington.
Climacteris picumnus subsp. victoriae Brown Treecreeper (V)	Occurs through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. Within the Lower Hunter Valley, this species is known from Werakata National Park, Rothbury, the HEZ and Ellalong (Atlas of NSW Wildlife).	**Low** This species was not recorded within the site during fauna survey. Although, this species is known to occur within Lower Hunter Spotted Gum Ironbark Forest in the Cessnock LGA, birds east of the Sugarloaf population are rare. Records occur within the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data). This species was recorded along George Booth Drive within the Stockrington Development Estate.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the Development Estate. Habitat will retained within the proposed Conservation Estates at Stockrington.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Melithreptus gularis gularis Black-chinned Honeyeater (V)	Occurs in eastern Australia, along the inland slopes of the Great Dividing Range, extending to the coast between Sydney and Newcastle, NSW, and north to Rockhampton, Qld. Occupies dry Eucalypt woodland within an annual rainfall range between 400-700 mm, particularly within associations containing Ironbark and Box species (Garnett *et al*, 2000). Within the Lower Hunter Valley, this species is known from Werakata National Park the HEZ and Ellalong lagoon (Harper Somers O'Sullivan 2004). Additionally, substantial and regular records of this species were noted from the Spotted Gum / Ironbark associations in the Cessnock / Kurri Kurri area during 2005 (RPS Ecologists pers. obs.).	**Moderate** This species was not recorded within the site during fauna surveys, although this may be a function of its general scarcity. Records for this species occur within Lower Hunter Spotted Gum Ironbark Forest less than 2 km to the north of the Development Estate (Atlas of NSW Wildlife data) and due to its mobility it is possible that it may occur within the site on an intermittent basis. Records occur within the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data) and this species was recorded during associated fauna surveys in that area. This species was recorded along George Booth Drive within the Stockrington Development Estate.	**Low** Considered unlikely to be adversely affected by the proposal due to widespread occurrence of suitable habitat outside of the site, although the loss of Spotted Gum Ironbark forest within the site would represent an incremental loss of potential habitat for this species. Large areas of suitable habitat will be retained within the proposed Conservation Estates at Stockrington.
Xanthomyza phrygia Regent Honeyeater (E, E*)	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the Lake Macquarie LGA this species is generally associated with *Eucalyptus robusta* (Swamp Mahogany). Local occurrences are during winter months when this species flowers, although their stronghold is west of the great divide and it appears that movements to the coast only occur when foraging resources fail in the west and, to some extent, the Central to Lower Hunter Valley.	**Low** This species was not recorded within the site during fauna surveys and no records occur within the locality of the Development Estate. Most sightings within the Lower Hunter are from lowland riparian habitats containing winter-flowering canopy trees. Although these habitat attributes occur to some extent within the site, the chance of occurrence is considered low, due to the lack of records from the locality of the site.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site. Potential habitat for this species will retained within the proposed Conservation Estate at Stockrington.
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania. When recorded within the Lake Macquarie LGA this species is often associated with winter flowering eucalypt species such as *E. robusta* and *E. tereticornis* (Author pers. obs.), but they are known to forego nectar resources for lerps, which occur on a variety of eucalypt species. Locally this species has been recorded on Point Wollstonecraft and Nord's Wharf to the west (Atlas of NSW Wildlife data).	**Moderate** This species was not recorded within the site during fauna surveys. Due to the occurrence of records within the wider locality of the site, its high mobility and the presence of a wide variety of canopy tree species representing a potential food source, the likelihood of this species using the site on an intermittent basis cannot be ruled out.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of considerably larger areas of potential foraging habitat within the Stockrington and Tank Paddock proposed Conservation Estates.
Neophema discolor Turquoise Parrot (V)	Turquoise Parrot is typically recorded west of the Great Divide on the tablelands and western slopes, extending to the coastal districts through the dry forest corridor of the Hunter Valley (Crome & Shields, 1992). The species occurs in eucalypts woodlands and open forests, with a ground cover of grasses and low understorey of shrubs (NPWS, 2002). This species forages primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of mosses. Breeding pairs nest in small hollow branches of Eucalypts.	**Low** This species was not recorded within the Development Estate during fauna surveys. Despite the occurrence of a record 1.2 km to the north (Atlas of NSW Wildlife data), within the Hunter Region this species occurs sparsely across the western to Central Hunter, and as such it is unlikely to occur in the Lower Hunter on more than a rare occasion.	**Low** Considered unlikely to be adversely affected by the proposal due to the Development Estate occurring outside of its normal known range.
Glossopsitta pusilla Little Lorikeet (V)	*Glossopsitta pusilla* extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. *G. pusilla* feeds on abundant flowering Eucalypts, but will also take nectar from, *Melaleuca* sp and *Mistletoe* sp. *Eucalyptus albens* (White Box) and *E. meliodora* (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. robusta* (Swamp Mahogany) and *E. pilularis* (Blackbutt). Nesting takes place in hollow bearing trees.	**High** This species was recorded within the northern area of the site. Habitat within the site is considered suitable for both foraging and roosting and records occur within the locality.	**Low – Moderate** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Ninox connivens Barking Owl (V)	Occurs in forests, woodlands, and savannah and riverine woodland although more open country is favoured for foraging and large hollow-bearing eucalypts for breeding. The Barking Owl is widespread within New South Wales, with records from coastal areas along with the slopes, plains, tablelands, and far western plains. Holland's (1991) regards the habitat of this species as open country with a choice of large trees for roosting and nesting. Prey species taken includes arrange of mammals and birds, as well as invertebrates (Readers Digest 1982). Usually occupies permanent territories, generally greater than 100 ha.	**Moderate** Not recorded during owl call back and nocturnal spotlighting surveys. A number of widely scattered records for this species occur within the Lower Hunter, including two records within similar habitat to the north and west of the Development Estate respectively. For this reason, despite the paucity of records in the Lower Hunter its intermittent presence within the site cannot be entirely discounted. However, the possibility that the site is part of the permanent home range of individuals or pairs is considered unlikely.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of considerably larger areas of potential foraging habitat within the Stockrington and Tank Paddock proposed Conservation Estates.
Ninox strenua Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas. Records from the Hunter Sub-bioregion are fairly widespread (HBOC records; RPS ecologists pers. obs.).	**High** This species was recorded within the Development Estate during nocturnal surveys. Habitat within the site is considered suitable, and records occur within the locality, including a roosting bird at Tank Paddock during associated fauna surveys. Hollows of sufficient size to represent potential breeding sites for this species were noted during habitat assessment.	**Low – Moderate** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Tyto novaehollandiae Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and prefers to roost in these hollows as well. Records from the Hunter Sub-bioregion are fairly widespread within the sub-coastal districts and often of road kill birds (HBOC records; RPS ecologists pers. obs.).	**High** This species was heard calling within the site's riparian corridor during nocturnal surveys and records occur to the north (Atlas of NSW Wildlife data) and within the proposed Conservation Estates at Tank Paddock (Atlas of NSW Wildlife data; Green Corridor Coalition). Hollows of sufficient size to represent potential breeding sites for this species were noted during habitat assessment.	**Low** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Tyto tenebricosa Sooty Owl (V)	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows. Most Hunter records exist from the Watagan mountains (Atlas of NSW Wildlife data), but this species has also been observed to the southwest of Awaba (RPS ecologist pers. obs.).	**Low** Despite the presence of mesic vegetation assemblages within the forested drainage lines of the site, these communities are not considered to be of sufficient extent or structural complexity to support this species.	**Low** The current proposal is unlikely to impact upon this species due to a lack of suitable habitat within the Development Estate, however other areas that are more suited to this species will be retained as Conservation Estates at Stockrington and Tank Paddock within the current proposal.
Ptilinopus magnificus Wompoo Fruit Dove (V)	Ranges from Cape York (Qld.) along the coast and ranges south to the Hunter River (N.S.W.), with the southern end of the range decreasing having once extended to Nowra. This Fruit-Dove is a frugivorous rainforest specialist inhabiting the canopy of sub-tropical, warm-temperate and depauperate rainforests. Occasionally it will stray to fruiting trees outside of rainforest areas. Breeding occurs between July and December and is linked to the fruiting cycles of favoured feed trees including figs, laurels, myrtles and native tamarind. This species prefers relatively undisturbed to completely undisturbed rainforest.	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species. Therefore the chance of occurrence is considered low. Atlas of NSW Wildlife records occur within proposed Conservation Estates west of Stockrington.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate. Retained areas of potential foraging habitat occur within the proposed Conservation Estates at Stockrington.
Ptilinopus regina Rose-crowned Fruit Dove (V)	Ranges through Eastern Australia, from Cape York south to the vicinity of Port Stephens. Occasionally it extends into Victoria. The Rose-crowned Fruit Dove generally lives in rainforest, though it also frequents brushes of coastal districts as well as forests and mangroves. It usually feeds on figs or other fruit and berry-bearing trees.	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species. Therefore the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Ptilinopus superbus Superb Fruit Dove (V)	Occurs from north-eastern rainforest, forest and mangroves north of Cardwell, Qld; becoming uncommon nomads or non-breeding migrants further south to the Hunter River, with rare sightings recorded south to Tasmania. It is mainly a rainforest inhabitant but will feed in adjacent mangroves or Eucalypt forest, venturing into coastal brushes also at various times of the year. It usually feeds on figs or other fruit and berry-bearing trees.	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species. Therefore the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Mammals			
Dasyurus maculatus Spotted-tailed Quoll (V, V*)	Found sparsely across a relatively wide variety of habitats from coastal heathland to rainforest habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally, it does not occur in otherwise suitable habitats that are in close proximity to urban development. Local records for this species only occur with a level of regularity within large tracts of undisturbed forest as occurs in ranges surrounding the region.	**Low** This species was not recorded within the site during fieldwork. Potential habitat for this species within the site is not considered as highly favourable, due to the lack of extensive areas of high quality habitat. This species is not tolerant of human disturbance and is known to occur within extensive tracts of undisturbed habitat, which do not occur within the site. Furthermore, the site has only limited connectivity to extensive areas of more suitable habitat to the south. Therefore the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat resources and proximity to human disturbances.
Phascogale tapoatafa Brush-tailed Phascogale (V)	Inhabits dry open forest and woodlands, often in areas with sparse groundcover. It is one of the most arboreal Dasyurids and mainly hunts invertebrates, although some vertebrate prey is taken on occasion. Utilises small tree hollows for nesting and refuge sites.	**Low** This species was not recorded within the site during fieldwork. Habitat within the site is not considered ideal for this species due to limited nesting and refuge sites. Previous records of this species are limited to areas north of the Hunter river (Atlas of NSW Wildlife data). Therefore the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat resources and records of this species within the Development Estate and its locality.
Petaurus australis Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Most records in the Lower Hunter Region occur in the Watagan Mountains and other areas exhibiting significant stands of forest (Atlas of NSW Wildlife data).	**Low – Moderate** Not recorded during the survey. Some habitat within the Development Estate is considered as containing potential foraging opportunities and potential breeding hollows were noted in riparian vegetation during habitat assessment. Atlas of NSW Wildlife records occur within proposed Conservation Estates west of Stockrington and feeding scars that are consistent with those of tis species were observed in the Stockrington Conservation Estate along George Booth drive.	**Low** The current proposal is likely to remove some potential habitat for this species within the Development Estate, however habitat areas highly suited to this species will be retained as Conservation Estates at Stockrington and Tank Paddock within the current proposal.
Petaurus norfolcensis Squirrel Glider (V)	Occurs in Eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. Widely distributed across the lower Hunter Sub-bioregion, few records from the Upper Hunter (Atlas of NSW Wildlife data).	**Moderate** Not recorded during surveys although records exist within the immediate vicinity to the north and locally to the west of the site (Atlas of NSW Wildlife data). Habitat within the Development Estate is considered suitable as the closely related *P. breviceps* was recorded during nocturnal surveys. Atlas of NSW Wildlife records occur within proposed Conservation Estates west of Stockrington. Feeding scars that may be attributable to this species were observed in dry forest occurring within the Stockrington Conservation Estate.	**Low** Although the proposed Development Estate may represent a small incremental loss of potential habitat for this species, larger areas containing abundant foraging and sheltering habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particularly *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions. Records from the Hunter Sub-bioregion are generally scarce, with a small number of records from Cessnock, Singleton and Muswellbrook LGA's. Within the Greater Hunter Region it is largely confined to the Port Stephens area, the Lake Macquarie hinterland and the Watagan Mountains (Atlas of NSW Wildlife data).	**Low – Moderate** This species was not recorded within the proposed Development Estate during the survey. Whilst Koala feed tree species occur within the Development Estate there is a scarcity of local records from within the wider locality.	**Low** The provision of corridors for fauna including Koalas will be maintained within the proposed Conservation Estates to the west and north at Stockrington and Tank Paddock respectively. Therefore, it is unlikely that the current proposal will represent a significant threat to local populations of this species.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. Frequently observed to forage in flowering Eucalypts. May occur anywhere within the Hunter Sub-bioregion where food or roosting resources are available.	**High** Recorded within the proposed Development Estate during nocturnal surveys. There are no roosting camps for this species in the vicinity of the site. Extensive foraging habitats and potential roosting camp sites occur within the proposed Stockrington Conservation Estates.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Miniopterus schreibersii subsp oceanensis Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat. Widely distributed across the Hunter Sub-bioregion, particularly in sub-coastal districts (Atlas of NSW Wildlife data). A number of records for this species occur within the vicinity of the site.	**High** This species was not detected within the Development Estate during this survey, but has previously been recorded within the site (Atlas of NSW Wildlife data). Although there is no suitable roosting habitat such as cave-like structures within the site or its vicinity, the site represents abundant potential foraging habitat and this species is far-ranging in its foraging habits. Therefore its occurrence on the site on at least an intermittent basis cannot be discounted.	**Low** Although the current proposal represents a small incremental loss of foraging habitat for this species, larger areas containing abundant foraging habitat will be retained as Conservation Estates at Stockrington and Tank Paddock with potential roosting habitat occurring with Stockrington under the current proposal.
Miniopterus australis Little Bentwing-bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. Largely confined to more coastal areas in the Hunter region. A number of records for this species occur within the local area (Atlas of NSW Wildlife data).	**High** This species was recorded within the proposed Development Estate during fauna surveys and it is likely that this species may use the site on at least an intermittent basis. No known potential roosting sites exist within the site. Recorded within proposed Conservation Estates at Stockrington (Atlas of NSW Wildlife data), which also contains potential roosting habitat.	**Low** Although the current proposal represents a small incremental loss of foraging habitat for this species, large areas containing abundant foraging habitat will be retained as Conservation Estates at Stockrington and Tank Paddock with potential roosting habitat occurring with Stockrington under the current proposal.
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. It roosts in tree hollows, under bark and within man-made structures. Found within a scattered distribution across the Lower Hunter Region. Locally it occurs within the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	**Moderate – High** Not recorded within the proposed Development Estate, however there are records occurring within the vicinity of the site to the north (Atlas of NSW Wildlife). Due to the high mobility of this species the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. Potential roosting sites in the form of tree hollows exist in low to moderate numbers throughout the site.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Occurs in a range of habitats from rainforest to arid Shrubland, roosts in tree-hollows. Near coastal records occur to the south in the Wyong and Gosford LGAs (Atlas of NSW Wildlife data).	**Moderate – High** Not recorded within the proposed Development Estate, however there are records occurring within its near locality to the north (Atlas of NSW Wildlife). Due to the high mobility of this species the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Few records occur within the Hunter Sub-bioregion.	**Moderate – High** Not recorded within the proposed Development Estate, however there are records occurring within its near locality to the north (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging and roosting habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Chalinolobus dwyeri Large-eared Pied Bat (V)	This species forages in tall open forests, including dry forests and the edges of rainforest. It roosts in mine shafts and similar structures. Hunter Region records for this species are largely confined to the Watagan Mountains (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however there are records occurring within its wider locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat within the Development Estate, it is possible that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Myotis adversus Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Roosts in colonies of between a dozen and several hundred individuals in caves, mines and disused railway tunnels (Atlas of NSW Wildlife data).	**Low – Moderate** Not recorded within the proposed Development Estate, however there are records occurring within the wider locality (Atlas of NSW Wildlife). Despite the high mobility of this species there is an absence of potential foraging habitat within the Development Estate; therefore this species is unlikely to occur within the site apart from transitory movements. No known potential roosting sites exist within the site.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows and is relatively widespread within the Lower Hunter Region (Atlas of NSW Wildlife data).	**Moderate – High** Not recorded within the proposed Development Estate, however there are records occurring within its vicinity to the north (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging and roosting habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Vespadelus troughtoni Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas. The distribution of this species is largely to the north of the Hunter (Strahan 1995), with one record at Windermere Park in south-western Lake Macquarie (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however there are records occurring within its locality (Atlas of NSW Wildlife). Due to the high mobility of this species the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** The proposed Development Estate will result in an incremental loss of potential foraging habitat. However no known potential roosting habitat will be lost, and larger areas of potential foraging and roosting habitat will be retained as Conservation Estates under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Endangered Ecological Communities			
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin & South East Corner bio-regions	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Wetlands or parts of wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum*, *Leersia hexandra* and *Carex appressa*. Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata*. Correlates with LHCCREMS Map Unit (MU) 46 – 'Freshwater Wetland Complex'.	**Low** This community was not recorded to occur within the site.	**Low** Those areas where this community exists will be retained as Conservation Estates within the current proposal.
Lower Hunter Redgum Forest in the Sydney Basin and NSW Coast Bioregions	Fund on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor in the Sydney Basin and NSW North Coast Bioregions. Recorded from the local government areas of Maitland, Cessnock and Port Stephens (in the Sydney Basin Bioregion) and Muswellbrook and Singleton (in the NSW North Coast Bioregion) but may occur elsewhere in these bioregions. Common canopy tree species are *Eucalyptus tereticornis* (Forest Red Gum) and *E. punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora costata*, *Corymbia maculata*, *E. crebra* and *E. moluccana*. The mid-storey is open and characterised by sparse shrubs such as *Breynia oblongifolia*, *Leucopogon juniperinus*, *Daviesia ulicifolia* and *Jacksonia scoparia*. The ground cover typically comprises grasses and herbs. Correlates with LCCREMS Map Unit (MU) 19 'Hunter Lowland Redgum Forest'.	**Low** This community was not recorded to occur within the site.	**Low** Due to the lack of occurrence of this EEC within the site, the likely level of impact is considered low.
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.	This community is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark) with occasional occurrences of *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark). Several distinctions have been noted within the LHCCREMS community profiles between this community and other Spotted Gum / Ironbark associations, often characterised by the dominant canopy composition, range, soil type and topography (NPWS 2000). Within the Lower Hunter, the peak of distribution occurs within the forested areas between Beresfield and Cessnock. On the basis of revised vegetation mapping conducted in 2002, a total of 32,366ha of LHSGIF has been mapped within the LHCCREMS study area boundary. Correlates with LCCREMS Map Unit (MU) 17.	**High** The geomorphological characteristics and the species composition of this vegetation community were found to occur within the site.	**Low - Moderate** Whilst this community comprises the greater proportion of this site, due the widespread occurrence of this community on a regional basis, and the retention of areas of this EEC within the proposed Conservation Estates, the proposed development represents a small incremental loss.
Lowland Rainforest of the NSW North Coast and Sydney Bioregion	Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions.	**Low** This community was not found to occur within the site.	**Low** Due to the lack of occurrence of this community within the site, it is considered that the current proposal will have a low level of impact.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions	This community is associated with periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, typically occurring on grey-black clay-loams and sandy loams. Usually occurring below 20 m altitude. Within the site this community correlates with LHCCREMS MU 40 'Swamp Oak – Rushland Forest'.	**Low** This community was not found to occur within the site.	**Low** Due to the lack of occurrence of this community within the site, it is considered that the current proposal will have a low level of impact.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	The community is associated with humic clay or sandy loams on waterlogged or episodically flooded alluvial flats and drainage lines within coastal floodplains. It is generally characterised by an open to dense canopy of Eucalypts and / or Paperbarks. Canopy heights generally vary from 8m to 25m depending on species composition. In the Hunter Region the canopy often contains *Eucalyptus robusta* and / or *Melaleuca quinquinervia* although other species, such as *Casuarina glauca*, *Eucalyptus resinifera* subsp. *hemilampra* and *Livistona australis* may be present. Within the site this community correlates with LHCCREMS MU 42 'Riparian Melaleuca Swamp Woodland' and MU 37 'Swamp Mahogany - Paperbark Forest'.	**Low** This community was not found to occur within the site.	**Low** Due to the lack of occurrence of this community within the site, it is considered that the current proposal will have a low level of impact.

Notes: (V) = Vulnerable Species listed under the *Threatened Species Conservation Act 1995*.
(E) = Endangered Species listed under the *Threatened Species Conservation Act 1995*.
(V*) = Vulnerable Species listed under the *Commonwealth EPBC Act 1999*.
(E*) = Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(CE*) = Critically Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(M*) = Migratory Species listed under the *Commonwealth EPBC Act 1999*.

6.2 Assessment of Threatened Species, Populations and Ecological Communities

As per the assessment carried out within Table 6-1, the following species / communities have been deemed appropriate to be applied further detailed assessment due to projected potential levels of impacts likely to result from the proposal.

Flora

- *Caladenia tessallata* (Thick Lip Spider Orchid)
- Callistemon linearifolius (Netted Bottlebrush)
- *Diuris praecox* (Newcastle Doubletail)
- *Grevillea parviflora* subsp. *parviflora* (Small Flowered Grevillea)
- *Rutidosis heterogama* (Heath Wrinklewort)

Endangered Ecological Communities

- Lower Hunter Spotted Gum Ironbark Forest of the Sydney Basin Bio-region.

Fauna

- *Callocephalon fimbriatum* Gang-gang Cockatoo
- *Pomatostomus temporalis* Grey-crowned Babbler
- *Melithreptus gularis gularis* Black-chinned Honeyeater
- *Lathamus discolor* Swift Parrot
- *Glossopsitta pusilla* Little Lorikeet*
- *Ninox strenua* Powerful Owl
- *Tyto novaehollandiae* Masked Owl
- *Petaurus norfolcensis* Squirrel Glider
- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Miniopterus schreibersii* Eastern Bentwing-bat
- *Miniopterus australis* Little Bentwing-bat
- *Mormopterus norfolkensis* Eastern Freetail-bat
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Falsistrellus tasmaniensis* Eastern False Pipistrelle
- *Chalinolobus dwyeri* Large-eared Pied Bat
- *Scoteanax rueppellii* Greater Broad-nosed Bat
- *Vespadelus troughtoni* Eastern Cave Bat

6.2.1 Threatened Flora

It should be recognised (as alluded to below) that potential habitat for unrecorded species does exist within the site, including in areas that were not intensively surveyed during these investigations. The following species are considered to have potential habitat within the Black Hill Development Estate.

***Diuris praecox* (Newcastle Doubletail)**

Diuris praecox was not recorded, despite targeted surveys within the flowering period. However, the cryptic nature of this orchid, combined with sporadic flowering makes it difficult to detect. Suitable habitat for this species exists within the Development Estate and as such it has been addressed here even though it was not recorded.

As a precautionary approach, areas of vegetation communities that have been known to support this cryptic orchid have been included in calculations of potential habitat within the Development Estate. Potential habitats for *Diuris praecox* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, (approximately 132ha). However, some of the areas within this community contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid. An example of these differences in habitat is the understory, portions of the LHSGIF have dense thickets of *Melaleuca nodosa* and it is highly unlikely that this species would be present within this type of habitat. As such, the potential habitat calculations given above are likely to be an overestimate.

A number of records of this species occur to the east of the Northern Estates, along the coast between Merewether and Tingira Heights. The species was not recorded within the Development Estates despite targeted surveys.

Notably, approximately 545ha of potential habitat will be protected within the Stockrington and Tank Paddock Conservation Estates. However, approximately 132.9ha of potential habitat will be removed as part of the proposal within the Black Hill Development Estate, representing an incremental local loss of habitat in the locality.

***Caladenia tessellata* (Thick Lip Spider Orchid)**

Caladenia tessellata was not recorded, despite targeted surveys within the Development Estates. However, the cryptic nature of this orchid, combined with sporadic flowering makes it difficult to detect. Suitable habitat for this species exists within the Development Estates and as such it has been addressed here even though it was not recorded.

As a precautionary approach, areas of vegetation communities that have been known to support this cryptic orchid have been included in calculations of potential habitat within the Development Estate. Potential habitats for *Diuris praecox* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, (approximately 132ha). However, some of the areas within this community contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid. An example of these differences in habitat is the understory, portions of the LHSGIF have dense thickets of *Melaleuca nodosa* and it is highly unlikely that this

species would be present within this type of habitat. As such, the potential habitat calculations given above are likely to be an overestimate.

Considering the cryptic nature of this species, it is not known whether any *C. tessellata* individuals would be removed as a result of the proposal. An incremental loss of approx 132ha of potential *C. tessellata* habitat in the locality would occur. Moreover, the proposal will result in the conservation 'in perpetuity' of 545ha of potential habitat for this species.

Given that over 545ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Callistemon linearifolius **(Netted Bottlebrush)**

This species has been recorded in both the north western and north eastern portion of the site on the Wildlife Database Atlas in 2004 and 2005 respectively. In addition a further specimen has been recorded adjoining the northern boundary. It is difficult to determine the exact location of the records as these records are accurate to ± 1 km; however the area was searched to find these plants. Several plants were located which were similar to *Callistemon linearifolius.* The leaves of these specimens were examined in detail and distinct oil dots were observed on the underside with no net veins visible. It was concluded after examination that these species were *Callistemon rigidus.*

An incremental loss of approximately 132.9ha of suitable habitat in the locality would occur as a result of the proposal. However, this species was not recorded during the survey period and approximately 363.8ha of suitable habitat will be protected within the Stockrington and Tank Paddock Conservation Estates. A population of this species was located within northern portion of the Stockrington Conservation Estates and will be protected in perpetuity.

Given that over 363.8ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Grevillea parviflora **subsp.** ***parviflora*** **(Small Flowered Grevillea)**

This species was not recorded during surveys within the Development Estate. However, potential habitat for this species occurs throughout the Lower Hunter Spotted Gum-Ironbark Forest (Approximately 132.9ha) within the Development Estate.

Given that over 363.8ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

***Rutidosis heterogama* (Heath Wrinklewort)**
Targeted searches for this species within the Black Hill Development Estate did not locate any individuals of this species. However, suitable habitat for the species exists within the Lower Hunter Spotted Gum Ironbark Forest.

An incremental loss of approximately 132.9ha of suitable habitat in the locality would occur as a result of the proposal. However, this species was not recorded during the survey period and approximately 363.8ha of suitable habitat will be protected within the Stockrington and Tank Paddock Conservation Estates. In addition a large population of this species was located within the western portion of the Stockrington conservation estates and will be conserved in perpetuity.

Given that over 363.8ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

6.2.2 Endangered Ecological Communities

One of the EECs listed in Section 5 is present within the site, being (LHSGIF). The impacts upon extant EECs within the Development Estate are summarised below.

Lower Hunter Spotted Gum Ironbark Forest
This vegetation community encompasses the majority of the Development Estate. Approximately 132 ha within the site. However approximately 131.46 ha will be conserved within the Conservation Estates to the south west of the Black Hill site. Given that 131.46 ha of this EEC will be reserved within the northern lands Conservation Estates in addition to that secured under the Minmi Link Road proposal approx 181.66ha, it is considered highly unlikely that removal of this EEC will significantly compromise the viability of the local stand. The LHCCREMS mapping project has mapped over 31,000 ha of this vegetation community within the LHCCREMS study area. Thus the removal of 0.4% of this community within the Lower Hunter Valley as a result of the Black Hill proposal is unlikely to have a significant impact upon this EEC.

6.2.3 Threatened Fauna

Gang-Gang Cockatoo
Although not observed within the site, records for this species occur within 1 km to the north of the Development Estate (Atlas of NSW Wildlife data). The records occur within Lower Hunter Spotted Gum Ironbark Forest that is continuous with similar habitat within the site. This species moves widely during some seasons into such habitat from its more usual montane habitats in response to variations in foraging resource availability. In light of the close proximity of other records and the similarity of habitat to that within the proposed Development Estate lands it is possible that this species may occur within the site on an intermittent basis. Records occur within the western extremity of lands to be retained for conservation purposes at Stockrington and in the immediate vicinity of proposed Conservation Estates at Tank Paddock. Therefore it is considered that despite a loss of some potential habitat within the proposed Development Estate the current proposal will benefit this species by securing suitable local habitat.

Grey-crowned Babbler

Records for this species occur to the west of the Development Estate within open pasture habitats punctuated with scattered stands of trees. Within the Development Estate wooded habitats are of a more closed structure, which is not consistent with the open habitats favoured by this species. Open grassy habitats are maintained on the site within power infrastructure easements, but these habitats are overgrown with rank grasses such as *Paspalum dilatatum* (Paspalum), which prevents their use as foraging habitat for this species. It is therefore considered unlikely that Grey-crowned Babblers would use the Development Estate for foraging purposes, despite the proximity of local records. Furthermore, roosting and breeding nests of Grey-crowned Babblers are associated with home-range territories, which were not observed within the site and as such it is unlikely that local birds would use the site for breeding purposes. Therefore it is unlikely that the current proposal will threaten the viability of a local population of this species.

Black-chinned Honeyeater

Although not observed within the site, records for this species occur within 2 km to the north of the Development Estate. The records occur within Lower Hunter Spotted Gum Ironbark Forest that is continuous with similar habitat within the site. This species is nomadic within such habitat in response to variations in foraging resource availability and is relatively sparse within such habitat. In light of its elusive habits and the proximity of local records its occurrence within the site on an intermittent basis cannot be entirely discounted. However, those areas in the Lower Hunter where this species can be reliably observed on a somewhat regular basis (RPS ecologist pers. obs.), are characterised by understorey strata that is more complex with regard to diversity and density than that which occurs within the Development Estate. Records occur within the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data) and this species was recorded during associated fauna surveys within proposed Conservation Estates to the west of Stockrington. Therefore it is considered that despite a loss of some potential habitat within the Development Estate the current proposal will benefit this species by securing more suitable local habitat.

Swift Parrot

This species does not occur in the Lower Hunter Region on a continuous basis, as it only moves from Tasmania into south-eastern Australia during the winter months and migrates back to Tasmania in the summer, where the population breeds. Regional records for this species occur at western Lake Macquarie, Raymond Terrace, Maitland and widely within the Cessnock LGA. Regional habitat preferences for this species are for Swamp Sclerophyll Forests containing *E. robusta* (Swamp Mahogany), Spotted Gum – Ironbark dominated vegetation communities, *E. tereticornis* (Forest Red Gum) occurrences across the Lower Hunter Region and *E. tereticornis* on the lower drainage flats and lower lakeside slopes adjacent to Lake Macquarie and Port Stephens.

While no Swift Parrots were observed within either the Conservation or Development Estates during the 2008 surveys. The widespread occurrence of *Corymbia maculata* (Spotted Gum) across large areas of both proposed Development and Conservation Estates suggests that these lands have the potential to attract Swift Parrots during those

seasons when Spotted Gum is an important winter flowering species within the central to lower Hunter Valley. Investigation of forests containing Spotted Gum during 2008 surveys found that there were only occasional Spotted Gums flowering, which were attracting small widespread parties of Noisy Friarbirds.

Although no Swift Parrots were observed within the Coal & Allied lands during the 2008 survey these results are not considered to be a representative indication of the capacity of these lands to support the Swift Parrot or Regent Honeyeaters. Overall the Conservation Estates exhibit greater habitat opportunities for these species, due to the greater extent of widespread habitat, predominantly Spotted Gum-Ironbark assemblages, ATMF, and the inclusion of riparian Forest Red Gum communities, which are likely to represent focal habitat points for these species during seasons when they occur within the locality. The absence of both of these species from the site during the winter of 2008 is consistent with the paucity of coastal and Lower Hunter records for both of these species during the 2008 season. There have been few Swift Parrot records within the region compared with previous years and no Regent Honeyeaters during the 2008 winter period. Evaluation of potential habitats within Conservation Estates suggests that there is a good probability that both of these species would use the site during favourable years within the region. However, the same assumptions are not considered to apply to the Development Estates, due to the smaller amounts of suitable habitat, lack of Forest Red Gum habitats and the somewhat isolated and to some extent fragmented nature of these lands in comparison with the extent of the Conservation Estates and their continuity to large significant forest areas in the regional context. On this basis it is concluded the proposal will benefit this species by securing local habitat in the proposed conservation estates and thus a deleterious impact on the long term viability of this transient population as a direct result of this proposal is unlikely. Nevertheless it is recommended that preferred forage tree species for *Lathamus discolor* (Swift Parrot) be included within landscaping plant schedules.

Powerful Owl

This species was recorded on three nights, within or adjacent to riparian forest at the southern end of the Development Estate and within riparian forest and open forest habitat at the northern end of the site during owl call back surveys. A roosting bird was also observed in Alluvial Tall Moist Forest within the southern section of the Tank Paddock during associated fauna studies conducted diurnally. Furthermore, there are other records for this species in the locality of the site to the north and west of the site (Atlas of NSW Wildlife data). In addition to sightings of this species, a number of arboreal mammal species were observed during spotlighting surveys, which is the favoured prey guild of Powerful Owls. Removal of vegetation within the site will reduce the area of onsite foraging habitat, although, if the riparian corridor, which represents the core Powerful Owl habitat within the site, were to remain throughout the process of development this species may remain extant within the site as part of its wider local range. Nevertheless, large areas of suitable habitat for this species will be retained as Conservation Estates. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Masked Owl

This species was recorded within the site's riparian corridor during nocturnal fauna surveys. There is also a single DECCW Wildlife Atlas record for this species to the north of the Development Estate. Other records (DECCW Wildlife Atlas) occur within lands to be retained as Conservation Estates at Stockrington (3 records) and Tank Paddock (1 record). Although some potential habitat for this species will be lost within the Development Estate, much greater areas of potentially occupied habitat will be retained as Conservation Estates. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Squirrel Glider

This species was not recorded within the site during nocturnal fauna surveys; there is a nearby Atlas of NSW Wildlife record for this species to the north of the Development Estate and another within the site's wider locality to the west. Other records occur within lands to be retained for conservation at Stockrington. Suitable foraging habitat for this species occurs throughout the Development Estate lands, although most incidences of hollow-bearing trees occur within the riparian corridor, which is not a preferred habitat for this species. While any loss of habitat must be regarded as an incremental loss of habitat for this species within the locality, much greater areas of suitable habitat for this species are to be retained as Conservation Estates under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Grey-headed Flying Fox

This species was recorded within the Development Estate lands in Lower Hunter Spotted Gum Ironbark Forest, although there is no indication that there are roosting camps for this bat in the vicinity of the site. Potential foraging habitat for this species occurs widely across the Development Estate and bushland areas within the wider locality, which is not surprising in light of the mobility of this species. A large established population of this species is known form Blackbutt Reserve in Newcastle, as such a high probability exists the individuals observed were members of this population. Although an incremental loss of potential foraging habitat for this species will occur within the Development Estate, much greater areas of suitable foraging habitat will be retained as Conservation Estates under the current proposal, including potential roosting habitat opportunities within Stockrington lands. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Eastern Bentwing-Bat

This species was not recorded within the Development Estate during fauna surveys, but other records occur within the site and within the close vicinity and wider locality of the site, including lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data). Being a species that utilises a diverse range of open forest and woodland habitats for foraging, it is likely that the Development Estate lands may be regularly used as part of its local foraging range. No potential roosting habitat is known within the site, but potential roosting sites occur within the Sugarloaf Range to the southwest. Although it is likely that an incremental loss of foraging habitat for this bat will be removed during the development process, large areas of suitable foraging habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current

proposal. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Little Bentwing-Bat

This species was recorded within the Development Estate during fauna surveys and other records occur within the vicinity and wider locality of the site, including lands to be retained for conservation purposes at Stockrington. Being a species that utilises a diverse range of open forest and woodland habitats for foraging, it is likely that the Development Estate lands may be used as part of its local foraging range. No potential roosting habitat is known within the site, but potential roosting sites occur within the Sugarloaf Range to the southwest. Although it is likely that an incremental loss of foraging habitat for this bat will be removed during the development process, large areas of suitable foraging habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Eastern Freetail-Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the site, its immediate vicinity and the wider locality. Being a species that utilises a diverse range of open forest and woodland habitats for foraging and roosting purposes, it is likely that the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range and may be used periodically for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will be removed during the development process, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Yellow-bellied Sheathtail-Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the wider locality of the site. Records from the wider locality are scarce, but onsite habitats represent continuous open forest and woodland habitat within the locality, which provide both foraging and roosting opportunities for this species. As such the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range and may be used periodically for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will be removed during the development process, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Eastern False Pipistrelle

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within similar habitat to that occurring within the site to the north. Records from the wider locality are scarce, but onsite habitats represent continuous open forest and woodland habitat within the locality, which provide both foraging and roosting opportunities for this species. As such the Development Estate

lands may be used on at least an intermittent basis as part of its local foraging range and may be used periodically for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will occur during the development process, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Large-eared Pied Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the wider locality of the site. Records from the wider locality are scarce, but onsite habitats represent continuous open forest and woodland habitat within the locality, which provide foraging opportunities for this species. There are potential roosting opportunities occurring within the Sugarloaf Range to the south. As such, the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will be removed during the development process, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Greater Broad-nosed bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within similar habitat to that occurring within the site to the north. Records from the wider locality are relatively scarce, but onsite habitats represent continuous open forest and woodland habitat within the locality, which provide both foraging and roosting opportunities for this species. As such the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range and may be used periodically for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will occur during the development process, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

6.2.4 Additional Threatened Fauna Species

The list of threatened species generated from the 10 km search included a number of species that are considered to have a low chance of occurrence within the Development Estate based on the lack of suitable habitat within the Development Estate. The requirements of these species include specific coastal, wetlands or inland habitats. For this reason, the following species were omitted from the Assessment of Significance.

- *Anseranas semipalmata* Magpie Goose
- *Stictonetta naevosa* Freckled Duck
- *Charadrius leschenaultia* Greater Sand-plover
- *Calidris tenuirostris* Great Knot
- *Chelodina mydas* Green Turtle

- *Charadrius mongolus* Lesser Sand-plover
- *Pterodroma leucoptera* Gould's Petrel
- *Pterodroma solandri* Providence Petrel
- *Sterna albifrons* Little Tern
- *Haematopus longirostris* Pied Oystercatcher
- *Irediparra gallinaceae* Comb-crested Jacana
- *Pandion cristatus* Osprey
- *Hamirostra melanosternon* Black-breasted Buzzard
- *Ephippiorhynchus asiaticus* Black-necked Stork
- *Ixobrychus flavicollis* Black Bittern
- *Limicola falcinellus* Broad-billed Sandpiper
- *Limosa limosa* Black-tailed Godwit
- *Oxyura australis* Blue-billed Duck
- *Rostratula australis* Australian Painted Snipe
- *Xenus cinerius* Terek Sandpiper

6.3 Key Threatening Process (KTP)

A Key Threatening Process (KTP) is defined in the *TSC Act (1995)* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

> *adversely affects two or more threatened species, populations or ecological communities;* or
>
> *could cause species, populations or ecological communities that are not currently threatened to become threatened.*

Key Threatening Processes are listed in Schedule 3 of the *TSC Act*. Those potentially applicable to the proposal are as follows:

- Loss of Hollow-bearing trees;
- Clearing of native vegetation;
- Human-caused climate change;
- Infection of native plants by *Phytophthora cinnomomi*;
- Invasion of native plant communities by exotic perennial grasses;
- Removal of dead wood and dead trees;
- Predation by the Feral Cat;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and

wetlands;

- Lantana camara; and
- Predation by the European Fox.

Loss of Hollow-bearing trees

The proposed development will require the removal of some hollow-bearing trees and as such is considered as contributing to the Key Threatening Process "Removal of Hollow-bearing Trees". It is expected that low – moderately high numbers of hollow-bearing trees will be removed, depending on the vegetation community removed. LHSGIF has the lowest incidence of hollow-bearing trees, due to the relatively low age cohort of most trees throughout this community. ATMF contains large mature trees, which have the potential for carrying a range of different sized hollows. Those guilds of threatened fauna that may potentially be affected by this KTP are threatened Microchiropteran bats, forest owls and arboreal mammals including gliders.

Although hollow-dwelling Microchiropteran bats may use hollows on the site for shelter on an intermittent basis, the securing of large areas of potential roosting habitat within lands to be retained as Conservation Estates at Stockrington and Tank Paddock will ensure that significant areas of local habitat for these species will be protected.

Although not recorded Squirrel Gliders potentially occurring within the Development Estate may be adversely affected by the removal of hollow-bearing trees, due to their use of this habitat resource for nesting purposes. However, large areas of suitable habitat for this species will be secured within lands to be retained as Conservation Estates at Stockrington and Tank Paddock.

There are low numbers of large hollow-bearing trees occurring within the riparian corridor of the Development Estate that are suitable for the breeding purposes of forest owl species. The removal of these resources could adversely affect Powerful and Masked Owls that might potentially use the site for breeding purposes. Nevertheless, large areas of suitable breeding habitat for these species will be secured within lands to be retained as Conservation Estates at Stockrington and Tank Paddock.

It is considered that although the proposal is likely to represent a loss of locally occurring hollow-bearing trees, these losses are more than adequately compensated for by a greater abundance of similar and greater quality habitat that will be secured as Conservation Estates at Stockrington and Tank Paddock.

Clearing of Native Vegetation

The proposed development will require the removal of native vegetation and as such is considered to contribute to the Key Threatening Process "Clearing of Native Vegetation". Vegetation that will be removed for the Development Estate will include native vegetation community includes, LHCCREMS MU 17 Lower Hunter Spotted Gum Ironbark Forest. This vegetation community is equivalent to Lower Hunter Spotted Gum Ironbark Forest EEC (LHSGIF). Approximately 132.92 ha of LHSGIF EEC occur within the Development Estate and will be removed as part of the proposal. However, approximately 131.46 ha of

LHSGIF will be secured outside the Development Estate as Conservation Estates within the proposal. Alluvial Tall Moist Forest and Hunter Valley Moist Forest will also be removed as part of the proposal. However, whilst these areas will be removed for the development proposal over 2,000 ha of native vegetation will be retained within the Conservation Estates to the west of the Development Estate and these lands will be set aside for conservation purposes in perpetuity.

A number of threatened fauna guilds potentially use these lands for foraging, including, insectivorous Microchiropteran bats, nectivorous species such as flying-foxes, birds and arboreal mammals and forest owls. As such removal of vegetation within the Development Estate has the potential to impact upon local populations of dependant species. Those threatened species, including potentially occurring species, which may be affected by the proposal include, Squirrel Gliders, Grey-headed Flying-foxes, Microchiropteran bats and Swift Parrots. It is considered that although the proposal is likely to represent a loss of locally occurring native vegetation, these losses are more than adequately compensated for by a greater abundance of similar and greater quality habitat that will be secured as Conservation Estates at Stockrington and Tank Paddock.

Threatened flora species, which are considered to potentially have individuals displaced by the Development Estate are *Callistemon linearifolius* and *Diuris praecox*. However, there is abundant habitat of much greater quality throughout the site for each of these species that will be secured as Conservation Estates within the current proposal.

For all of these species and communities, it is considered that the removal of vegetation from within the site will not represent a significant impact upon locally occurring entities, in light of the much greater areas of similar or higher quality habitat that will be secured as Conservation Estates within the current proposal, although vegetation removal must be viewed as an incremental loss of potential habitat for these species.

Human caused climate change

The proposal is likely to contribute to the Key Threatening Process "Human Caused Climate Change" as a result of clearing vegetation. It is considered that clearing and modification of the landscape would constitute only a minor incremental increase in the effects of this KTP. Thus the extent to which the proposal could contribute to this process is considered unlikely to be significant.

Infection of native plants by Phytophthora cinnamomi

Phytophora cinnamomi is a water mould (like a fungus) that attacks the roots of susceptible plants, in many cases killing the plant. In some native plant communities, epidemic disease can develop causing death of large numbers of plants. This water mould has recently been discovered in the Sydney region and within the Barrington Tops and is becoming more widespread within NSW.

P. cimmomoi may spread with the movement of infected soil or plant material by people, animals and may be transported by percolating through the soil, in creeks or stormwater runoff. People can also transport the fungus to new areas on dirt adhering to vehicles, items they are carrying or footwear.

Humans have the capacity to spread the fungus long distances and across barriers which sets up apart from the natural mechanisms which normally spread this water mould. Therefore, not a lot can be done to control the natural spread of the water mould or to destroy it, in native plant communities. Due to the use of heavy machinery that will be used for construction of the Development Estate, there is opportunity for the KTP "Infection of native plants by *Phytophthora cinnomomi*". The transportation of *Phytophthora cinnomomi* from other areas may occur by the movement of soils attached to earth moving machinery. Precautionary measures such as cleaning of machinery prior to clearing can help limit the potential for this KTP to occur, and should be addressed in Environmental Management plans generated for site construction activities.

Invasion of native plant communities by exotic perennial grasses

There is opportunity for the KTP "Invasion of native plant communities by exotic perennial grasses" to occur within the site due to the removal of vegetation and the exposing of underlying soils. For the most part, this KTP already occurs within weeds and cleared areas of the site. It is expected that those measures employed to reduce potential sediment and erosional impacts to surrounding areas will contribute to minimising the potential for this KTP to impact upon surrounding lands.

Removal of dead wood and dead trees

During the clearing of vegetation within the site a number of dead trees are likely to be removed and this may represent the KTP "Removal of dead trees and dead wood". Within the Development Estate land there is a relatively low incidence of these habitat attributes and it is unlikely that this KTP will represent a significant threat to threatened species occurring within the site, provided an ecologist is present during clearing works. Consideration should be given to selective relocation of dead trees and logs into Conservation Estates.

Predation by feral cats

The increase of industrial development within the area has the potential to increase opportunities for the KTP "Predation by feral cats". This KTP is unlikely to significantly impact upon local wildlife provided responsible pet ownership is encouraged and adopted.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The displacement of natural vegetation communities combined with industrial development is likely to increase the opportunity for the KTP "Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands". This is due to increased water flows and runoff potentials as a consequence of water falling upon manmade surfaces. Of greatest risk with regard to this KTP are downstream wetland vegetation assemblages including EEC's and fauna associated with these communities such as threatened waterbird species and other aquatic fauna. Impact to these threatened entities will be prevented by the implementation of sediment and water management plans during the planning and construction phases of development and suitable stormwater runoff treatment and control, coupled with riparian vegetation retention.

Lantana camara

There is a small opportunity for *Lantana camara* to establish, due to the removal of canopy vegetation and the exposing of underlying soils. This exotic plant species already occurs within the Development Estate in relatively high densities in the Alluvial Tall Moist Forest in the centre of the site. It is likely that the development will considerably reduce the incidence of Lantana within the Development Estate. Nevertheless there will still be opportunities for this KTP at the edges of the development without appropriate management. It is expected that those measures employed to reduce potential sediment and erosional impacts to surrounding areas will contribute to minimising the potential for this KTP.

Predation by the European Fox

The removal of vegetation and hence habitat for this species has the potential to increase habitat competition within retained areas and the Conservation Estates. As such this may contribute to an increase in the KTP "Predation by the European Fox". If appropriate management measures are employed by the land manager (currently Coal & Allied and DECCW in the long term) this KTP should not have a significant impact on the local wildlife.

No other KTP's are believed to be relevant to the current proposal.

6.4 SEPP 44 (Koala Habitat Protection)

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

6.4.1 First Consideration – Is the Land 'Potential Koala Habitat'?

Schedule 2 of State Environmental Planning Policy (SEPP) No. 44 – 'Koala Habitat Protection' lists 10 tree species that are considered indicators of 'Potential Koala Habitat'. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for 'Potential Koala Habitat'. SEPP 44 defines potential Koala Habitat as:

> *"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".*

One tree species listed in Schedule 2 of SEPP No. 44 – 'Koala Habitat Protection' occurs on site, namely, *Eucalyptus punctata* (Grey Gum), was found to occur within the Development Estate. In addition to this species a further eight species listed within the LHCCREMS fauna survey guidelines (Murray *et al*. 2002) as Koala feed and browse trees, occur within the site including, *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *C. maculata* (Spotted Gum), *E. acmenoides*

(White Mahogany), *E. capitellata* (Brown Stringybark), *E. grandis* (Flooded Gum), *E. paniculata* (Grey Ironbark) and *E. umbra* (Broad-leaved White Mahogany).

A. costata, *C. gummifera*, *E. capitellata*, *E. punctata* and *E. umbra* occur as low density trees within Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) at individual densities < 15%, but with inclusive densities > 15%. *C. maculata* occurs widely within LHSGIF at a density > 15% of total canopy cover.

E. acmenoides, *E. grandis*, *E. paniculata* and *E. punctata* occur with Tall Alluvial Moist Forest (ATMF) at individual densities > 15% of total canopy cover.

Based upon the density of *E. punctata* alone ATMF can be regarded as 'Potential Koala Habitat' according to the provisions of SEPP 44, but based upon locally occurring Koala feed trees, as listed within regional fauna survey guidelines (Murray *et al*. 2002), both LHSGIF and ATMF should be considered as 'Potential Koala Habitat', due to the widespread occurrence of potential foraging trees within the Development Estate.

6.4.2 Second Consideration – Is the Land 'Core Koala Habitat'?

Searches were made for any secondary indications of Koalas on the Development Estate including scats, scratches on tree trunks, scent markings on tree trunks, tracks in the soil and audible noises including territorial or mating calls, fighting and movement in the trees. Searches for direct observations of Koalas were also conducted during nocturnal surveys. No animals were noted on site and no secondary evidence of the presence of Koalas could be found.

Apart from those records that occur north of the Hunter River, Koala records in the Lower Hunter Valley are very sparse; the nearest record to the Development Estate being a record some 7 km to the west of the site. Additionally, there is a recent record from LHSGIF adjacent to the Newcastle Link Road approximately 8 km to the south of the site (RPS ecologists pers. obs.). Due to the absence of evidence to suggest otherwise, targeted Koala surveys across the Link Road site assessed the observation as transitory movements by an unattached individual and not that of a sedentary animal representing a part of an insitu population. Despite the occurrence of 'Potential Koala Habitat' within the site, the lack of indications within the Development Estate suggest that Koalas are not using the Development Estate as part of the range of a local population. As such, it is considered that no further provisions of this policy apply to the site.

6.5 SEPP 14 (Coastal Wetlands)

Mapping of SEPP 14 'Coastal Wetlands' was consulted to determine if vegetation within the vicinity of the site might be deemed as Coastal Wetlands under the SEPP. SEPP 14 Coastal Wetlands were found to occur some 2.3 km to the north of the Development Estate. Viney Creek, which flows through the Development Estate lands, enters Woodberry Swamp to the north which is listed as a SEPP 14 wetland under the SEPP. As such, there is potential for alterations in the flow regimes of onsite watercourses to change water flow characteristics where onsite water enters these wetlands. Impact to

these threatened entities will be prevented by the implementation of sediment and water management strategies during the planning and construction phases of development by incorporating suitable stormwater runoff treatment and control, coupled with riparian vegetation retention and rehabilitation.

Therefore no further provisions of this policy apply to the site.

6.6 Groundwater Dependant Ecosystem's

It is highly unlikely that any additional vegetation communities to that aforementioned which are present within the Black Hill Development Estate are groundwater dependent. However, it is recommended that appropriate water sensitive design via the provision of surface water detention basins or swales to limit peak flows is implemented to protect the Riparian vegetation of Alluvial Tall Moist Forest within the Development Estate.

6.7 Corridors

Within the Lower Hunter region there are numerous reports, strategies, policies and stakeholder expectations surrounding corridor form, function, establishment and management all of which are of key relevance to Greenfield release sites. Of key relevance to the Coal and Allied Lower Hunter Lands Project are the following:

- Lower Hunter Regional Strategy;
- Lower Hunter Regional Conservation Plan;
- Western Corridors Study (WCS);
- In principle the Water Management Act; and
- Plans of Management associated with local conservation reserves.

The proposed land dedication of the Tank Paddock as a component of this proposal and the Stockrington conservation area that will be dedicated to the NSWG in consideration for development rights at Coal & Allied's Minmi/Link Rd estate, will consolidate a long sought after regional corridor for the Lower Hunter running from the Watagan Range to Stockton Bight. Further to its corridor function, the size of the Stockrington land holding will provide an area of vast habitat opportunities for regional flora and fauna.

In addition to the aforementioned land dedication, environmental provisions have been made in and around the proposed development estates. Firstly the WCS seeks to provide west to east corridor opportunities within all new developments for the locality to cater for regional faunal movements. While these corridors will generally be linear in nature, they will also provide further habitat for resident fauna. At a local scale, the proposed riparian zone within the Development Estate provides such a habitat corridor. To provide further corridor surety an additional corridor has been proposed along the eastern boundary abutting the F3.

The proposal seeks to encompass the intent of the Water Management Act where the riparian corridor has been established based on the developments stormwater management requirements. Furthermore, secondary uses within these areas have been minimised, as such bushfire Asset Protection Zones have been provided for outside the riparian corridors.

At a landscape scale, it is considered the proposal delivers a sound development and conservation outcome where the built environment has made way for the biophysical, thus greatly assisting in the maintenance of local ecological character and faunal movements.

6.8 Environmental Management & Impact Mitigation

This section of the report has been included to provide the reader with an 'in principle' elucidation of the Statement of Commitment (SoC) outlined within the overarching EA report. Specifically, Coal & Allied's intent to manage the retained open spaces, riparian corridors within the development areas and conservation land edge zones adjacent to the development areas for predetermined periods. Coal & Allied proposes entering into a Voluntary Planning Agreement (VPA) with Newcastle City Council to manage all local open space and other areas proposed to be dedicated to Council for 5 years or until the adjacent development is completed whichever the later.

While the end user agencies (Newcastle City Council) future management will be in line with their internal practices, a VPA will provide a 'stepping stone' for the environmental management during construction periods. On completion of the VPA periods the lands will be dedicated to Newcastle City Council in the case of the open space associated with the development area.

Generally the proposed VPA will cover issues such as biodiversity maintenance, stormwater management both permanent and temporary, ecological and bushfire management, cultural and natural heritage which will be consistent with other related Plans of Management that the SoC sets out and strategies for the region. This should not necessarily be construed as a comprehensive list.

7 Key Thresholds Assessment (Part 3A)

As required by the Draft *Guidelines for Threatened Species Assessment* for Part 3A applications (DEC / DPI 2005), the following assessment of Key Thresholds is provided for the proposed Development Estate at Black Hill.

1. **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

It is considered that the information presented within this document, and in particular the proposal that includes the proposed land dedication to the NSWG for the site as detailed within the concept plan and this EAR, is likely to result in a maintained if not an improved long term outcome for biodiversity within the region.

2. **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

The threatened species, populations and ecological communities considered within the report occurring within the proposed Development Estate are well represented in the proposed conservation estates and wider locality, and are also represented or have potential habitat within other conservation lands and considered unlikely to reduce the long-term viability of a local population of species or endangered ecological community.

3. **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

The threatened species, populations and ecological communities considered within the report occurring within the proposed Development Estate are well represented in the proposed dedication lands and wider locality, and are also represented or have potential habitat within other conservation reserves and considered unlikely to be placed at risk of extinction.

4. **Whether or not the proposal will adversely affect critical habitat.**

There is no declared “Critical Habitat” within the Black Hill Development Estate locality, and as such the proposal will not adversely affect any such habitat.

7.1 Offsetting Principles (Lower Hunter Regional Conservation Plan: Appendix 1)

In order to comply with the broader biodiversity objectives of the DGEARs, an assessment against the Offsetting Principles outlined within Appendix 1 of the Lower Hunter Regional Conservation Plan has been undertaken herewith.

1. Impacts must be avoided first by using prevention and mitigation measures. Offsets are then used to address remaining impacts.

The Development Estates have been selected within areas of previous disturbance and/or areas that represent an extension of the existing urban framework. The scope of the estates were also subject to extensive discussions with NSW Government, consultations with the community, Federal and NSW Government environmental agencies, independent hearings under the EP&A Act, urban design charrettes and public exhibition and refinement of proposals.

All of the proposed development and conservation offsets are in accordance with the provisions of the Lower Hunter Regional Strategy (LHRS) and supporting LHRCP, noting here that the LHRCP cites the LHRS as a 'partner document', emphasising that the two should be considered together and that is precisely what the Coal & Allied proposals do. The proposals improve biodiversity protection through transfer of proposed conservation lands from private to NSW Government ownership. Such lands have been identified within these planning and conservation documents and are fundamental to the success and achievement of the objectives and benchmarks therein as detailed within Appendix 2 of the LHRS and succinctly captured within the LHRCP executive summary.

2. All regulatory requirements must be met.

The proposal has considered the regulatory and statutory frameworks associated with the NSW Part 3A assessment process and beyond. The Environmental Assessment Report identifies and assesses the impacts associated with the ecological constraints and opportunities of the proposal. Other accompanying Environmental Assessment Reports identify and assess the impacts on Cultural Heritage, European Heritage, Contamination, Water Sensitive Urban Design and other relevant environmental impacts. All recommend actions to be taken to mitigate or compensate for such impacts have been duly considered within the concept master planning process and represent additional project benefits that are separate from the offset proposal.

Notably Coal & Allied's proposal has been determined as not a controlled action by the Federal Minister for the Environment under the Environment Protection and Biodiversity Conservation Act. Importantly the proposal assessed herewith is consistent with that provided to the Minister for his consideration and determination. Refer to Appendix 7.

3. Offsets must never reward ongoing poor performance.

The proposed Development Estate lands are part of lands owned by Coal and Allied that are not required for their current or future mining operations. In part these lands have been utilised previously for mining and related activities and as such clearing has occurred.

The lands have not been the subject of unnecessary clearing and where mining and current industrial activity has been undertaken on parts of the site it has largely been

underground and as a consequence the overlying high biodiversity surface and vegetative cover has been preserved. The lands have been (and continue to be) managed by Coal and Allied such that they do not become an environmental burden and/or degrade adjacent lands.

The proposed development seeks to use industry best practice urban design and will be tested through the Part 3A assessment process.

As such the offsets will not be rewarding poor land management practices or poorly designed development proposals as they are of high biodiversity value as identified through the ecological assessment process and the environmental audit.

4. Offsets will complement other government programs.

The proposed offsets represent a significant conservation opportunity that will secure environmental assets, in perpetuity, that have been highly sought after under the NSW Government Lower Hunter Regional Strategy (LHRS) and specifically identified as highly valued assets in the LHRCP and DECCW 25 year Biodiversity Investment Layer.

In summary, the Coal & Allied conservation dedications provide outcomes that contribute to meeting the Environmental conservation goals outlined in the Sustainability Criteria contained within the LHRS. Such includes:

- Outcomes consistent with the Lower Hunter Regional Conservation Plan;
- Maintains/improves areas of regionally significant biodiversity;
- Maintains environmental areas for natural air & water quality; and
- Protects areas of Cultural heritage value and European heritage value.

These outcomes:

- Conserve in perpetuity key strategic parcels of land that complete long sought after regional biodiversity conservation corridors and buffer areas;
- Conserve in perpetuity significant areas of vegetation communities for which reservation targets have not been met in the Lower Hunter region;
- Provide large intact areas of conserved habitat that will function as regional biodiversity gene pools;
- Protect an important array of vegetation communities, flora and fauna species, and natural landscape assets, including threatened species and EEC's;
- Contribute significantly to the successful implementation of the Lower Hunter Regional Conservation Plan; and
- Achieve additional conservation benefits within development estates via appropriate urban design and management practices.

5. Offsets must be underpinned by sound ecological principles.

The Environmental Assessment as informed by this EAR has been underpinned by the DEC 2005 Draft Biodiversity Assessment Guidelines coupled with implementation of the precautionary principle of 'assumed presence' to ensure a holistic ecological assessment. Key principles in relation to the offset lands that have been considered include (but are not limited to):

- Issues of connectivity and fragmentation
- Landscape structure, species diversity, floristic composition, habitat type and availability
- Presence or absence of threatened species, population and ecological communities known from the region
- Biodiversity enhancement coupled with long term viability
- Ecosystem structure and function as it relates to patch size and influences of disturbance, fragmentation, isolation and issues surrounding potential island biogeography.
- Benchmarks of 'like for like' and 'maintain or improve'
- Site and situation of offsets, within the available surplus lands, in order to maximise environmental conservation gains at a landscape scale through to individual species level.

The resultant offset proposal as documented by this ecological assessment being that, based on development estate approval, the offsets will secure a public asset which provides significant conservation benefits overall and positive outcomes for each of the abovementioned key principles.

6. Offsets should aim to result in a net improvement in biodiversity over time.

The Lower Hunter Region's vegetation is of bio-geographic significance as it supports a transition between the northern and southern plant and animal assemblages. This north-south link is not evident elsewhere in the Hunter Valley. The Region also forms an east-west migratory pathway and a drought refuge for inland species.

The preservation of large vegetated areas that are linked to other similar areas has been recognised as fundamentally important to achieving long term regional biodiversity outcomes in the Lower Hunter region. The Coal & Allied lands to be dedicated form large vegetated areas in their own right, and complete linkages of identified regional corridors in key areas being the green corridor that links the Watagans and Yengo National Parks with the coastal plains of the Tomago Sandbeds, Stockton Bight and Port Stephens

In addition to their important strategic location in a wider landscape context, the Conservation Estates contain valuable biodiversity resources. They contain and will conserve a range of important vegetation communities, including areas of Endangered Ecological Communities (EEC) and other vegetation types that have been depleted in the region. Several threatened plant species have been recorded within the Conservation

Estates, including *Arthropteris palisotii, Tetratheca juncea* (Black-eyed Susan), *Grevillea parviflora* subsp. *parviflora*, *Rutidosis heterogama* and *Callistemon linearifolius*. Refer to Table 5-1. Given patch size of each individual Conservation Estate, issues generally associated with smaller conservation patches such as edge effects, fragmentation, corridor viability, maintenance of biodiversity etc are not considered to be major deleterious factors to be associated with this proposal.

The diverse nature of both the landform settings, varying from coastal ranges forests and woodlands to coastal heath to wetlands, provides a diverse array of habitats and resources for native fauna. The Conservation Estates are known to contain important populations of numerous threatened fauna species, including birds, mammals and herpetofauna. The conservation of these lands will provide secure regional biodiversity gene pools, and also *through linkages facilitate valuable gene*tic material exchan*ge and other key pro*cesses a*ssociated* wi*th sustainable ecolog*ical *population dynamics.*

7. *O*ffsets must be enduring – they must offset the impact of the development for at least the period that the impact occurs.

The offset lands (Conservation Estates) will be dedicated to the NSW Government under the terms of a Voluntary Planning Agreement (VPA) that is legally enforceable and managed thereafter under NPWS Estate in perpetuity.

8. Offsets should be agreed prior to the impact occurring.

The nature and extent of the proposed offsets for all of the Coal & Allied Lower Hunter landholdings have been subject to rigorous debate and assessment with the NSW Government, Community, Stakeholder Groups, Federal and NSW Government environmental agencies, independent hearings under the EP&A Act, urban design charrettes and public exhibition.

The offsets encompassed by the proposal will be formally agreed upon through the Part 3A process and form part of the overall approval. Thereafter the offsets will be dedicated to the NSW Government to become a public conservation asset under NPWS Estate. The offset land dedication will occur in accordance with the terms of the VPA.

9. Offsets must be quantifiable – the impacts and benefits must be reliably estimated.

- The ecological assessment has quantified the nature and extent of vegetation communities and floristic structures over the conservation estates notwithstanding the presence and/or potential presence of threatened species, populations and endangered ecological communities that will become a public conservation asset if the current proposal is approved.
- The offsets make a significant contribution to the achievement of conservation objectives sought under the LHRS and LHRCP.
- At Stockrington and Tank Paddock, 2106ha (being 545ha offset for Black Hill and

1561ha offset for Minmi-Link Road) of high biodiversity offset lands (Conservation Estates) will be dedicated to the NSW Government through a voluntary planning agreement that is legally enforceable and managed thereafter under NPWS Estate in perpetuity. Development lands at Black Hill will be confined to 183ha.

- The conservation estates have been subject to an environmental audit that will guide rehabilitation efforts over the offset.

10. Offsets must be targeted – they must offset impacts on a like-for-like or better basis.

The proposed conservation offsets:

- provide a like for like environmental outcome at a minimum (refer to Table 5-1 and Table 5-2);
- are situated within areas and contain vegetation communities that are identified by the LHRCP as extant having a reservation target that is not met;
- provide the single largest contribution to the 'Watagan Ranges to Ports Stephens corridor' sought by the LHRS and LHRCP;
- contain and will conserve a range of important vegetation communities, including areas of EECs and other vegetation types that have been depleted in the region;
- contain known threatened flora and fauna species of significance at the state and national level;
- provide a diverse array of habitats and resources for native fauna including coastal range forests, woodlands, heathlands and wetlands; and
- will provide secure regional biodiversity gene pools, and through linkages facilitate valuable genetic material exchange and other key processes associated with sustainable ecological population dynamics.

11. Offsets must be located appropriately – they must offset the impact in the same region.

The proposed offsets are:

- located within adjacent areas to the Development Estates;
- within the same IBRA Bio-region and sub-region as the Development Estate occurs;
- large patches of vegetated land contiguous with large vegetated areas extant from the locality;
- representative of the impact areas, hence providing a valuable biodiversity resource. They contain and will conserve a range of important vegetation communities, including areas of Endangered Ecological Communities (EEC) and other vegetation types that have been depleted in the region; and
- not subject to edge effects, fragmentation, issues of corridor viability, maintenance of biodiversity related to disturbance due to their individual patch size.

12. Offsets must be supplementary – they must be beyond existing requirements

and not already be funded under another scheme.

The offsets represented by the Conservation Estates are currently private freehold lands that are not part of any existing NSW Government or other scheme. As stated in point 4 above the lands have been identified under several NSW Government conservation initiatives.

13. Offsets and their actions must be enforceable – through development consent conditions, licence conditions, conservation agreements or a contract.

The offset lands (Conservation Estates) will be dedicated to the NSW Government through a voluntary planning agreement that is legally enforceable and managed thereafter under NPWS Estate in perpetuity.

8 Recommendations

The following recommendations have been outlined to ensure that the ecological impact of the proposed Development Estate is minimised as far as possible.

- Foremost, the management of the Development is critical to ensure that no direct or indirect impacts occur in the short and long term on dedicated Conservation Estates. As such, appropriate management plans should be prepared and implemented within the development framework in consultation with the NSW NPWS. Such management will involve;
  - The implementation of nutrient and sediment control works in a buffer surrounding the development areas and within the development estates, to protect the flowlines within the conservation estates;
  - Weed control of the conservation estates in accordance with NSW National Parks and Wildlife Service (NSW NPWS) Policies; and
  - The preparation of a Plan of Management for the Conservation Estates in accordance with NSW NPWS Policy for the long term management of the area including bush fire, threatened species and recreation management. If a Plan of Management cannot be prepared for the Conservation Estates within a reasonable period of time, a SIMI (Statement of Interim Management Intent) must be prepared in accordance with NSW NPWS Policies.
- Mature and / or hollow-bearing trees should be retained wherever feasible within the development framework.
- Pre-clearing inspections should be undertaken by an ecologist in wooded areas where threatened fauna species have been recorded or are considered likely to occur. This is particularly important in areas where threatened fauna have been noted during recent surveys either breeding or nest-building. No breeding attempts should be disrupted during the course of the project, particularly by threatened fauna.
- During the construction phase, for any tree removal within forested areas, and in particular where hollow-bearing trees may be removed, all works should be supervised by an ecologist to recover any native fauna that are potentially displaced. Furthermore, where such risks occur, site-specific ecological advice should be sought to minimise impacts during the entire process. A clearing protocol should be adopted for the removal of trees containing suitable habitat hollows as follows (this is considered as a guideline, variations on the methods employed may be required to accommodate site specific factors):
  - All hollow bearing trees are to be flagged by an ecologist prior to the commencement of works on Development Estate.
  - Underscrubbing of the entire site should be carried out by a 4x4 tractor with a slashing deck, this will minimise the establishment of degradation processes and leave a layer of mulch to aid in soil retention in the event of adverse weather. At this time felling of non habitat trees can take place, however a matrix of trees *must* be maintained to allow animal movement into offsite habitat.

- After a period of two weeks, clearing of habitat trees should commence. Clearing must be carried out moving from the fringe of the matrix towards the refuge area. Trees should be 'soft felled' and inspected immediately by an ecologist for displaced fauna. All trees must be left for a minimum of two nights prior to being moved to a stockpile, to allow resident fauna to vacate tree hollows.

Note: Clearing should ideally take place outside of the dominant breeding seasons of resident fauna, preferably during late autumn and winter.

- Species selection for future landscaping works and seed stock for revegetation should be limited to locally occurring native species to maintain local genetic diversity. This should include regionally significant species and preferred Swift Parrot foraging habitat trees should be incorporated into future landscaping design where possible.
- Where possible, earthworks (and certainly all works in the vicinity of drainage lines) should be undertaken during appropriate (i.e. dry) weather conditions. This will ensure that any potential erosion events will be intercepted and that downstream impacts are minimised within any of the drainage lines. This will help to maintain existing habitat characteristics for native fauna in those areas, including those for threatened species.
- Nutrient and sediment control devices should be erected pre-clearing and post-construction works in sensitive areas where degradation processes may be triggered such as areas adjacent to watercourses until suitable rehabilitation has occurred to maintain surface integrity. Furthermore, stockpiles should be subject to individual sediment and nutrient control devices

9 Conclusion

The detailed studies undertaken herewith have confirmed that development of a small portion of the site as a whole will provide a mechanism for beneficial ecological outcomes within the proposed conservation lands for the vast majority of species and communities contained therein. The quantum of the offset lands, when viewed holistically with proximate existing and proposed conservation reserve areas, provides a robust long-term outcome for all species and communities. Furthermore, suitable actions are proposed to minimise potentially deleterious permanent and ongoing impacts to the conservation lands.

The field and desktop studies have recorded the following parameters of ecological significance within both the Conservation and the Development Estates:

- native vegetation commensurate with those listed as EECs;
- threatened flora species recorded within and adjacent to the proposed development;
- threatened fauna species recorded within and adjacent to the proposed development;
- habitat for threatened flora and fauna species known from within and adjacent to the proposed development; and
- other areas containing native vegetation with varying degrees of modification / degradation.

With these potential ecological issues noted, a series of recommendations have been outlined previously in this report, to aid in the reduction of potential impacts associated with the proposal.

Given that measures have been taken to avoid ecological impacts and that where native vegetation may be affected, efforts have been made to avoid particularly sensitive areas where practical, it is considered unlikely that any significant impacts would occur upon threatened species, communities or populations. The large areas of Conservation Estates at Tank Paddock and Stockrington that will be set aside as part of the development provide sound ecological outcomes across the site. The Stockrington Conservation Estates will contribute a large portion of land to conservation in perpetuity, which will in essence formalise the Watagan to Stockton Corridor. The importance of the conservation of Tank Paddock as part of the Conservation Estates will maintain a vegetation corridor from Hexham Swamp and the Hunter Estuary to the Watagan Mountains and the Sugarloaf Range. This large tract of native vegetation will provide habitat for a wide variety of native flora and fauna and will be managed for conservation in perpetuity by the NSW NPWS.

Therefore, due to the location of the proposed Development Estate within more disturbed portions of the Northern Estates and the dedication of much larger tracts of vegetation within strategic regional corridors, it has been concluded that the proposed development should not significantly impact upon threatened or regionally significant flora and fauna, ecological communities or populations. The implementation of operative environmental

management practices and the detailed design phase of the project should also ensure that the ecological impact of the project is minimised

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Appendix 1

DGEAR's

CONCEPT PLAN – BLACK HILL – MP10_0093
ENVIRONMENTAL ASSESSMENT REQUIREMENTS UNDER PART 3A OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Project Description	Proposed concept plan for employment lands at Black Hill located in the Newcastle Local Government Area
Site	Black Hill (Lot 30 DP 870411) and Tank Paddock (Lot 1 DP 1007615).
Proponent	Coal and Allied Industries Ltd.
Date of Issue	19 August 2010
Date of Expiration	19 August 2012
General requirements	The Environmental Assessment (EA) for the **Concept Plan** must include: (1) an executive summary; (2) a description of the project including: (a) need for the project; (b) alternatives considered; (c) various components and staging of the project; and (d) plan indicating the footprint of the proposed work at A3 size, (3) a thorough site analysis and description of the existing environment; (4) justification of the project, taking into consideration the environmental impacts of the proposal, the suitability of the site and whether or not the project is in the public interest; (5) a consideration of all relevant statutory and non-statutory provisions and identification of any non-compliance with such provisions (especially the *SEPP (Major Development) 2005, SEPP 33 – Hazardous and Offensive Development, SEPP 44 – Koala habitat Protection, SEPP 55 – Remediation of Land, SEPP (Infrastructure) 2007, SEPP (Mining, Petroleum Production & Extractive Industries), Newcastle LEP 2003, Lower Hunter Regional Strategy 2006, and Lower Hunter Regional Conservation Plan (DECCW, 2009).* (6) a draft Statement of Commitments outlining commitments to public benefits including State and Local infrastructure provision (or associated contributions), environmental management, mitigation and monitoring measures (especially in relation to flooding, biodiversity and stormwater) to be established on site and clear identification of timing and who is responsible for these measures; (7) a signed statement from the author of the EA certifying that the information contained in the report is neither false nor misleading; and (8) A report from a quantity surveyor identifying the capital investment value of the Concept Plan including the estimated cost of future development.
Key Assessment Requirements	**Urban design, development controls and land uses** (1) Describe future land uses within the employment lands and outline any proposed development controls for the site based on a comprehensive site analysis of constraints and opportunities. The resulting development controls should satisfy the objects of the *Environmental Planning and Assessment Act 1979* and the aims and objectives of relevant planning instruments. Consideration should also be given to development controls outlined in Council's existing and draft Local Environmental Plans and Development Control Plans; (2) Assess how the development controls will complement surrounding existing land uses and any conservational lands for dedication; (3) Assess the visual impact of the proposal, particularly from the F3 Freeway, John Renshaw Drive and adjoining employment lands; (4) Consider *Freight Hub Hunter Part 1- Executive Summary Report, October 2008* (NSW Department of Premier and Cabinet) within the context of the proposed concept plan; (5) Provide justification for any proposed non-industrial land uses, including how the proposed uses would be compatible with employment/industrial land use

zones and would not constitute a commercial/retail stand alone centre. Consideration should be given to the *Draft Centres Policy Planning for Retail and Commercial Development* (Department of Planning, April 2009); and

(6) Address the principles of Crime Prevention through Environmental Design.

Staging

(1) Prepare an outline of staging for the completion of the project and release of industrial land and timing for delivery for supporting infrastructure. This includes how the release of industrial land would align with proposed and future access arrangements to the site; and

(2) Identify the extent, locations and timing of dedication of proposed conservation lands with commitments to managing ongoing management of edge effects and need for any buffer zones.

(3) The staging of the proposed development and the timing of implementation of identified road network infrastructure upgrades;

Biodiversity

(1) Provide an assessment on impacts on flora and fauna in accordance the with *draft Guidelines for Threatened Species Assessment (DEC, July 2005);*

(2) Consider the corridor values or connective importance of any vegetation on the site and the likely cumulative impacts of proposed development on biodiversity;

(3) Describe the actions that would be taken to avoid or mitigate impacts on biodiversity or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment on the effectiveness and reliability of the measures and any residual impacts after these measures are implemented; and

(4) Demonstrate that biodiversity impacts can be appropriately offset in accordance with the NSW Government's policy for 'improvement or maintenance' of biodiversity values.

Transport and Accessibility

(1) Detail and justify the site access arrangements for the site, including how the proposed development will proceed and alternatives to the proposed access onto the F3 Freeway.

(2) Include a traffic study prepared in accordance with the *RTA Guide to Traffic Generating Developments*, which addresses:

- (a) All relevant vehicular traffic routes and intersections for access to/from the subject area;
- (b) Current traffic counts for all of the above traffic routes and intersections;
- (c) Anticipated additional vehicular traffic generated from the proposed development and associated trip distribution on the road network;
- (d) Consideration of the traffic impacts on existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicle traffic generated by the proposed development. The traffic impact shall also include the cumulative traffic impact of other proposed developments in the area;
- (e) Details of the necessary road network infrastructure upgrades that are required to maintain existing levels of service on both the local and classified road network;
- (f) Intersection analysis as well as a micro simulation model shall be submitted to determine the need for intersection and mid-block capacity upgrades, as well as ensure traffic signal co-ordination,
- (g) Consideration of impacts on existing property access.
- (h) Impact of Hunter Expressway and the proposed F3 to Raymond Terrace link;
- (i) Impacts on regional road networks during construction and operation. Assessment should be based on expected level of employment generation;
- (j) Traffic management and proposed access from the wider road network as well the opportunities and constraints of alternative vehicular access points;
- (k) Measures to introduce and promote public transport usage and mode share including pedestrian and cycle access within and to the site that connects to all relevant transport services and key off-site locations, having regard to the NSW Planning Guidelines for Walking and Cycling (2004) and the NSW

	Bike Plan (2010); and (l) Road design to cater for heavy vehicles associated with freight movement. (3) Assess the proposal against the objectives of the Integrating Land Use and Transport Policy packages. **Flooding, Stormwater and Water Quality Management** (1) Assess any potential impact of the proposed development on hydrology and hydrogeology of the site and adjacent areas in terms of impact on water balance and water quality (including groundwater) on any natural watercourse or groundwater source in keeping with the *Australian Guidelines for Water Quality Monitoring and Reporting (2000)*; (2) Identify drainage and stormwater management measures to be incorporated on the site, including riparian areas that respect creeks and the topography of the site, on site detention of stormwater, water sensitive urban design (WSUD), and drainage infrastructure; (3) Provide management arrangements for proposed stormwater infrastructure, and water quality and ecosystem health during construction and the life of the development, including the formation of buffer zones; (4) Develop suitable Flood Planning Levels for the development and demonstrate consistency with the *NSW Floodplain Development Manual: The management of flood liable land (2005)* and the *DECC Floodplain Risk Management Guideline – Practical Consideration of Climate Change (2007).* **Riparian Corridors** (1) Identify riparian corridors based on an assessment of the hydrology of the area, existing water courses and topography of the land and provide an assessment of how impacts on riparian corridors will be avoided, mitigated and managed. This should be undertaken with consideration to guidelines prepared by the former Department of Water and Energy (now the Office of Water); and (2) Location of all local bio-retention/detention basins are to be justified and assessed where these are not 'off-line' and outside the core riparian zone and an assessment of the construction works associated with the proposed precinct scale bio-retention/detention basin should be quantified and assessed. **Ownership/Maintenance of Public Domain** (1) Provide details of proposed ownership and management arrangements (through negotiation with State and local government agencies) for riparian areas, roads, asset protection zones, etc. **Soils, Contamination and Geotechnical** (1) Assess the capability of the land for the proposed development with regard to erosion potential, slope stability, salinity and the presence of potential and actual acid sulphate soils if any; (2) Provide an assessment of contamination in accordance with SEPP 55 and relevant DECCW guidelines if any contaminated soils are identified and likely to be disturbed, detail what actions, management and mitigation measures will be required; and (3) Identify the potential for subsidence, hazards associated with subterranean gases and other associated risks for development. Outline required actions, management and mitigation measures. **Mining** (1) Identify the impacts of the development of the proposal and conservation offsets on the future recovery of resources of coal and coal-seam methane below the site and outline required actions, management and mitigation measures; and (2) Identify the potential for future mine subsidence which may cause tilts and strains, affect flooding and stormwater conveyance and damage any surface structures. **Air Quality** (1) Assess the potential air quality impacts associated with the proposed development on the site; and

	(2) Assess the odour and air quality impacts of the nearby existing development including the adjoining poultry farm, any proposed sewerage treatment plant on the site and in light of potential coal mining and coal-bed methane extraction on the subject land. The assessment must be consistent with the *Technical Framework Assessment and management of odour from stationary sources in NSW (DECC November 2006)* and the *Technical Notes Assessment and management of odour from stationary sources in NSW (DECC November 2006)*. **Noise** (1) Provide an assessment in accordance with *Environmental Criteria for Road Traffic Noise* (1999) and *Industrial Noise Policy* (2000). Outline how any impacts would be mitigated and/or managed; and (2) Consideration should also be given to the impact of external noise which may have an impact on the development proposed on the site. **Heritage** (1) Provide an assessment in accordance with the *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005)* and measure to avoid, mitigate and/or manage any impacts during construction and operation. **Bushfire Risk Assessment** (1) Provide an assessment against the current version of *Planning for Bush Fire Protection 2006* and identify the ongoing management arrangements of proposed Asset Protection Zones (APZ), including negotiation with relevant agencies where APZs are proposed on land proposed to be transferred to public ownership. **Sustainability** (1) The EA should outline commitments to sustainability including water reuse, waste minimisation, the minimisation of energy use and car dependency etc. **Developer contributions** (1) Provide the likely scope of developer contributions between: (a) the Proponent and Newcastle City Council for local infrastructure; and (b) the Proponent and State Government agencies for the provision of State Infrastructure in accordance with Planning Circular PS 07-018 (Infrastructure Contributions). **Utilities** (1) Prepare a utilities infrastructure servicing report and plan for the site that demonstrates that the site can be adequately serviced in terms of water supply, sewerage services, stormwater management, gas, electricity, communication services and fire suppression facilities.
Consultation Requirements	During the preparation of the EA, the proponent must undertake an appropriate and justifiable level of consultation with relevant parties. If consultation has already been undertaken, this needs to be documented. Relevant agencies should include, but not be limited to: • Newcastle City Council; • Industry and Investment NSW; • Department of Environment, Climate Change and Water; • NSW Office of Water • Roads and Traffic Authority; • Transport NSW; • Mine Subsidence Board; • Hunter-Central Rivers Catchment Management Authority; • Hunter Water; • Department of Environment, Water, Heritage and the Arts; • The Local Aboriginal Land Council; • Utility and infrastructure providers including the Ambulance Service of NSW, the Rural Fire Service and NSW Fire Brigades;

	• AGL (SG) Operations Pty Limited (holder of Petroleum Exploration Licence 267); and • Donaldson Coal Company Pty Ltd (holder of Exploration Licence EL 5497 and Mining Lease 1618).
Deemed refusal period	60 days