Ecological Assessment

Central Coast Sands Quarry, Somersby

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Disclaimers

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Introduction

RPS has been commissioned by Insite Planning Engineering Environmental on behalf of Hanson Construction Materials Pty Ltd to prepare an Ecological Assessment. This report is to be prepared as part of a Part 3A application for the extension of the Central Coast Sands Quarry at Somersby. The Ecological Assessment will be prepared in accordance with the conditions as outlined in by the Director-General of the Department of Planning (DoP 22.10.80) and the EA conditions from the Department of Environment and Climate Change (DECC 11.09.08). The Central Coast Sands Quarry is located along Keighley Road, Somersby, NSW (Figure 1).

This assessment aims to:

(1) Examine the likelihood of the proposal to have a significant effect on any threatened species, populations or ecological communities listed within the *Threatened Species Conservation Act 1995* (TSC Act 1995). Recognition is given to the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979) and also with regard to those threatened entities listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999);

(2) Examine any potential impacts of the quarry extension upon groundwater ecosystems; and

(3) Identify appropriate rehabilitation strategies for the quarry.

Each of the abovementioned report aim have been presented herewith as individual components.

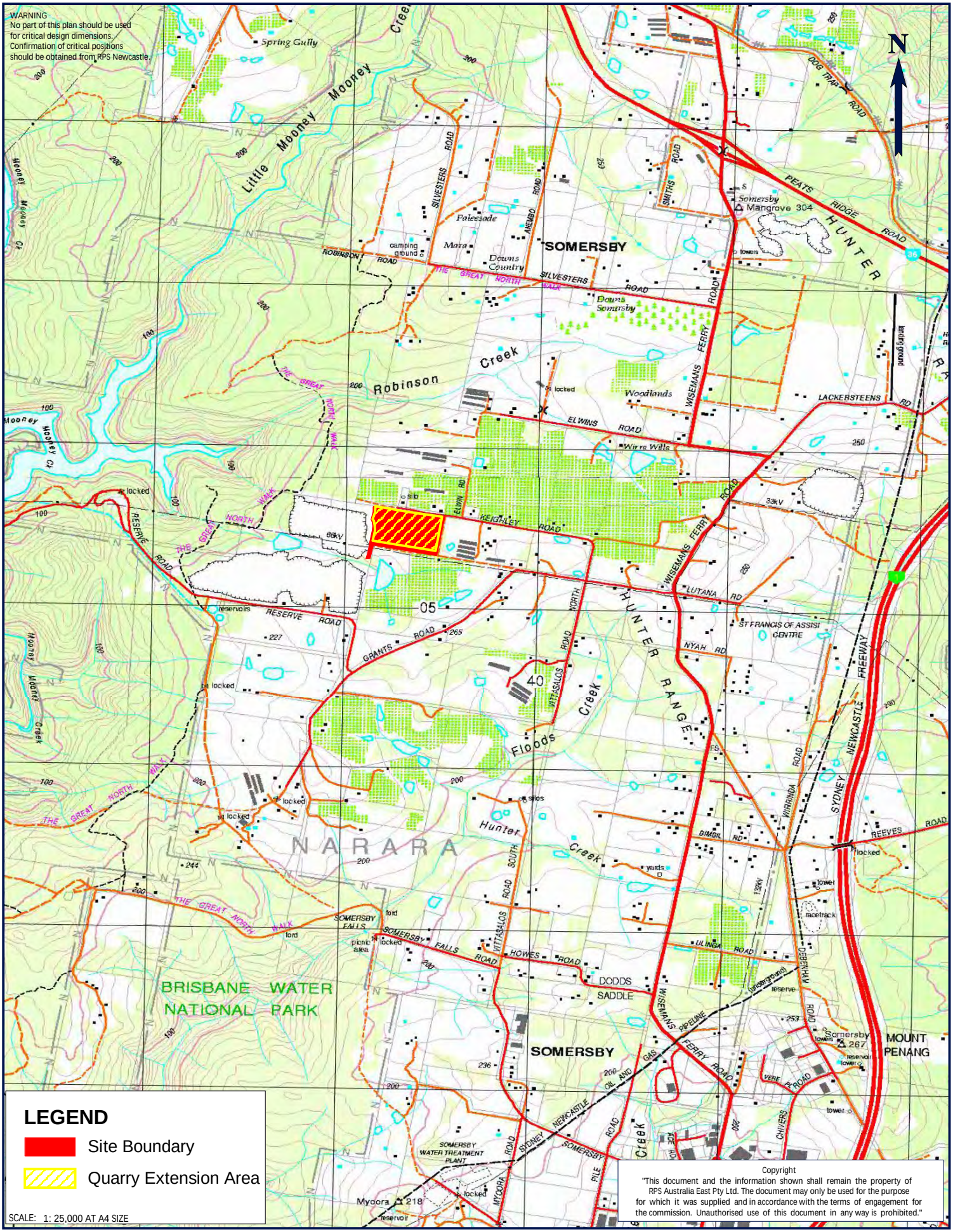
Site Particulars

Locality	Keighley Road, Somersby
LGA	Gosford City
Titles	Part Lot 10, DP 1090880
Area	Approximately 8 hectares of quarry extension area.
Zoning	1a Rural (Agriculture)
Boundaries	Keighley Road occurs to the north of the site, with the existing quarry occurring to the west and agricultural land to the east and south of the site.
Current Land Use	The site is currently used for a range of agricultural purposes, including poultry, farming and orchards (primarily Avocado).

Topography The site is characterised by a plateau with gentle slopes grading down to the west.

Soils and Geology The soil landscape across the site is comprised of the Somersby / Sydney Town type as described by Murphy (1993).

The soil on site is moderately deep to deep Yellow Earths and Earthy Sands on crest and slopes with Grey Earths in poorly drained areas and Leached Sands and Siliceous Sand along drainage lines. These soils are underlain by Hawkesbury Sandstone, with the site having medium to coarse-grained quartz sandstone with minor shale and laminate lenses.



TITLE: FIGURE 1 SITE LOCATION MAP
LOCATION: SOMERSBY
DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 3/5/2011
PURPOSE: EIA
LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting \Ecology\MapInfo Workspaces
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Description of the Proposal

An existing sand quarry operated by Hanson, Central Coast Sands Quarry, is currently under operation on Lot 33 DP755246, Reserve Road. Annually, the quarry produces approximately 310,000 tonnes with a total remaining resource of around 4.8 million tonnes. The current working depth of the quarry is approximately 55m below the natural ground level.

A Part 3A application to expand the existing quarry to incorporate the adjoining Lot 10 DP1090880 (approximately 8ha) to the east along with two access easements is being sought (east of Lot 10 and south along Reserve Road). The entire area will hereafter be referred to as the 'Site' (Figure 1). Hereafter the proposed quarry extension will be referred to as the 'Proposal'. The proposal aims to increase the life of the quarry by 17 years, the expansion of the quarry will allow for extraction of approximately 5 million tonnes of sand.

One road access to the east of the quarry extension will be through a narrow strip dominated by exotic species. The other access road to the south west of the quarry extension will be through an area of good condition native vegetation where some under-scrubbing and the removal of some trees are anticipated. The total area to be potentially affected by this roading activity being approximately 0.1 ha. No other areas of native vegetation will be removed as part of the Proposal.

Scope of the Study

The scope of this ecological assessment report is to:

- identify vascular plant species found on the site;
- identify and map existing vegetation communities;
- assess the status of identified plant species and vegetation communities under relevant legislation;
- identify existing habitat types on the site and assess the habitat potential for threatened species, populations, or ecological communities known from the proximate area;
- identify threatened fauna potentially using the site and assess the potential of the proposal to have a significant impact on any threatened species, populations or ecological communities identified during field surveys or as having potential habitat on the site;
- assess the likely impacts upon potentially affected groundwater ecosystems; and
- make recommendations regarding appropriate site rehabilitation measures and strategies.

Whilst survey work has been undertaken wholly within the bounds of the site, consideration has been afforded to areas off the site in order to appreciate the environmental context of the site.

The purpose of this report is to:

- ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any biodiversity components or potential significant impacts that may exist on the site; and
- provide information to enable compliance with applicable assessment requirements contained within the *TSC Act (1995)*, *EP&A Act (1979)*, the *Commonwealth EPBC Act (1999)*, and any other relevant state, regional and local environmental planning instruments.

Qualifications and Licensing

Qualifications

This report was written by David Paull (MResSc), Deborah Landenberger (BSc Hons), Rachel Manassa (BSc Hons), Alex Picton (BAppSc) and Steven Cox (BAppSc (Hons)) and reviewed by Toby Lambert (BEnvSc) and Matt Doherty (BLMC) of RPS.

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).

Component A: Ecological Assessment

1 Fauna and Flora Assessment

A variety of techniques were employed over the course of desktop and fieldwork to describe, record and assess the potential impacts of the proposal upon fauna and flora communities and their habitats present and potentially present on the site.

1.1 Methodology

Methodology for this proposal have been undertaken such that they have taken into consideration specific recommendations from DECC's EA requirements (DECC (11.09.08) and has taken in to consideration the following aspects:

(a) More than one survey method must be utilised for those subject species for which complementary methods have the potential to result in a significant increase in detection;
(b) Survey effort (including intensity, repetition and coverage) must be at a level that can be reasonably expected to detect the subject species if present in the study area; and
(c) Surveys are required to be undertaken during optimal climatic and seasonal conditions for all potentially occurring flora and fauna species and need to consider issues such as migratory species movements, the availability of shelter, breeding, pollination patterns and prerequisites, and also the relative availability of food resources and habitat.

1.2 Site Boundary Changes

Between the date of the field surveys and the finalisation of this report, the boundary location of the site changed significantly. The site boundary for field surveys included the narrow strip of native vegetation along the western boundary of the site and extending approximately 500m to the south. Following submission of the draft Flora and Fauna Assessment Report the site boundary contracted to that shown on Figure 2.

Where relevant to the assessment of species presence/absence and/or the likely level of impact within the local area, the results of the survey of the initial study area have been included.

1.3 Desktop Assessment

Assessments drew on a number of information sources including previous reporting by RPS in this locality 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. Assessment information sources included:

(1) Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the site;

(2) Review of fauna and flora records contained in the DECC Wildlife Atlas (DECC 2009/2010);

(3) DEWHA *EPBC Act 1999* Protected Matters Search (DEWHA 2009);

(4) Review of the Natural vegetation of the Gosford Local Government Area, Central Coast, NSW (Bell, 2004);

(5) A review of GIS data including (but not limited to) aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil Landscapes, Acid Sulphate Soil Potential;

(6) Review of the Department of Conservation and Land Management - Soil Landscapes of the Gosford – Lake Macquarie 1:100,000 Sheet (Murphy, 1993);

(7) Department of Environment and Climate Change (DECC) database of Threatened Species, Populations and Ecological Communities (website); and

(8) Collective knowledge gained from extensive work in the area.

1.4 Flora / Vegetation Survey

The survey of the flora/vegetation at the site was as follows:

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units.
- Review of the Natural vegetation of the Gosford Local Government Area, Central Coast, NSW (Bell, 2004);
- Confirmation of the community type(s) present (dominant species) via undertaking flora surveys and identification, with emphasis on particularly significant species.
- A single quadrat was undertaken at the approximate location of the proposed haul road between the existing quarry and the proposed quarry extension (Figure 2).
- Random meanders were utilised across the entire site to identify all plant species present.
- Consideration was given to the potential for the derived vegetation communities to constitute 'Endangered Ecological Communities' (EEC) as listed within the *TSC Act (1995)*.
- Flora surveys were carried out across the site, with an emphasis on potentially significant species, as outlined below. The general flora survey also included the casual consideration of the study area in line with methodology such as the "Random Meander Technique" described by Cropper (1993).
- Map the type and general extent of the community(s) present into definable map units where appropriate.
- A targeted flora survey was undertaken during the flowering period of *Hibbertia procumbens*, *Prostanthera junonis* and *Tetratheca glandulosa*. This targeted search was undertaken within the site and within the woodland area adjoining the eastern

boundary of the site on 25 October 2010 for a period of 2.5 person hours. In addition, prior to the survey a known location of the two species, approximately 4km distant from the site was inspected. The other location contained specimens of *H. procumbens* and *P junonis* which had previously been positively identified by the Royal Botanic Gardens of NSW. The specimens of *P. junonis* at the nearby site were found to be in flower, while the *H. procumbens* was found to be in the late flower bud stage.

1.4.1 Floristic Structure

Vegetation structure was determined based on Specht *et al,* (1995) by estimation of the height and PFC within each stratum present. Individual taxon data for each quadrat 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:

Table 1: Braun-Blanquet Projected Canopy Cover Scale

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%

1.4.2 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*, those species listed under the *EPBC Act*, Rare or Threatened Australian Plants (ROTAP) listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance (Appendix 2). Any such species identified were considered for potential occurrence, with targeted surveys undertaken throughout the site, where possible from a seasonal perspective.

1.5 Fauna Survey

A list of potentially occurring significant fauna species from the locality (10km radius) was compiled, which included threatened species (Endangered or Vulnerable) under the *TSC Act*, those species listed under the *EPBC Act* as well as any other species deemed to be of local importance.

The fauna survey methodology consisted of an assessment of the potential use of the site by threatened fauna species (as listed under the *TSC Act 1995* and / or *EPBC Act 1999*) identified from the vicinity of the site. This was achieved by undertaking literature and

database reviews followed by confirmation through field surveys, and any additional species observed were noted on the list.

1.5.1 Habitat Survey

An assessment of the relative habitat value present on site was undertaken. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna.

Habitat assessment was 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.

Hollow bearing trees throughout the site were also identified, with nocturnal stag watching undertaken to determine if they were currently being utilised.

1.5.2 Avifauna Survey

The presence of avifauna was determined via targeted diurnal and opportunistic observations during site fieldwork visits. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers, and owl regurgitation pellets etc. The potential for threatened avifauna to use the site was also assessed by habitat attributes occurring within the area and their capacity to support threatened species that are known to occur in the wider locality. Assessment of the site potential to provide opportunities for forest owl species was based upon the known habitat requirements of these species and nocturnal surveys including owl call playback.

1.5.3 Spotlighting Survey / Stag Watching

Spotlighting was undertaken over two nights with each spotlighting transect traversed on foot each night by two people with 35-Watt hand-held spotlights and head torches, resulting in a total of 10 person hours of spotlighting undertaken. Priority was given to those areas that were deemed most likely to contain nocturnal species, particularly arboreal and terrestrial mammals.

Hollow bearing trees were also targeted for stag watching, with four trees observed in close proximity to the quarry extension area.

The locations of spotlight transects are shown in Figure 2.

1.5.4 Trapping

Hair tube sampling was undertaken across the site to target *Dasyurus maculatus* (Spotted-tailed Quoll) and *Cercartetus nanus* (Eastern Pygmy Possum). The hair tube transect consisted of 20 hair funnels (Faunatech design) spaced throughout the site (Figure 2). Hair funnels were mounted on tree trunks, fallen logs and under woody debris.

Sixteen hair tubes were baited with a mixture of rolled oats, peanut butter and honey, with four baited with sardines. All hair tubes were left active for a period of 10 nights resulting in a total of 200 hair tube trap nights within the site.

1.5.5 Herpetofauna Survey

Targeted and opportunistic amphibian and reptile searches were conducted during fauna surveys. Known occurrences of threatened herpetofauna species from the region were taken into account during assessment of site habitat, to determine its potential to support such species.

1.5.6 Call Playback

Pre-recorded calls of owl species with the potential to occur on 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 design to project the sound for at least 1km under still night conditions. As described by Kavanagh and Peake (1993) 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. The call playback location was selected in an area where calls could be broadcast across the entire site (Figure 2).

1.5.7 Bat Call Survey

Anabat II Bat Detectors and CF ZCAIMs were used to record bat echolocation calls. Two Anabats were placed within the site over night for two nights to record any micro-chiropteran activity. One Anabat was place on the edge of the dam for two nights, with the other Anabat placed at the top of a track and moved to the bottom of the track on the second night (Figure 2). The recorded calls were analysed by A. McConville using "Analook" with reference to Pennay *et al.* (2004).

1.5.8 Secondary Indications and Incidental Observations

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

- Distinctive scats left by mammals.
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Feeding scars on Eucalyptus trees made by Gliders;
- Whitewash, regurgitation pellets and prey remains from Owls;
- The calls of fauna;
- Skeletal material of vertebrate fauna; and
- Footprints left by mammals.

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

1.6 Limitations

Limitations associated with this Flora & Fauna Assessment Report are presented herewith. The limitations have been taken into account 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 and scientifically justified to ensure a holistic assessment.

1.6.1 Seasonality

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.

The seasonality of the surveys places limits on the number of flora species identified in the study area as the surveys occurred in autumn when some species may have stopped flowering and are difficult to detect. Thus the flora species list cannot be considered to be complete when one survey has been completed, due to seasonality of flowering.

1.6.2 Data Availability and Accuracy

The collated threatened flora and fauna species records provided by the DECC 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 DECC Atlas of Wildlife Database and a DEWHA Protected Matters Search. 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 located with a Trimble GeoXH GPS unit, which is capable of sub-metre accuracy following post processing.

1.6.3 Fauna

The presence of fauna within a particular area is not static over time, may be seasonal or in response to the availability of a particular resource. As such, where survey effort targeting particular threatened fauna species has not specifically met guidelines recommended by DECC, habitat assessment and prediction of the occurrence of threatened fauna species has been applied. Nevertheless, it is considered that the combined survey effort and dataset from all of the investigations undertaken to date

provide a substantial picture of the fauna species and habitat values occurring within the study area.

TITLE: FIGURE 2 SURVEY LOCATIONS | LOCATION: SOMERSBY | DATUM: N/A | PROJECTION: MGA ZONE 56 (GDA 94) | DATE: 3/5/2011 | PURPOSE: EIA | LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting\Ecology\MapInfo Workspaces | VERSION (PLAN BY): A A4 (MD-NW)

CLIENT: HANSON CONSTRUCTION MATERIALS PTY LTD
JOB REF: 103611

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2 Results

The prevailing weather conditions during the survey period are presented in Table 2 below.

Table 2: Prevailing Weather Conditions

	23rd June 2009	24th June 2009
Temperature	12 - 21 °C	9 - 21 °C
Cloud	10%	10%
Rain (24 hrs to 9:00am)	5mm	0mm
Sun Rise	06:59	06:59
Sun Set	16:55	16:55
Moon Rise	07:17	08:13
Moon Set	17:14	18:30

2.1 Desktop Assessment

2.1.1 Vegetation Community

Natural vegetation of the Gosford Local Government Area, Central Coast, NSW (Bell, 2004), maps one native vegetation community adjacent to the site, being (MU E26d) *Somersby Plateau Open Forest.*

2.1.2 Threatened Flora

The results of a desktop search (DECC 2009) indicated that 13 threatened flora species have been previously recorded within 10km of the site (the locality) and / or have potential habitat within the site. These are:

- *Baloskion longipes* Dense Cord-rush
- *Callistemon linearifolius* Nettled Bottle Brush
- *Darwinia glaucophylla*
- *Diuris bracteata*
- *Epacris purpurascens* var. *purpurascens*
- *Eucalyptus camfieldii* Camfield's Stringybark
- *Grevillea shiressii*
- *Hibbertia procumbens* Spreading Guinea Flower
- *Melaleuca biconvexa* Biconvex Paperbark
- *Prostanthera askania* Tranquility Mintbush

- *Prostanthera junonis* Somersby Mintbush
- *Syzygium paniculatum* Magenta Lilly Pilly
- *Tetratheca glandulosa*

A search of Matters of National Environmental Significance within area of 10km of the site revealed the following additional threatened species. Species not identified under the *Threatened Species Conservation Act (1995)* are asterisked:

- *Acacia bynoeana** Bynoe's Wattle
- *Bothriochloa biloba** Lobed Blue-grass
- *Caladenia tessellate** Thick-lipped Spider-orchid
- *Cryptostylis hunteriana** Leafless Tongue – orchid
- *Eucalyptus camfieldii* Camfield's Stringybark
- *Grevillea parviflora subsp. parviflora** Small-flower Grevillea
- *Grevillea shiressii*
- *Melaleuca biconvexa* Biconvex Paperbark
- *Melaleuca deanei** Deane's Melaleuca
- *Prostanthera junonis* Somersby Mintbush
- *Rhizanthella slateri** Underground Orchid
- *Syzygium paniculatum* Magenta Lilly Pilly
- *Tetratheca glandulosa* Glandular Pink-bell

A total of 20 state and federally listed species were identified in desktop searches. No EPBC listed endangered ecological communities were identified.

2.1.3 Threatened Fauna

The results of a desktop search (DECC 2009) indicated that 27 threatened fauna species have been previously recorded within 10km of the site (the locality) and / or have potential habitat within the site. These are:

- *Litoria brevipalmata* Green-thighed Frog
- *Heleioporus australiacus* Giant Burrowing Frog
- *Mixophyes balbus* Stuttering Frog
- *Mixophyes iteratus* Giant Barred Frog
- *Pseudophryne australis* Red-crowned Toadlet
- *Callocephalon fimbriatum* Gang Gang Cockatoo
- *Calyptorhynchus lathami* Glossy Black Cockatoo
- *Grantiella picta* Painted Honeyeater

- *Pomatostomus temporalis* Grey-crowned Babbler (eastern ssp.)
- *Pterodroma nigripennis* Black-winged Petrel
- *Neophema pulchella* Turquoise Parrot
- *Ninox connivens* Barking Owl
- *Ninox strenua* Powerful Owl
- *Tyto novaehollandiae* Masked Owl
- *Tyto tenebricosa* Sooty Owl
- *Cercartetus nanus* Eastern Pygmy Possum
- *Dasyurus maculatus* Tiger Quoll
- *Mormopterus norfolkensis* East Coast Freetail Bat
- *Petaurus australis* Yellow-bellied Glider
- *Phascolarctos cinereus* Koala
- *Potorous tridactylus* Long-nosed Potoroo
- *Pteropus poliocephalus* Grey-headed Flying Fox
- *Falsistrellus tasmaniensis* Eastern Pipistrelle
- *Miniopterus australis* Little Bent-wing Bat
- *Miniopterus schreibersii* Eastern Bent-wing Bat
- *Myotis adversus* Large-footed Myotis
- *Scoteanax rueppellii* Greater Broad-nosed Bat

A search of Matters of National Environmental Significance within area of 10kms of the site revealed the following additional threatened species. Species not identified under the *Threatened Species Conservation Act (1995)* are asterisked:

- *Anthochaera phrygia** Regent Honeyeater
- *Chalinolobus dwyeri** Large-eared Pied Bat
- *Dasyurus maculatus maculatus* Spotted-tail Quoll
- *Heleioporus australiacus* Giant Burrowing Frog
- *Hoplocephalus bungaroides** Broad-headed Snake
- *Lathamus discolour** Swift Parrot
- *Litoria aurea** Green and Golden Bell Frog
- *Litoria littlejohni** Littlejohn's Tree Frog
- *Macquaria australasica** Macquarie Perch
- *Mixophyes balbus* Stuttering Frog
- *Mixophyes iteratus* Southern Barred Frog
- *Petrogale penicillata** Brush-tailed Rock-wallaby

- *Potorous tridactylus ssp. tridactylus* Long-nosed Potoroo
- *Prototroctes maraena** Australian Grayling
- *Pteropus poliocephalus* Grey-headed Flying Fox
- *Rostratula australis** Australian Painted Snipe

A total of 37 state and federally listed species were identified in desktop searches.

2.2 Flora Survey

2.2.1 Vegetation Community Assessment

Site inspection and vegetation community delineation identified three vegetation communities (Figure 3);

- Somersby Plateau Open Forest (MU E26d);
- Pine – Lantana Open Forest; and
- Disturbed lands.

The following section provides a brief outline of the dominant floral characteristics of each vegetation community. A full list of species is provided in Appendix 2.

Somersby Plateau Open Forest

Plate 1: Somersby Plateau Open Forest – Facing West within the Quarry Extension Area

Description: This vegetation community is commensurate with MU E26d – Somersby Plateau Open Forest as mapped by the Natural Vegetation of the Gosford Local Government Area (Bell, 2004). This community is defined as Open Forest. This community occurs along the western boundary (after the Pine-Lantana Open Forest) all the way south along the western boundary of the site to Reserve Road. This vegetation community covers approximately 0.25 ha of the quarry extension area and less than 2 ha of the entire site. Some scattered hollow-bearing trees were also observed. This community can be separated into two areas based on overall condition of the understorey. The northern section adjacent to the proposed quarry extension was dominated by lantana and pine regrowth especially within the mid section adjoining the orchid. The southern end of the native vegetation strip was in a much better condition in terms of condition of the native understorey, with little weed infestation. This area coves less than 0.5 ha of the entire extent of this vegetation community in the site.

Upper-storey: 18 to 22m – 30%-40% Percent Foliage Cover (PFC) *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple), and *Eucalyptus sieberi* (Silvertop Ash).

Upper mid-storey: 4 to 15m – 10%-20% PFC *Acacia decurrens* (Black Wattle), *Allocasuarina torulosa* (Forest Oak), *Banksia serrata* (Old Man Banksia) and a number of juvenile canopy species.

Mid-storey: 1 to 4m – 10%-30% PFC *Leptospermum polygalifolium* (Lemon-Scented Tea Tree), *Grevillea buxifolia* (Grey Spider Flower) and *Pomaderris sp.*

Under-storey: 0.1 to 2m – 30%-50% PFC *Entolasia marginata* (Bordered Panic), *Phytolacca octandra* (Inkweed), *Gahnia clarkei* (Tall Saw-sedge), *Doryanthes excelsa* (Gymea Lily), *Gleichenia rupestris* (Coral Fern), *Persoonia levis* (Broad-leaved Geebung), *Dodonaea triquetra* (Hop-bush), *Lantana camara* (Lantana) and *Solanum mauritianum* (Wild Tobacco).

Pine – Lantana Open Forest

Plate 2: Pine-Lantana Open Forest – Looking north-west across the Site

Description: This community is found along the majority of the east and west boundaries of the quarry extension area and is defined as Open Forest. This community has a high degree of weed incursion and disturbance with the mid-storey dominated by the introduced *Lantana camara* (Lantana), preventing the development of a native understorey layer. This vegetation community covers approximately 0.25 ha of the quarry extension area and 2 ha on the eastern side.

Upper-storey: 10 to 20m – 20%-50% Percent Foliage Cover (PFC) *Pinus radiata* (Monterey Pine)

Mid-storey: 0.5 to 5m – 70%-80% Percent Foliage Cover (PFC) *Lantana camara* (Lantana)

Ground layer: None

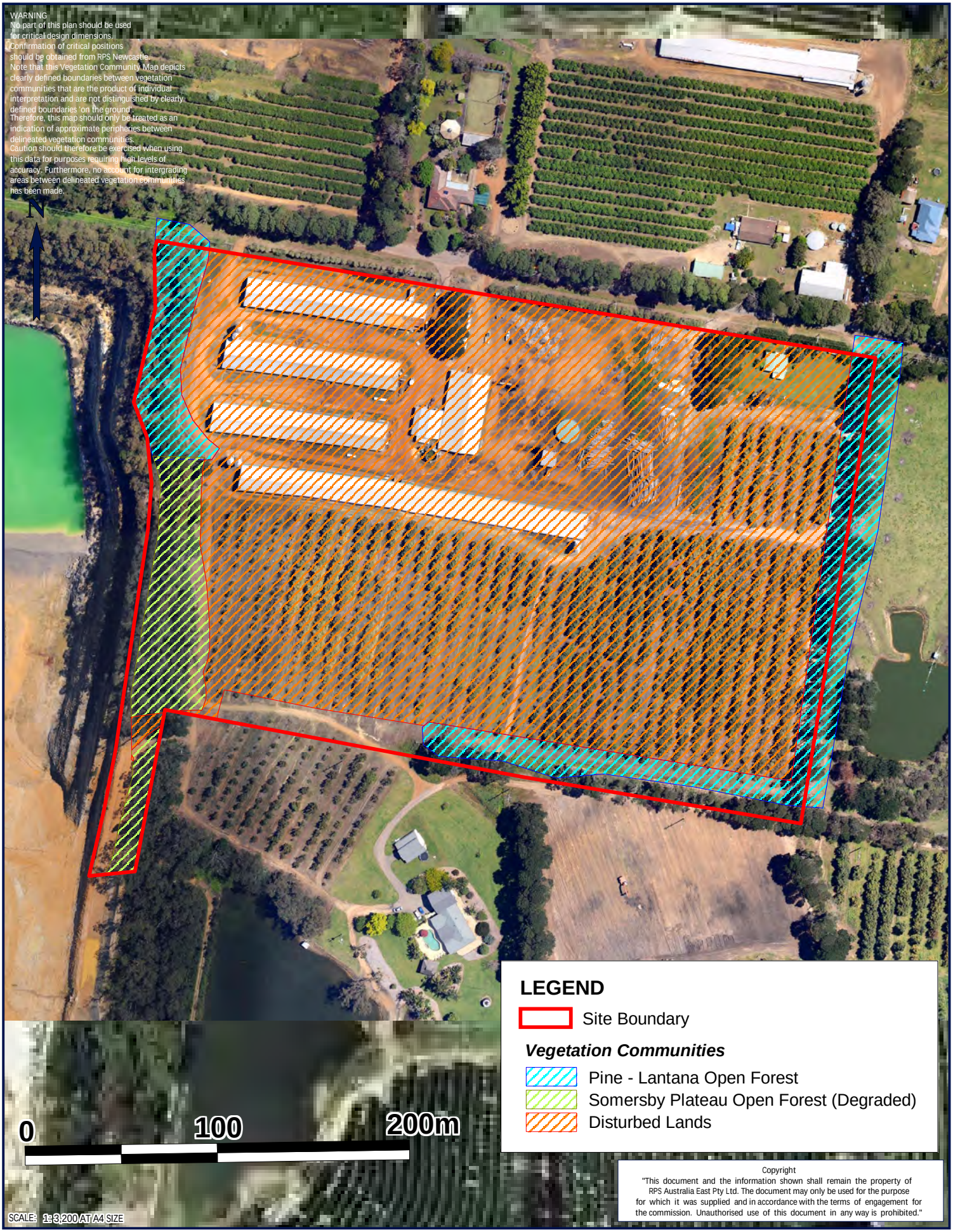
Disturbed Lands

Plate 3: Quarry Extension Area – Looking south-east across the Site

Description: This community is found throughout the majority of the quarry extension area. Previous clearing of the area has occurred for a variety of agricultural uses. Currently the area is utilised for poultry farming (4 sheds), avocado farming, and other minor land use activities. Very few native species are present and the site offers little habitat for native fauna and flora.

2.2.2 Threatened Flora Survey

No threatened flora species were detected within the site during the initial survey, or during targeted surveys undertaken during the flowering season for *Hibbertia procumbens*, *Prostanthera junonis and Tetratheca glandulosa* in late October 2010. No ROTAP species listed by Briggs and Leigh (1996) were recorded within the site.



TITLE: FIGURE 3 VEGETATION COMMUNITIES

LOCATION: SOMERSBY

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

DATE: 3/5/2011
PURPOSE: EIA

LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting\Ecology\MapInfo Workspaces
VERSION (PLAN BY): A A4 (MD-NW)

CLIENT: HANSON CONSTRUCTION MATERIALS PTY LTD
JOB REF: 103611

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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2.3 Fauna Survey

2.3.1 Habitat Assessment

Habitat within the site was assessed for its potential to support native fauna species including threatened fauna for which records occur within the wider locality.

Open forest communities provide moderately suitable habitat for a number of terrestrial mammals. They also provide abundant foraging resources such as foliage, pollen, nectar and invertebrates for possums and gliders. The dominant tree species have potential to supply nectar for the majority of the year, however most areas are characterised by trees of limited maturity, which limits the incidence of hollow-bearing trees within the site.

Disturbed areas with a low diversity and density of eucalypt species hold limited habitat for arboreal species. However these areas provide suitable habitat for common native browsers, such as various macropod species. They also provide habitat for pest species such as *Oryctolagus cuniculus* (Rabbit) and *Rattus rattus* (Black Rat).

The small number of hollow bearing trees located within the site limits roosting and den habitat for micro-chiropteran bats and some other hollow-dependent mammals, with no rocky outcrops or other cave like structures present. Hollow trees present were not suitable as breeding or roosting sites for owls, larger parrots or cockatoos. See Figure 4 for location of hollow-bearing trees and threatened species.

The wooded areas provide suitable foraging resources and nesting and roosting opportunities for a variety of sedentary birds, with the Pine-Lantana Open Forest vegetation community providing potential habitat for a range of woodland species. Only two trees of the species *Allocasuarina torulosa,* a favoured food source of *Calyptorhynchus lathami* (Glossy Black-Cockatoo) exists on the site, suggesting this species is unlikely to utilise the area to any significant extent. Terrestrial mammal species are present within the site and may provide hunting opportunities for a variety of forest owl species including *Ninox strenua* (Powerful Owl).

There are limited habitat opportunities for frog and reptiles species, with low to moderate shelter and foraging opportunities. The areas with the greatest potential habitat for frogs exist along the small drainage line running south west through the site and for reptiles within the good condition patch at the southern extremity of the site.

Within the quarry extension area the habitat opportunities for native flora and fauna are minor. The majority of the vegetated strip between the existing and proposed quarries is not of high quality due to the dominance of an exotic understorey and minimal structural diversity within the overstorey and understorey strata. Therefore habitat within this area is considered to exhibit very limited capacity to support potentially occurring threatened species in isolation. However it cannot be entirely discounted that more mobile species (eg. frogs, forest owl and bat species) may use it on an intermittent transitory basis.

2.3.2 Avifauna Survey

Bird species recorded within the quarry extension area were limited to common species such as *Cracticus tibicen* (Australian Magpie), *Dacelo novaeguineae* (Laughing Kookaburra) and *Rhipidura leucophrys* (Willie Wagtail). A wider variety of birds were recorded to the south of the quarry extension area, where the vegetation (Somersby Plateau Open Forest) is more extensive. Species included; *Grallina cyanoleuca* (Magpie-lark), *Lichenostomus chrysops* (Yellow-faced Honeyeater), *Cacatua galerita* (Sulphur-crested Cockatoo), *Anas superciliosa* (Pacific Black Duck) and *Chenonetta jubata* (Australian Wood Duck). A full list of birds observed within the site is provided in Appendix 3.

2.3.3 Spotlighting Survey / Stag Watching

A number of *Trichosurus vulpecula* (Brushtail Possums) were observed during spotlighting surveys and stagwatches. An individual *Pseudocheirus peregrinus* (Ringtail Possum), *Mus domesticus* (House Mouse) and *Rattus rattus* (Black Rat) were also noted.

2.3.4 Hair Tube Trapping

The results of the hair analysis from samples taken from the hair tubes identified three ground-dwelling species *Antechinus swainsonii* (Dusky Antechinus), *Antechinus stuartii* (Brown Antechinus) and the Black Rat.

2.3.5 Herpetofauna Survey

Targeted and opportunistic surveys were conducted for amphibians and reptiles within the proposed quarry extension area. Two common amphibian species, *Crinia signifera* (Common Eastern Froglet) and *Litoria verreauxii* (Whistling Tree Frog) were observed calling throughout the site, with one unidentified amphibian species, *Pseudophryne sp.*, heard calling on the edge of the vegetated area adjacent to the quarry extension.

The threatened frog, *Pseudophryne australis* (Red-crowned Toadlet) has been recorded within 1km of the site, it is likely that the individual heard calling may have been this species or the closely related more common *Pseudophryne bibroni*.

2.3.6 Call Playback

During call playback an individual owl species of the *Tyto* genus was noted flying overhead for a limited period of time. Due to the limited time the owl was in the area, and the height of the individual within the sky, identification was unclear. Threatened owl species are assessed further in Table 3.

2.3.7 Bat Call Survey

Seven species of bats were definitely identified, with one further species *Myotis adversus* probably identified from Anabat echo-location surveys of the site. A total of three threatened species were identified, *Miniopterus australis, Miniopterus shreibersii* and the probable recording of the *Myotis adversus*. The full results of this assessment are presented in Appendix 4.

2.3.8 Secondary Indications and Incidental Observations

No secondary indications and incidental observations of note were recorded on site.

2.4 Corridors and Habitat Linkages

The proposal will involve the removal of less than half a hectare of native vegetation within the quarry extension area and less than a quarter of a hectare within the southern access easement. The site is located between the quarry and adjacent agricultural lands, with broken links in the north to Brisbane Waters National Park. The construction of an access road though the southern portion of the native vegetation strip is the biggest potential impact of the development upon the native ecosystems within the site, but given ameliorating actions are taken to minimise vegetation removal, this road is unlikely to represent a significant break in vegetation connectivity sufficient to hinder the movement of native fauna as currently exist within the site and in the neighbouring area (Figure 1).

TITLE: FIGURE 4 THREATENED SPECIES AND HOLLOW-BEARING TREES
LOCATION: SOMERSBY
DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 3/5/2011
PURPOSE: EIA
LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting\Ecology\MapInfo Workspaces
VERSION (PLAN BY): A A4 (MD-NW)

CLIENT: HANSON CONSTRUCTION MATERIALS PTY LTD
JOB REF: 103611

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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3 Legislative Constraints Assessment

3.1 Identification of Subject Species and Communities

Threatened flora and fauna species (listed under the *TSC Act 1995* and / or the *EPBC Act 1999*) that have been gazetted and recorded within a 10 km radius of the site have been considered within this assessment (DECC 2009). Endangered Ecological Communities (EEC's) known from the broader area have also been addressed. Each species / community is considered for its potential to occur on the site and the likely level of impact as a result of the proposal. This assessment deals with each species / community separately and identifies the ecological parameters of significance associated with the proposal.

Those species / communities that have been identified as having either a moderate or greater chance of occurring within the site or that have been recorded on site during field investigations (subject species) have been subject to 7-part tests of significance in Appendix 1.

This assessment deals with the following heads of consideration in tabulated form (refer to Table 3 overleaf):

'Species / Community'/ Population – Lists each threatened species / EEC's known from the vicinity. The status of each threatened species under the *TSC Act (1995)* and the *Commonwealth EPBC Act (1999)* are also provided.

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

'Chance of Occurrence on Site' – Assesses the likelihood of each species / community to occur along or within the immediate vicinity of the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as Atlas of NSW Wildlife) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impacts from Proposal' – Assesses the likely level / significance of impacts to each species / community/ population that would result from the proposed development, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community on site with due recognition to other parameters such as home range, habitat utilisation, connectivity etc. It also considers the scope of the proposal, including the likely extent of disturbance, duration of construction works etc. The 'subject species / communities' are identified within this part of the assessment process and have been recommended where necessary for the application of the Seven-part test of significance in Appendix 1.

Table 3: Threatened Species and Communities Considered and Assessment of Potential Impacts

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Plants			
Acacia bynoeana Bynoe's Wattle (V*)	This species is endemic to central eastern NSW and occurs in an area from the Hunter district on the Central Coast south to Berrima and Mittagong in the Southern Highlands. Associated overstorey species also include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leafed Apple. This species is known from Lake Macquarie State Conservation Area, Blue Mountains, Royal and Marramarra National Parks, and Castlereagh, Dharawal and Agnes Banks Nature Reserves.	**Low** This species was not recorded within the site, with limited associated overstorey species present on site and a lack of preferred habitat.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Baloskion longipes Dense Cord-rush (V)	Found from the Kanangra Boyd area to the Southern Tablelands. Sometimes grows in Sphagnum moss but more commonly found in swamps or depressions in sandy alluvium. Also occurs in Black Gum (*Eucalyptus aggregata*) woodland and sails in tall forest.	**Low** This species was not recorded within the site, with preferred habitat, swamps or depressions, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Bothriochloa biloba Lobed Blue-grass (V*)	Lobed Blue-grass is known from the Darling Downs district in Queensland, south along the western slopes of the Great Dividing Range to North Star, Warialda, Bingara and Merriwa in NSW. It also occurs west to Dubbo and around the Hunter Valley Lobed Blue-grass grows in cleared eucalypt forests and relict grassland, often dominated by Purple Wiregrass (*Aristida ramosa*), Red-leg Grass (*Bothriochloa macra*), Red Grass (*B. decipiens*), Queensland Bluegrass (*Dicanthium sericeum*) or *Austrostipa aristiglumis*.	**Low** This species was not recorded within the site, with preferred habitat and associated species not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Caladenia tessellata Thick-lipped Spider-orchid (V*)	*Caladenia tessellata* is a member of a group of orchids characterised by five long spreading petals and sepals around a broad down-curled labellum ('lip'). This orchid is found in sheltered moist places in scrub and forests and prefers well-structured clay loam soils and often only seen following fire. It is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW.	**Low** This species was not recorded within the site, with preferred habitat and soil type, clay loam soils, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Callistemon linearifolius Netted Bottle Brush (V)	*C. linearifolius* grows in dry sclerophyll forest on the coast and adjacent ranges from the Georges River to Hawkesbury River in the Sydney area, and north to the northern shores of Port Stephens. Within the Lower Hunter this species has been recorded as a common-uncommon shrub within the Spotted Gum-Ironbark dominated associations within the Cessnock LGA. This species is also known from Lion Island Nature Reserve and Spectacle Island Nature Reserve (Atlas of NSW Wildlife).	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Cryptostylis hunteriana Leafless-tongue Orchid (V*)	The Leafless Tongue Orchid occurs from the Gibraltar Range (N.S.W) to eastern Victoria. RPS HSO have recorded this species in Catherine Hill Bay. This species is a saprophytic orchid, which grows in small localised colonies on flat plains close to the coast. This species has also been recorded in mountainous areas growing in moist depressions as well as in swampy habitats.	**Low** This species was not recorded within the site, with preferred habitat, flat plains and/or mountainous areas, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Darwinia glaucophylla (V)	Occurs entirely within the Gosford LGA of the Sydney Basin Bioregion, know from 15 sites of which several are within or near Brisbane Water N.P., with one in Popran N.P. Habitat includes sandy heath, scrub and woodlands associated with sandstone rock platforms, friable sandstone shallow soils and near hanging swamps.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Diuris bracteata (E)	Only 50 individuals known from the Sydney Basin Bioregion, all of which are not in conservation areas. Is known from several sites in Dry Sclerophyll woodland.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Epacris purpurascens var. *purpurascens* (V)	An erect shrub, 50-150 cm high that grows in sclerophyll forest, scrubs and swamps. This species occurs in a range of habitat types, most of which have a strong shale soil influence. Records for this species exist from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the south.	**Low** This species was not recorded within the site, with preferred habitat and soil type, strong shale soils, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Eucalyptus camfieldii Camfield's Stringybark (V,V*)	This species has a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. This species generally occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas, with associated species including; stunted *E. oblonga*, *E. capitellata* and *E. haemastoma*.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea (V*)	*Grevillea parviflora* ssp. *parviflora* is distributed from Prospect to Camden and Appin, with disjunct northern populations occurring near Putty, Cessnock and Cooranbong. A number of records of the species from the locality are known from secure habitats within Werakata National Park and from a number of other 'unprotected' locations around Kurri Kurri, Heddon Greta, Ellalong and on the western slopes of the Sugarloaf Range.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Grevillea shiressii (V,V*)	Endemic to the Gosford area, *Grevillea shiressii* is confined to a few valleys on the northern shores of the Hawkesbury River e.g. Mullet Creek and Mooney Mooney Creek. *G. shiressii* occurs in wet sclerophyll forest within its range.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Hibbertia procumbens Spreading Guinea Flower (E)	Found in locations in the Gosford and Wyong LGA's. Populations also in Yengo, Popran and Brisbane Water N.P., also in Strickland State Forest. Occurs in skeletal sandy soils within *Banksia ericifolia – Angophora hispida – Allocasuarina distyla* scrub/heath. Can associate with 'hanging swamp' vegetation communities on sandy deposits.	**Low - Moderate** This species was not recorded within the site despite targeted searches for this species during the 2010 flowering season, However several species of the same genus (ie Hibbertia) were recorded, these were carefully checked under a microscope and were not identified as this species. Low potential habitat for this species exists within the poor quality Somersby Plateau Open Forest and the Disturbed areas throughout the site.	**Low** Due to the potential habitat it is considered that this species may occur on site. Targeted searches throughout the site during the 2010 flowering period did not detect this species onsite. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas often near streams or low lying areas on alluvial soils of slopes or sheltered aspects from Jervis Bay to Port Macquarie. It may occur in dense stands adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Melaleuca deanei Deane's Melaleuca (V*)	*Melaleuca deanei* occurs in disjunct populations in coastal NSW in the Sydney region, predominantly in two areas. The first is known from the Mount Ku-ring-gai / Berowra area and the other from the Holsworthy / Wedderburn area, south of Sydney. Other isolated populations exist in the Blue Mountains, Nowra and Central Coast areas. *M. deanei* occurs in heath on sandstone habitats. Estimates on the total population of this species are within the vicinity of 1000-3000 plants (NSW NPWS Scientific Committee 2000), although due to the clonal nature of the species, this may be an overestimation.	**Low** This species was not recorded within the site, with preferred habitat, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Prostanthera askania Tranquility Mintbush (E)	*Prostanthera askania* is restricted to the Ourimbah-Narara area near Gosford on the Central Coast of NSW, where it is known to exist in only 5 populations. It grows in sclerophyll forests on ridges adjacent to rainforest.	**Low** This species was not recorded within the site, with preferred habitat, sclerophyll forests on ridges, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Prostanthera junonis Somersby Mintbush (E, E*)	*Prostanthera junonis* is restricted to the Somersby area near Gosford on the Central Coast of NSW. There are currently eight known populations within a restricted range of approximately 10km north to south in the vicinity of Somersby. A ninth population occurs as an outlier colony, 9km outside of the remaining eight. Occurs in soil landscapes over weathered Hawkesbury sandstone within open forest/ low woodland/ open scrub.	**Low - Moderate** This species was not recorded within the site despite targeted searches during the flowering season.	**Low** Due to the low quality of potential habitat it is considered that this species is unlikely to occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Rhizanthella slateri Eastern Underground Orchid (E*)	*Rhizanthella slateri* ranges from southeastern Queensland to the south coast of NSW. In NSW, it is currently only known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. At each location, only a few individuals are known. The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available.	**Low** This species was not recorded within the site, with no preferred habitat located within the site and limited records within the area.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
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.	**Low** This species was not recorded within the site, with preferred habitat, sub-tropical and littoral rainforest, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Tetratheca glandulosa Glandular Pink-bell (V,V*)	It is found in heath and woodland communities, with a range restricted to the North Shore of Sydney and an area north of the Hawkesbury River. It prefers well-drained soils in an open sunny position.	**Low - Moderate** This species was not recorded within the site, however potential habitat for this species exists within the Somersby Plateau Open Forest throughout the site.	**Low** Due to the potential habitat it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Herpetofauna			
Heleioporus australiacus Giant Burrowing Frog (V,V*)	The current distribution of *H. australiacus* is south-eastern NSW to Vic. Locally it occurs north to Jervis Bay (Daly 1996), and is mostly restricted to sandy creek banks, often in association with crayfish burrows in this area (Robinson, M. 1996). The northern population has a marked preference for sandstone ridge-top habitat and broader upland valleys. In these locations the frog is associated with small headwater creek lines and along slow flowing to intermittent creek-lines. The Giant Burrowing Frog is grey to dark chocolate brown or black above with a white belly, a few yellow spots along the flanks. During the summer, males call like an owl hoot, from burrows within creek banks. Females lay eggs in a foamy nest in the burrow, and the developing tadpoles are washed from the burrows into the creeks during heavy rain.	**Low - Moderate** This species was not recorded within the site. Potential habitat for this species exists along the drainage line, running south west through the site.	**Low** Due to the potential habitat and records within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Hoplocephalus bungaroides Broad-headed Snake (V*)	Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	**Low** This species was not recorded within the site, with the preferred habitat of this species and shelter requirements not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Litoria aurea Green and Golden Bell Frog (V*)	This frog was formerly known to inhabit the eastern seaboard of New South Wales and Victoria from Byron Bay to the Gippsland Lake Region as well as highland sites (New England District, south-western slopes of N.S.W. and Monaro District). Recent literature indicates that it is no longer found on sites above an altitude of 300m above sea level. This frog species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. *L. aurea* is thought to be displaced from more established sites by other frog species thus explaining its existence on disturbed sites.	**Low** The survey did not record this species within the subject site with no potential habitat present within the site. Recent records suggest this species prefers habitat with a saline influence in the proximity to the lower reaches of the Hunter River.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Litoria brevipalmata Green-thighed Frog (V)	Occurs in a range of habitats in areas where surface water gathers after rains. From rainforests and moist Eucalypt forest to dry Eucalypt forests and heath. Males congregate around temporary pools that form after very heavy rains.	**Low** This species was not recorded within the site, with the preferred habitat of this species, wet forests and riparian areas, not present within the site. Records of this species occur from at least 5kms away.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Litoria littlejohni Littlejohn's Tree Frog (V*)	A pale brown frog with dark speckles which occurs along permanent rocky creeks with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Occurs on the plateaus and eastern plains of the Great Dividing Range. Records within the Hunter Region occur from within the Watagan State Forest.	**Low** This species was not recorded within the site with the preferred habitat of this species, along permanent rocky creeks with thick fringing vegetation, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Mixophyes balbus Stuttering Frog (E,V*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breed in streams during summer after heavy rain, outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.	**Low** This species was not recorded within the site with the preferred habitat of this species, rainforest and wet, tall open forests, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Mixophyes iterates Giant Barred Frog (E,E*)	Mostly restricted to wet sclerophyll forest and rainforest, including Antarctic Beech forest. Usually found within close proximity to permanent running water. Hunter Region records are largely confined to the Watagan National Park and to the north of Heaton State Forest (Atlas of NSW Wildlife data).	**Low** This species was not recorded within the site with the preferred habitat of this species, wet sclerophyll forest and rainforest, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Pseudophryne australis Red-crowned Toadlet (V)	Generally restricted to Hawkesbury Sandstone where it may be found beside temporary creeks, gutters and soaks and under rocks and logs. Breeds in deep leaf litter inundated with heavy rain (Robinson, M, 1996).	**Low - Moderate** Possible calls of this species were heard during fieldwork however this was not confirmed. Potential habitat for this species exists along the drainage line, running south west through the site.	**Low** Due to the possible presence of this species, potential habitat and records within the area, it is considered that this species may occur on site. However given the limited amount of potential foraging habitat being removed as a result of the quarry extension and the location of the proposed access road such it avoids any potential breeding areas for this species, the development is not likely to have any significant impact upon this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Avifauna			
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Found in the summer months in tall mountain forests and woodlands, and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	**Low** This species was not recorded within the site with the preferred habitat of this species not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones, particularly those of *A.littoralis*, *A. torulosa* and occasionally *A. distyla*. Requires large Eucalypt tree hollows for nesting.	**Low - Moderate** This species was not recorded within the site, however foraging habitat exists with a small number of *Allocasuarina* species noted during field surveys.	**Low** Due to the potential foraging habitat and records within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Grantiella picta Painted Honeyeater (V)	*Granitella picta* (Painted Honeyeater) can be found throughout eastern and parts of northern Australia. *G. picta* lives almost entirely on the berries of mistletoes, and therefore its movements are tied to the flowering and fruiting of these plants, other food sourced consists of nectar and insects. The nest is a small, cup shaped, lace-like structure composed of fine rootlets and fibre bound with cobweb. It is placed in the outermost drooping branches of a Eucalypt, Tea-tree or Oak at 5-20m from the ground.	**Low** This species was not recorded within the site with the preferred foraging habitat of this species, the berries of mistletoes, not present within the site.	**Low** No potential foraging habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Pomatostomus temporalis Grey-crowned Babbler (V)	Occupies open forests and woodlands, *Acacia* shrubland and adjoining farmland. They feed on terrestrial invertebrates and insects on lower trunks and branches. They prefer wooded areas with an intact ground cover. Appears unable to persist in cleared and highly fragmented habitats.	**Low** This species was not recorded within the site with the preferred habitat of this species not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Pterodroma nigripennis Black-winged Petrel (V)	*Pterodroma nigripennis* (Black-winged Petrel) is a markedly pelagic species occasionally ranging into shelf-break waters. *P. nigripennis* feeds by surface seizing, dipping and patterning, with cephalopods and prawns being the main prey types taken. During the non-breeding season this species inhabits the north central Pacific Ocean. During the breeding season (October -February), *P. nigripennis* inhabit subtropical and tropical islands and islets in the southwest of the Pacific Ocean. This species is rarely seen in Australian waters. *P. nigripennis* nest in burrows or rock crevices on vegetated coastal slopes or rugged terrain inland.	**Low** This species was not recorded within the site with the preferred habitat of this species not present within the site.	**Low** No potential foraging habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Neophema pulchella Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Occurs in more easterly site on the Cumberland Plain and the Hunter Region.	**Low** This species was not recorded within the site with the preferred habitat of this species and suitable nest hollows absent from the site.	**Low** No potential foraging habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Lathamus discolor Swift Parrot (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 as a consequence of varying eucalypt blossoming cycles. Nests only in Tasmania.	**Low** This species was not recorded within the site with the preferred foraging habitat of this species limited within the site.	**Low** Limited potential foraging habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Ninox connivens Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Hunts a range of prey species including birds and both terrestrial and arboreal mammals.	**Low** This species was not recorded within the site with the preferred nesting and roosting habitat of this species limited within the site.	**Low** Limited potential nesting and roosting habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
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.	**Low - Moderate** This species was not recorded within the site; however foraging habitat exists within the site.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
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 these hollows are also preferred for roosting sites.	**Low** This species was not recorded within the subject site. Suitable breeding habitat for this species does not exist on site.	**Low** Due to the lack of individuals and lack of breeding habitat observed on the site, this species is unlikely to be affected by the 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.	**Low - Moderate** This species was not recorded within the site; however foraging habitat exists with limited roosting habitat present.	**Low** Due to the potential foraging habitat and limited roosting habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Anthochaera phrygia Regent Honeyeater (E*)	*A. phrygia* occurs in temperate woodlands and open forest, including forest edges. Seasonal movements appear to be dictated by the flowering of various species of *Eucalypt* sp. that are characteristic of the dry forests and woodlands of South-Eastern Australia. *Anthochaera phrygia* prefers to forage on large-flowered Eucalypts (e.g. *Eucalyptus sideroxylon*, *E. melliodora*, *E. albens, E. leucoxylon*) and also *Corymbia maculata* (Spotted Gum) particularly where these trees grow in more productive areas and yield plentiful and predictable nectar flows. This species has been recorded in Werakata National Park and has also been recorded over several seasons within Aberdare State Forest. Regionally, records exist from a number of conservation reserves including Cattai, Scheyville, Blue Mountains, Brisbane Water, Dharug, Bouddi, Wollemi and Yengo National Parks and Muogamarra Nature Reserve.	**Low** This species was not recorded within the site with the preferred foraging habitat of this species limited within the site.	**Low** Limited potential foraging habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Rostratula australis Australian Painted Snipe (V*)	*R. australis* appears to be nomadic, with movements mainly north in winter and south in summer. It requires shallow fresh water for breeding, though the nest is not deserted if the water dries up. Within New South Wales, the Painted Snipe occurs at both inland and coastal localities. It is known to inhabit shallow freshwater wetlands with muddy ground for foraging and dense	**Low** This species was not recorded within the site with the preferred habitat of this species not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
	low vegetation for cover. Such wetlands can be permanent or ephemeral in nature.		
Mammals			
Cercartetus nanus Eastern Pygmy-possum (V)	Occurs from rainforest through sclerophyll forest to tree heath. Favoured food being banksias, myrtaceous shrubs and trees and insects. Nesting sites are generally in drier habitats.	**Low - Moderate** This species was not recorded within the site; however suitable foraging habitat exists.	**Low** Due to the potential foraging and nesting habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
Chalinolobus dwyeri Large-eared Pied Bat (V*)	This species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. Records of this species exist in dry sclerophyll forest and woodland, both to the east and west of the Great Divide. Recordings of this species have also been made in subalpine woodland and at the ecotone of rainforest and wet Eucalypt forest.	**Low** This species was not recorded within the site with preferred roosting habitat, ie. cliffs and caves, not present, but potential foraging habitat present on the site.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.
Dasyurus maculatus maculatus Spotted-tailed Quoll (V,E*)	Found in a variety of forested habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development.	**Low - Moderate** This species was not recorded within the site; however foraging habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
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.	**Low - Moderate** This species was not recorded within the site however suitable foraging habitat exists.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
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.	**Low** This species was not recorded within the site with preferred habitat, tall and mature wet Eucalypt forest, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Petrogale penicillata Brush-tailed Rock-wallaby (V*)	The Brush-tailed Rock-wallaby is an agile inhabitant of rocky slopes of south-eastern Queensland and northern New South Wales with remnant populations in Victoria and western New South Wales. The sites occupied by *P. penicillata* mostly have a northerly aspect, so as to allow the animals to sun themselves in the early morning and late afternoon. They are known to occur in forests and woodlands along the Great Divide and on the western slopes in escarpment country with suitable caves and rocky overhangs for shelter.	**Low** This species was not recorded within the site with the preferred habitat for shelter, caves and rocky overhangs, not present within the site.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	**Low** This species was not recorded within the site. The preferred feed tree, *Eucalyptus haemastoma* was present; however it occurred in less than 15% of the site with no secondary indications observed.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the quarry extension.
Potorous tridactylus tridactylus	Prefers cool rainforest, wet sclerophyll forest and heathland. Sleeps by day in a nest on the ground, and digs for succulent roots, tubers, fungi and subterranean insects. Some diggings	**Low** This species was not recorded within the site with preferred habitat, cool	**Low** No potential habitat is present within the site and thus this species is unlikely

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Long-nosed Potoroo (V,V*)	seemingly attributable to this species may belong to *Isoodon macrourus* (Northern Brown Bandicoot).	rainforest, wet sclerophyll forest and heathland, not present within the site.	to be effected by the quarry extension.
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.	**Low - Moderate** This species was not recorded within the site however suitable foraging habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.
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.	**Low - Moderate** This species was not recorded within the site however suitable foraging and roosting habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.
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.	**High** This species was recorded within the site where suitable foraging habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.
Miniopterus schreibersii 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.	**High** This species was recorded within the site where suitable foraging habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.
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. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels.	**High** This species was recorded within the site where suitable foraging and roosting habitat exists.	**Low** Due to the potential foraging and roosting habitat within the site (including adjacent dam area) it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species. *Notwithstanding, it is recommended that a Part 7 Test Of Significance be applied to this species (see Appendix 1).*
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, especially *Eucalyptus* sp.	**Low - Moderate** This species was not recorded within the site however suitable foraging and roosting habitat exists.	**Low** Due to the potential foraging habitat within the area it is considered that this species may occur on site. However the limited amount of potential habitat being removed as a result of the quarry extension is likely to only have a low impact on this species.

Key: **(V) =** Vulnerable Species listed under *Threatened Species Conservation Act 1995* (TSC Act 1995).
(E) = Endangered Species listed under *TSC Act 1995*.
(EP) = Listed as an Endangered Population under the *TSC Act 1995.*
(V*) = Vulnerable Species listed under *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999).
(CE*) = Critically Endangered Species listed under *EPBC Act 1999.*
(M*) = Listed as a Migratory species under the *EPBC Act 1999.*

3.2 Key Threatening Processes

KTP's are listed in Schedule 3 of the *TSC Act (1995).* Five KTP's have the potential to affect the site as a consequence of the proposal, being:

- Clearing of Native Vegetation;
- Invasion, establishment and spread of Lantana camara (Lantana);
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees; and
- Human Caused Climate Change.

"Clearing of Native Vegetation"

The proposal is likely to contribute to the Key Threatening Process 'Clearing of Native Vegetation' as the quarry extension would involve clearing of small areas of Somersby Plateau Open Forest. This KTP is, however, not believed to be of significance to any of the threatened species addressed due to the presence of larger tracts of similar habitat opportunities south within the immediate area and west within the Brisbane Rivers National Park.

"Invasion, Establishment and Spread of Lantana"

The proposal is not likely to contribute to the Key Threatening Process "Invasion, establishment and spread of *Lantana camara* (Lantana)". Provided great care is taken when clearing commences, so as to not allow the spread of Lantana into the surrounding area, the opportunities for weed invasion will be reduced as a result of the quarry extension.

"Loss of hollow-bearing trees"

The proposal is likely to contribute to the Key Threatening Process "Loss of hollow-bearing trees". A small number (2) of hollow-bearing trees occur within the quarry extension area; however it is considered that clearing is unlikely to be of major significance to locally occurring fauna or threatened species due to the low numbers and the presence of larger more substantial hollow bearing trees south within the immediate area and west within the Brisbane Rivers National Park.

"Removal of dead wood and dead trees"

The proposal is likely to contribute to the Key Threatening Process "Removal of dead wood and dead trees" as the proposal will involve the removal of ground debris. A limited amount of dead wood and dead trees occurs within the quarry extension area; however it is considered that clearing is unlikely to be of significance to any threatened fauna species due to the low numbers of hollow dead wood or dead trees and the presence of larger tracts of similar habitat opportunities south within the immediate area and west within the Brisbane Rivers National Park.

"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 and modification of the environment. It is considered that clearing and modification of the landscape could constitute a minor incremental change. Thus the extent to which the proposal would contribute to this process is considered unlikely to be significant.

3.3 Considerations under EPBC Act

Considerations have been made under the Commonwealth *EPBC Act (1999*). An EPBC Act Protected Matters Search was undertaken within the Department of the Environment, Water, Heritage and the Arts (DEWHA 2009) on-line database to generate a list of those matters of National Environmental Significance (NES) from the area, which may have the potential to occur within the site. This data, combined with other local knowledge and records, was utilised to assess whether the type of activity proposed on the site will have, or is likely to have a significant impact upon a matter of (NES), or on the environment of Commonwealth land*.

* The site is not land owned by the Commonwealth, and hence this portion of the Act is not applicable. The matters of NES and site-specific responses are listed below.

- World Heritage areas:

The site is not a World Heritage area, and is not in close proximity to any such area.

- Wetlands protected by international treaty (the RAMSAR convention):

The site is not part of any RAMSAR Wetland area, and is not in close proximity to any such area.

- Nationally listed threatened species and ecological communities:

A total of 29 nationally listed threatened species under the *EPBC Act (1999)* were listed as being relevant within the proximate region of the site (See Section 3.1).

- *Acacia bynoeana* Bynoe's Wattle
- *Anthochaera phrygia* Regent Honeyeater
- *Bothriochloa biloba* Lobed Blue-grass
- *Caladenia tessellata* Thick-lipped Spider-orchid
- *Chalinolobus dwyeri* Large-eared Pied Bat
- *Cryptostylis hunteriana* Leafless Tongue – orchid
- *Dasyurus maculatus maculatus* Spotted-tail Quoll
- *Eucalyptus camfieldii* Camfield's Stringybark

- *Grevillea parviflora subsp. parviflora* Small-flower Grevillea
- *Grevillea shiressii*
- *Heleioporus australiacus* Giant Burrowing Frog
- *Hoplocephalus bungaroides* Broad-headed Snake
- *Lathamus discolor* Swift Parrot
- *Litoria aurea* Green and Golden Bell Frog
- *Litoria littlejohni* Littlejohn's Tree Frog
- *Macquaria australasica* Macquarie Perch
- *Melaleuca biconvexa* Biconvex Paperbark
- *Melaleuca deanei* Deane's Melaleuca
- *Mixophyes balbus* Stuttering Frog
- *Mixophyes iterates* Southern Barred Frog
- *Petrogale penicillata* Brush-tailed Rock-wallaby
- *Potorous tridactylus ssp. tridactylus* Long-nosed Potoroo
- *Prostanthera junonis* Somersby Mintbush
- *Prototroctes maraena* Australian Grayling
- *Pteropus poliocephalus* Grey-headed Flying Fox
- *Rhizanthella slateri* Eastern Underground Orchid
- *Rostratula australis* Australian Painted Snipe
- *Syzygium paniculatum* Magenta Lilly Pilly
- *Tetratheca glandulosa* Glandular Pink-bell

The potential for the proposal to significantly impact on individuals or local populations for the above species has been assessed under the provisions of the *EPA Act (1979)*. This assessment concluded that it is considered unlikely the current proposal will have a significant impact upon a local population such that local extinctions would occur. Likewise, it is considered that no significant impacts are likely to occur on a Commonwealth level. As such, the proposal is not likely to be a controlled action in relation to any of these matters of National Environmental Significance. Thus referral to the DEWHA is not considered necessary.

A total of 12 Nationally listed migratory species were identified from DEWHA search (2009):

- *Apus pacificus* Fork-tailed Swift
- *Ardea alba* Great Egret
- *Ardea ibis* Cattle Egret
- *Gallinago hardwickii* Latham's Snipe

- *Haliaeetus leucogaster* White-bellied Sea Eagle
- *Hirundapus caudactus* White-throated Needletail
- *Merops ornatus* Rainbow Bee-eater
- *Monarcha melanopsis* Black-faced Monarch
- *Myiagra cyanoleuca* Satin Flycatcher
- *Rhipidura ruffifrons* Rufous Fantail
- *Rostratula benghalensis* Painted Snipe
- *Anthochaera phrygia* Regent Honeyeater

The proposal is not likely to cause any significant impact to those migratory species potentially occurring in the vicinity of the site.

- All nuclear actions:

No type of nuclear activity is proposed for the site.

- Commonwealth marine areas:

The proposed activity on the site will not have a significantly adverse effect on any Commonwealth marine area.

Summary Statement:
Based on the above, it is considered the current proposal will not have a significant impact on any matters of NES under the *EPBC Act (1999*); hence referral to the DEWHA is not considered to be necessary.

4 Key Thresholds and Compensatory Strategies

Pursuant to the DECC's EA requirements, *"The EA will need to document actions that will be taken to avoid or mitigate impacts, or compensate or offset for unavoidable impacts on threatened species and their habitat, if applicable. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. The EA needs to clearly state whether it meets each of the key thresholds set out in the Guidelines (DEC 1979). Where significant modification of the proposal to minimise impacts on threatened species, populations or endangered communities is not possible then compensatory strategies should be considered (if applicable)"*.

(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**

Actions taken as part of this proposed development which will have an ameliorating effect upon the native ecosystems present on the site include:

(a) Placement of quarry extension in relation to extent of native vegetation on the site. Only 0.5 ha of vegetation will be removed as a result of the extension, half of which is dominated by exotic species, the other half is native vegetation which is in a degraded condition.

(b) Placement of access road to the east of the quarry extension will involve the removal of exotic vegetation only.

(c) Placement of access road to the south-west of the quarry extension will avoid any incursion into lands protected under the Water Management Act (2000) and potential breeding habitat for *Pseudophryne australis* and will follow a strategy of minimal tree removal accompanied by some under-scrubbing. Approximately 0.1 ha of native vegetation is anticipated to be directly affected by the access road;

(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**

As long as the above measures are adhered to, their effectiveness in minimising direct and indirect impacts upon fauna and flora communities will be sufficient such that the long-term viability of any threatened species, population or ecological communities will not be adversely affected by the proposal.

(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.**

As long as the above measures are adhered to, their effectiveness in minimising direct and indirect impacts upon fauna and flora communities will be sufficient such that the extinction-proneness of any threatened species, population or ecological communities will not be adversely affected by the proposal.

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

There is no declared "Critical Habitat" within the Gwandalan site locality, and as such the proposal will not be adversely affect any such habitat.

- Appendix 1 details the 7 Part tests to test if any of the proposed exceed any of the thresholds identified in the Threatened Species Assessment Guidelines: The Assessment of Significance (DECC 2007) and is compliant with the Draft Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning and Assessment Act (DEC 1979).
- No residual impacts upon threatened species are anticipated, therefore no compensatory habitat is warranted.

5 Ecological Assessment Conclusion & Recommendations

5.1 Conclusions

RPS has been commissioned by Insite Planning Engineering Environmental on behalf of Hanson Construction Materials Pty Ltd to prepare a flora and fauna assessment for inclusion into an Environmental Assessment. Two vegetation communities were identified as occurring on the site, that being MU E26d "Somersby Plateau Forest" and "Pine-Lantana Open Forest". Most of the quarry extension area itself may be described as a third community "disturbed area".

The majority of the vegetation present within the quarry extension area is disturbed with less than half a hectare of Somersby Plateau Open Forest present. The habitat within this area is not of high quality due to minimal structural diversity within the overstorey and understorey strata and the disturbed nature of the site. Limited roosting and shelter habitat exists for native fauna and possible threatened species, with the area possibly utilised primarily for foraging purposes.

Therefore the removal of less than a hectare of native vegetation within both the quarry extension area and the southern access easement is unlikely to affect the movement and dispersal of fauna. The habitat within this area is considered to exhibit very limited capacity to support potentially occurring threatened species in isolation. However it cannot be entirely discounted that more mobile species (eg. forest owl species) may use it on an intermittent, transitory basis.

5.2 Recommendations

The potential impacts arising from the quarry extension on threatened species, populations and / or Endangered Ecological Communities listed under the *TSC Act 199*5 and/or *EPBC Act 1999* is likely to reduce biodiversity. However, if the recommendations outlined below are implemented the impacts can be reduced. These general recommendations are as follows, with specific study area recommendations below;

- Sediment and nutrient controls should be implemented to help prevent *Lantana camara* (Lantana) seed dispersal;
- Pre-clearing inspections should be undertaken by an ecologist in wooded areas including during the removal of hollow bearing trees. Should the removal of hollow-bearing trees be required, then appropriate tree removal guidelines and certification should be implemented using a qualified ecologist onsite. This may involve the supervision of clearing and habitat augmentation. No breeding attempts should be disrupted during the course of the project, so clearing should be undertaken in late summer /autumn;

- Where possible, protect the drainage line running east-west along the southern boundary of the proposed quarry extension area from direct and indirect disturbance. Where any disturbance is required to occur to this potential habitat for Red-crowned Toadlet (*Pseudophryne australis)* it is recommended that an ecologist be present during works to ensure that any toadlets in affected areas are relocated to appropriate adjoining suitable habitat;
- Retention of hollow-bearing trees with respect to the southern access, where practical, to provide continued habitat for fauna species;
- Minimise potential impacts associated with erosion and sedimentation during construction through the inclusion of appropriate erosion and sediment controls; and
- Minimise potential impacts arising from stormwater runoff into riparian areas by designing and installing appropriate stormwater detention and/or filtering devices. Avoid any construction within any 10m of the mapped stream onsite.

Component B: Groundwater Dependant Ecosystems Assessment

1 Groundwater Dependent Ecosystems

1.1 What is a Groundwater Dependent Ecosystem?

Groundwater is water which occurs beneath the soil that has filtered down to the zone where the soil or rocks are fully saturated. Water occupies the spaces between the particles of clay and sand, or in cracks and crevices in rock. The top of this saturated zone is called the watertable (DLWC, 2002). There are differing types of Groundwater Systems, each with their associated dependent ecosystems (DLWC, 2002) and these include the following:-

(1) *Deep Alluvial Groundwater Systems* – associated with floodplains of major rivers west of the Great Dividing Range (eg. Murray, Lachlan and Murrumbidgee Rivers);

(2) *Shallow Alluvial Groundwater Systems* – associated with coastal rivers and the higher reaches of rivers west of the Great Dividing Range (eg. Hunter, Pell, Cudgegong, Bellinger and Nambucca Rivers);

(3) *Fractured Rock Groundwater Systems* – associated with outcropping and sub-cropping rocks contain fractures, joints, bedding planes and faults (eg. Alstonville Basalt, Molong Limestone and Young Granite);

(4) *Coastal Sand Bed Groundwater Systems* – associated with sand beds along the coast of NSW (eg. Botany Bay Sand Beds and Tomago Sand Beds); and

(5) *Sedimentary Rock Groundwater Systems* – associated with sandstone, shale and coal bedrocks (eg. Great Artesian Basin, Sydney Basin and Clarence Moreton Basin).

Groundwater Dependent Ecosystems (GDE's) is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). There are four types of ecosystems that have been identified as GDE's and these include:-

(1) *Terrestrial vegetation* – Forests and Woodlands can be dependent upon groundwater either permanently or seasonally by extending their roots into a shallow groundwater system (eg Shallow Alluvial Groundwater Systems);

(2) *Base flow in streams* – River flows can be maintained largely by groundwater long after a rainfall event and can provide some rivers with their base water flows;

(3) *Aquifer and cave ecosystems* – These systems are usually associated with limestone or karst caves, these cave support aquatic fauna such as crustaceans;

(4) *Wetlands* – These communities include paperbark swamps, hanging swamps and aquatic wetlands, these communities are usually permanently reliant upon groundwater.

1.2 Legislative Requirements

There are several levels of legislation which have been developed to protect GDEs. These include at a state legislation, state planning polices and at a local level water sharing plans. Legislation and policies which are relevant the site including the following:-

- *Water Management Act 2000* in which the Minister for Land and Water Conservation manages and controls the extraction of groundwater under the. This act aims to sustainable and integrated management of water. Section 5(2)a of the act relates to protection of water source and Section 5(2)c relates to water quality. Both of these sections of the act would directly relate to Groundwater Dependent Ecosystem (GDE) as both water quality and quantity would impact upon these ecosystems;
- *The NSW State Groundwater Dependent Ecosystem Policy (2002)* has been developed to protect ecosystems which have a reliance on groundwater for survival. This document outlines a rapid assessment process which is used for identifying and valuing GDE's which assists in the management of GDEs at a state level;
- *Groundwater Dependent Ecosystems Assessment, Registration and Scheduling of High Priority (2006)* this document was written by Department of Land and Water Conservation and was developed to classify GDE's in order of priority of protection; and
- *Water Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources (2004)* this document was written by the Department of Infrastructure, Planning and Natural Resources under Section 50 of the *Water Management Act 2000.* The aims of the plan are the "sustainable, equitable and efficient use of groundwater in the Kulnura Mangrove Mountain Groundwater sources to preserve, enhance and rehabilitate the environmental, social, cultural and economic uses of groundwater for the present and the future".

1.3 Relevance of GDE's to the Proposal

Groundwater levels within the site are variable but generally occur between 16m and 30m below ground level. The existing quarry workings currently have a maximum of 50m below natural ground level. Therefore the existing works are likely to have caused a depression within the water table as there is currently no seepage on quarry walls (Insite, 2009). Depending upon the final design and operation the proposed quarry expansion has the potential to lower the groundwater table further. Therefore potential impacts associated with lowering of the current water table could occur such as influence water availability to GDEs.

1.4 Aims of the Groundwater Dependent Ecosystem Assessment

The aims of the assessment on GDE's are as follows:

- Identify any Groundwater Dependent Ecosystems within the site or surrounding the site;
- Review of the Natural Vegetation of Gosford LGA (Bell 2004) to identify any GDE's located within the surrounding area;
- Assess the potential of the proposal to have a significant impact on any groundwater dependent ecosystems which may have the potential to occur within the site or within the vicinity of the site.

The purpose of this assessment is to:

- ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any Groundwater Dependent Ecosystems or potential significant impacts that may exist on the site or within the vicinity of the site;
- provide information to enable compliance with applicable assessment requirements contained within the WM Act (2000) and any other relevant state polices, regional and local environmental planning instruments; (as mentioned above); and
- enable the identification of potential management avenues for any potential impacts which may occur.

1.5 Methodology

Several methodologies were used to identify any potential GDEs within and surrounding the site. These methodologies included a combination of desktop assessment and field assessments and these are outlined below:-

1.5.1 Desktop Assessment

Assessments drew on a number of information sources and information provided by Government Authorities in identifying GDE's. Data gathered during preliminary assessments was used to assist in identifying potential GDEs so that field investigations could more efficiently focus survey effort. Assessment information sources included:-

(1) The NSW Groundwater Dependent Ecosystem Policy providing definition of a GDE was used to determine potential GDEs;

(2) Review of the Natural Vegetation of the Gosford LGA (Bell, 2002) for terrestrial vegetation within the surrounding region;

(3) A review of Water Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources (2004) to identify GDE's of high priority;

(4) A review of GIS data including (but not limited to) aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil Landscapes, and geology and;

(5) A review of Preliminary Assessment Report (Insite, 2008) on groundwater and hydrology to assess the depth of watertable.

1.5.2 Field Survey

Vegetation mapping carried out on the site has been undertaken follows the methodology set out in Section 2 of this report. Field observations of geology, soils and existing drainage lines were made to assist in the assessment of GDEs within the site.

1.6 Groundwater Systems

The soil landscape across the site is comprised of the Somersby landscape as described by Murphy (1993). These soils are underlain by Hawkesbury Sandstone, with the site having medium to coarse-grained quartz sandstone with minor shale and laminate lenses. It is therefore found that the Groundwater system present within the area is classified as Sedimentary Rock Groundwater System. This groundwater system is commonly occurs within the Sydney Basin (DLWC 2002).

1.6.1 GDEs within the site

None of the vegetation communities within the site equate to any GDEs. However one creekline was observed within the site which is mapped on the topographic map as traversing the site from east to west and flows into Mooney Mooney Creek. It is unclear if this tributary is groundwater fed. Boreholes within the existing quarry workings estimate the water to be between 16m and 30m below ground level, which indicates that this tributary is not groundwater fed. Thus this small tributary is not considered to be a GDE. This tributary now flows into dams within the existing quarry workings and surface water runoff is collected and discharged into the adjacent Brisbane Water National Park under a license issued by the NSW EPA.

1.6.2 GDEs within the region

The vegetation mapping undertaken by Bell (2002) has been used to develop a map of potential Terrestrial Vegetation and Wetland ecosystems which could occur within the region. This mapping has been done on a large scale so as to take into account the broad catchment of Mooney Mooney Creek. The Water Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources was consulted to determine the sources for the groundwater. This site occurs within Zone 8 Mooney Mooney and Mullet Creek. However the adjoining Zone 1 is the Drinking Water Catchment, which is included, as the existing quarry workings occur within this zone. The combined proposed extension and the existing workings may possibly impact upon this Zone as well.

Fifteen potential vegetation communities mapped by Bell (2002) have been identified as potential GDEs (Figure 5). In addition to vegetation, physical systems such as rivers and caves can also be groundwater dependent, and it is highly likely that Mooney Mooney Creek and its tributaries are GDEs. This creek has been identified within the Water

Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources as a groundwater source. It must be noted that this creek system has a large catchment and water flow would be a combination of surface and groundwater flows, however groundwater is required to maintain base flows in times of low rainfall. These GDEs have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types. Table 4 below outlines the GDE types, classes and sub-classes as per DLWC (2006) which occur within the Mooney Mooney Creek catchment.

As shown in Figure 5 the closest GDE's are Sandstone Hanging Swamps and Hawkesbury Banksia Scrub – woodland. These communities are located approximately 500 m to the south and 500m to the south east of the site. Within the Water Sharing Plan for the Kulnura Mangrove Mountain Groundwater Sources these two GDE's have been identified as High Priority Groundwater dependent ecosystems with additional protection measures put in place to protect these GDEs.

Table 4: GDE's Types and Classes for Somersby

GDE	GDE TYPE	Class	Description of Class	Habitat
Sandstone Hanging Swamp	Wetlands (W)	W10	Hanging Swamp	Epigean
Coastal Narrabeen Moist Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Coastal Sand Swamp Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Coastal Warm Temperate Rainforest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Dharug Footslopes Apple Redgum Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Estuarine Juncus Rushland	Marine Estuarine Habitats (M)	M4	Tidal Freshwater swamp forests	Epigean
Estuarine Mangrove Scrub	Marine Estuarine Habitats (M)	M4	Mangrove Swamp	Epigean
Estuarine Saltmarsh / Grassland	Marine Estuarine Habitats (M)	M3	Saltmarshes	Epigean
Estuarine Swamp Oak Forest	Marine Estuarine Habitats (M)	M4	Tidal Freshwater swamp forests	Epigean
Hawkesbury Banksia Scrub - Woodland	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Sandstone Ranges Gully Rainforest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Sheltered Blue Gum Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial

GDE	GDE TYPE	Class	Description of Class	Habitat
Sheltered Rough-barked Apple Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Swamp Mahogany – Paperbark Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Umina Lepironia Sedgeland	Wetlands (W)	W10	Sedge Swamp	Epigean
Mooney Mooney Creek / Mullet Creek	River Base Flow (H)	H	River Systems	Hyporheic

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

LEGEND

- Site Boundary
- Drainage Lines

25497 Groundwater Dependent Ec by EFS COMM

- Coastal Narrabeen Moist Forest
- Coastal Sand Swamp Forest
- Coastal Warm Temperate Rainforest
- Coastal Wet Gully Forest
- Dharug Footslopes Apple Redgum Forest
- Estuarine Juncus rushland
- Estuarine Mangrove Scrub
- Estuarine Saltmarsh/Grassland
- Estuarine Swamp Oak Forest
- Hawkesbury Banksia Scrub - Woodland
- Sandstone Hanging Swamps
- Sandstone Ranges Gully Rainforest
- Sheltered Blue Gum Forest
- Sheltered Rough-barked Apple Forest

N

SEE INSERT

0 1 2kms

SCALE: 1:30,000 AT A2 SIZE

TITLE:	FIGURE 5 GROUNDWATER DEPENDENT ECOSYSTEMS AT SOMERSBY	LOCATION:	SOMERSBY	DATUM: PROJECTION:	N/A MGA ZONE 56 (GDA 94)	DATE: PURPOSE:	4/05/2011 EIA
LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting\Ecology\MapInfo Workspaces VERSION (PLAN BY):		A A2 (MD-NW)					

CLIENT: HANSON CONSTRUCTION MATERIALS PTY LTD
JOB REF: 103611

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1.7 Surface Water Systems

1.7.1 Existing Environment

A review of the 1:25,000 topographic map shows a tributary of Mooney Mooney Creek which flows from east to west through the site (Martens & Associates, 2008). Site inspections by Martens & Associates (2008) show that the natural passage of this drainage line no longer exists due to the current quarrying operations, though surface runoff still occurs. The approved quarry operations capture this surface runoff from lands hydro-geologically upslope of the quarry. This water is used to satisfy on site water demands with any remainder being discharged from the site into the adjacent Brisbane Water National Park under license by the NSW EPA. The water quality is good due to onsite settling ponds, tailings dams and re-use system which filter the water before discharge.

1.7.2 Potential Impacts

The current extension proposal is situated on lands which currently drain into the existing quarry operations but will not interfere with the natural flow of this drainage system flowing in to Mooney Mooney Creek.

No existing natural or undisturbed drainage lines are present within the quarry extension area and removal of the current agricultural use will decrease the nutrient content of the surface water runoff. The proposed quarry extension could potentially cause the mobilisation of sediments due to an increased area of disturbed land. Offsite impacts due to increased dewatering could also occur. Water quality can be maintained at the current standards due to current regime of filtration through settlement ponds, tailings dams and filtering systems which increase water quality before discharge. Water quality is of high importance for the Mooney Mooney Creek GDE as this catchment provides drinking water for the Gosford LGA.

1.8 Impact Mitigation

The preliminary surface and groundwater report (Martens & Associates, 2008) indicate that the current approved quarry workings allow to a depth of approximately 120m below existing ground levels. Currently, site water capture and filtration systems adequately deal with any inflowing groundwater and water leaving the site is not likely to have any adverse impact upon the drinking water of the Mooney Mooney Creek system.

Like the existing quarry, the quarry extension is not likely to have a working depth of more than 60m.

Quarrying to a depth of greater than 60m is likely to result in a lowering of the groundwater table and require the removal of inflowing groundwater. In this case, the dewatering of groundwater via bores may be required as it has the potential to impact on

groundwater yields from bores nearby and have adverse impacts upon surface water systems and GDEs.

Under Section 39 of the Water Sharing Plan for the Kulnara Mangrove Mountain Groundwater Sources Plan highlights that groundwater extraction from a new or replacement water supply (ie bore) for any purpose is to be excluded within 100ms of a high priority groundwater dependent ecosystem listed in schedule 5. Two the GDEs (Sandstone Hanging Swamp and Hawkesbury Banksia Scrub – Woodland) have been listed in Schedule 5, however these GDEs are approximately 500m from the site. In addition to this, no new bores are being installed. Therefore under this plan these high priority GDEs are adequately protected.

The impact upon the surrounding GDE's are difficult to determine with precision as it is unknown what the groundwater requirements are for these ecosystems. However due to the distance from the identified GDEs from the quarry it is unlikely that the quarry extension will have any significant impact upon these GDEs.

Mooney Mooney Creek system is currently being impacted upon by the existing quarry workings, however the proposed quarry extension is unlikely to provide any further significant impact upon this system or GDE's more than what is currently being experienced from the existing quarry. There is likely to be some increase in the level of groundwater inflow as a result of the quarry extension, this effect may be mitigated by the upgrading of existing water capture and filtration systems to accommodate inflow into the new quarry.

2 GDE Recommendations

The following recommendations have been outlined to provide guidelines and site management strategies that may prevent any ongoing deleterious impacts upon Groundwater Dependent and Surface Water Ecosystems surrounding the site, particularly:

- Measures currently being implemented such as filtration through sediment ponds and tailings dams to improved water quality within the existing quarry operations be continued and upgraded before discharge offsite.
- New water capture and filtration infrastructure may be required to accommodate the quarry extension.

Component C: Site Rehabilitation

1 Site Rehabilitation

Upon completion of all sand mining activities it would be expected that the land be rehabilitated to a level where the landscape and soils are stabilised.
The rehabilitation of the site has three primary objectives:

(a) to restore soil stability using vegetation and / or mulching,

(b) to create an agricultural grazing pasture of predominantly native grasses, and

(c) maintain a free-draining landscape.

A draft final plan is indicated in Figure 6. Aspects of this are dealt with below.

1.1 Topsoil

The success of the rehabilitation plan depends heavily on the preparation and health of the topsoil layer.

The expansion of the quarry will allow for extraction of approximately 5 million tonnes of sand, extending the life of the quarry operation by 35 years. Due to the long life of the proposed mine topsoil stockpiling would not be a feasible option. Stockpiling of topsoil for more than 12 month period would see a loss of seed bank, other biota and nutrients.

Insite's preliminary environmental impact assessment report outlines that excavation works at the existing site may be undertaken with backfill material selected on the basis of a careful analysis of its impacts on hydrological conditions. It is recommended that commercial topsoil is chosen on the basis of compatibility with existing soil profiles in the local area. The site is mapped as being a "Sydney Town" soil landscape (Murphy 1993).

These soils are characterised as being shallow to moderately deep (<50 to >150 cm) Yellow Earths, Earthy Sands and some Siliceous Sands on crests and slopes; shallow to moderately deep (<50 to >150 cm) Siliceous Sands, Leached Sands and Grey Earths in poorly drained areas and drainage lines; and moderately deep (100-150 cm) Yellow Podzolic Soils and Gleyed Podzolic Soils associated with Shale lenses.

A depth of 10-20cm of topsoil will be sufficient to grow plants however it is important that underlying material can enable root penetration and hydrological conductivity. The soils of the site are not characterised as being acid-sulphate prone, though the area drains in to an acid sulphate prone zone which is associated with the Mooney Mooney Creek drainage (acid sulphate mapping Gosford Council website).

The sub-surface material should be scarified on top to allow topsoil to fix better and is less likely to be lost through erosion. Scarification across any slopes also prevents erosion and the final surface should be raked to aerate topsoil prior to seeding. Scarification parallel to slope aspect should be avoided.

It is recommended that topsoil be tested for nutrient content prior to seeding. If nutrient levels are found to be depleted, organic fertilisers are cost effective and will aid in the establishment of the plants.

The most cost-efficient method to apply soils is by the use of a front-end loader and a tip-truck. Pre-spreading scarification should be done by rotary hoe or similar shallow ripping device, spreading is best done using harrows and tractor.

Adequate amounts of nitrogen and phosphorous must be available in soils if plants are to grow effectively. Any topsoil used should be tested first to determine any nutrient shortcomings and actions then be taken to treat the soil. The long-term nitrogen requirements can be sourced from a variety of sources or come from the return of organic matter to the soil (Wong *et al*., 1999).

1.2 Revegetation (Phase 1 for 1 year)

In order to achieve stability of the rehabilitated landscape, and to avoid issues with topsoil loss and erosion, it is recommended that a grass/herbland be established on the site in the first year. This would entail a mixture of grasses and herbs. This type of revegetation is a cheap and quick alternative to a full scale native vegetation rehabilitation plan. Succession of grasses and herbs will ensure that soil stability is restored to the site and ultimately provides a good base for any further revegetation works that may be required at the site in the future.

Direct Seeding: Direct seeding of grasses has several advantages over the use of tubestock.

- Direct seeding is much cheaper (10 - 20% or less of the cost of planting tubestock), and requires minimal labour.
- Existing farm equipment can be used. Alternatively, several organisations and Landcare groups have direct seeding machines for hire.
- Higher plant density after germination provides better shelter to new seedlings and reduces weed competition. It also allows natural selection to sort out the stronger from the weaker plants without creating gaps to be replanted.
- Plants are able to “self select” suitable establishment sites within the revegetation area, particularly if a mixture of species is sown.
- The plants are usually healthier and have stronger, deeper root systems because they are not transplanted and there is no disturbance to root growth. This enables plants to be more tolerant of stressful conditions such as pest attack and drought.
- Final plant cover is random, and looks more natural than planting.
- Little maintenance is required after plants are established, apart from ongoing weed control for at least the first season (which ensures no watering).

Direct seeding has the advantage that rainfall is not so critical as the native species have adapted to the climatic conditions of the area. It is also time efficient and cost effective.

The strong seasonal influence of the climate dictates that direct seeding should occur as early in the "wet season" as possible. This allows the larger plants to become established so they can survive the long dry period that follows (Ashwarth *et. al.,* 1994). The ground needs to be wet enough to maintain sufficient moisture for seedlings to survive a period of several days between rain. Rainfall patterns of previous years indicate that the optimum time is from mid December to mid January.

Seed Supply: Based on a grass / herbland being the desired outcome, seed stock of hardy and stabilising grasses, legumes and clovers would be required for the affected lands in terms of nitrogen fixing abilities. Seed stock is a cheaper alternative to established tube stock and would provide a quick successive cover to reduce erosion of soil. A mixture of prostrate, rhizomous grasses, clovers and native tussock grasses is recommended. Where possible seeds with local provenance should be used.

Suitable native grasses are identified below in Table 5. They are hardy species with a high success rate. *Acacia* species, which can establish very quickly, are also recommended to stabilize soils in steeper sections of the site. These are best established using tubestock.

Table 5: Recommended plant species suitable for site rehabilitation

Species	Common Name
Acacia ulicifolia	Prickly Moses
Oplismenus aemulus	Basket Grass
Themeda australis	Kangaroo Grass
Lepyrodia scariosa	
Dichondra repens	Kidney weed
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Dichelachne micrantha	Short-hair Plume Grass

Succession: Plant succession models indicate that there may be long term impacts if a representative range of species do not initially establish on the rehabilitation areas.

Also studies have shown that recruitment of species into rehabilitated areas is slow or minimal and therefore, a variety of species should be included in the original seed mix to ensure a diversity of species become established (Roche et al., 1997, Walker & del Moral, 2003). It is also important to include coloniser species that will establish quickly. These species will help to create the right environment for other slower establishing species to flourish.

Irrigation: Watering of seedlings should be continued as required until all plants are established. Weather and site conditions will determine the frequency of watering for plants over the maintenance period to ensure they do not perish. Moisture levels and plant health should be monitored weekly during drier periods.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

N

DRAFT

TITLE: FIGURE 6 SITE REHABILITATION LANDSCAPE

LOCATION: SOMERSBY

DATUM: N/A
PROJECTION: NON-EARTH (FEET)

DATE: 4/5/2011
PURPOSE: EIA

LAYOUT REF: J:\JOBS\103k\103611 Somersby\10- Darfting \Ecology\MapInfo Workspaces
VERSION (PLAN BY): A A4 (MD-NW)

CLIENT: HANSON CONSTRUCTION MATERIALS PTY LTD
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The most important factors for plant establishment are:

- The surrounding soil is moist at the time of planting;
- Mulch is a safe and effective way of ameliorating soil conditions. It helps control soil water loss, soil temperature fluctuations and weed invasion (Buchanan, 1989);
- Sufficient rain occurs and / or watering is provided in the following months; and
- The plants are free of weed competition.

1.3 Other Re-Planting Options

While it is recommended here that grasses form the predominate landscape cover, additional planting of woody native vegetation may be a desired outcome from a conservation or visual amenity perspective. These may also be added to enhance site stability (particularly in steeper sloping areas).

If this is a desired outcome, then plantings of trees should take note of the following suggestions:

(a) Use of local, indigenous species (list of species found in the Somersby Plateau forest given in Appendix 2);

(b) Strategic placement (in steep locations or adjacent to existing areas of native vegetation in order to enhance future habitat connectivity);

(c) Clumped establishment in tree copses in order to maximise habitat value and/or target areas of visual impact.

1.4 Monitoring (Phase 2 for 5 years)

Ongoing restoration projects must be guided by regular analysis and review. As the primary function of this plan is to improve soil stability, monitoring should aim to assess;

(1) Success of revegetation – (a) establishment success rate, (b) self-regeneration;

(2) Stability of soils;

(3) The ability of the landscape in retaining water and nutrients; and

(4) Extent of weed Invasion.

Native grasses require establishment maintenance, watering and weed control.

With continued restoration work at this site, an improvement in ecological function will occur. It is not considered necessary to require a structured monitoring program to measure that change. However it is recommended that monitoring continues for five years after sowing to evaluate the success of the regeneration and to determine whether follow up re-sowing is considered necessary.

2 Site Rehabilitation Recommendations

In addition to contributing to soil structure and stabilising the battered slopes, native plants are attracting a diverse array of flora and fauna. Selection criteria for plant species included minimal maintenance self-sustaining, locally indigenous to the area and low water requirement.

The site should be rehabilitated back to an agricultural grazing final landform to enable the opportunity to use the land for agricultural investment once extraction ceases. This can be achieved via the following recommendations:

- Topsoil stockpiling is not recommended as seed bank and genetic diversity will be lost over the 35 year mining lease life;
- Topsoil used for rehabilitation of the site should be sourced from a commercial wholesaler with the intent to grow mainly native grasses and legumes;
- Topsoil preparation outlined in section 3.1 should be followed to assist in the success of the rehabilitation of plants on site;
- It is recommended that revegetation takes place via direct seeding and the spreading of vegetation mulch containing seed;
- Planting should include coloniser and soil stabilizing grass species that will establish quickly;
- Watering of seedlings should be continued as required until all plants are established;
- Seeding should take place at the beginning of summer when rain periods are more likely to take place;
- If woody vegetation is desired, then use of locally occurring species is recommended. Their placement should enhance habitat connectivity and visual impact; and
- Monitoring for a period of 5 years should be undertaken to ensure success of revegetation, stability of soils, whether weed invasion is apparent, that the landscape is retaining water and nutrients and is free draining.

General Recommendations

Given the scope of the extent of proposed clearing native vegetation, the need for site rehabilitation and the potential impacts upon groundwater dependent ecosystems, the following key recommendations are central to the minimisation of impact of the proposed quarry expansion and associated infrastructure.

- Retention of hollow-bearing trees with respect to the southern access road where practical. Should removal of such trees be required, then appropriate wildlife management actions should be implemented.
- Minimise potential impacts associated with stormwater runoff, erosion and sedimentation and the spread of weeds during construction through the inclusion of appropriate erosion and sediment controls.
- Where possible, protect the drainage line running east-west along the southern boundary of the proposed quarry extension area from direct and indirect disturbance. Where any disturbance is required to occur to this potential habitat for Red-crowned Toadlet (*Pseudophryne australis)* it is recommended that an ecologist be present during works to ensure that any toadlets in affected areas are relocated to appropriate adjoining suitable habitat.
- Measures currently being implemented such as filtration through sediment ponds and tailings dams to improved water quality within the existing quarry operations be continued or upgraded as necessary before discharge offsite.
- Site rehabilitation should encompass a strategy that aims to provide the greatest stabilisation of the site in the shortest period of time. The most cost-effective approach would be to establish a grassland using direct seeding techniques. The success of this technique is dependent upon the site being free-draining, the use of stabilising grass species, and the establishment of a monitoring program to ensure that all areas rehabilitate successfully.
- Monitoring of the rehabilitated site needs to be undertaken for a period of 5 years to ensure the success of revegetation, stability of soils, and that weed invasion does not become a problem.

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Appendix 1

Seven-part Tests

Seven-Part Tests

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

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

***Prostanthera junonis* – Somersby Mintbush**

This species was not recorded within the site during a targeted seasonal survey on 25 October 2010 during the flowering period of this species. Due to the low quality of onsite habitat and an abundance of more suitable habitat locally (ie. Brisbane Waters National Park) the loss of some onsite disturbed and poor quality habitat is considered to be not significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Hibbertia procumbens* – Spreading Guinea Flower**

This species was not recorded within the site during a targeted seasonal survey during the flowering period of this species. Due to the abundance of suitable habitat in the local area (ie. Brisbane Waters National Park), the loss of some onsite habitat is considered to be not significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Tetratheca glandulosa* – Glandular Pink-bell**

This species was not recorded within the site during a targeted seasonal survey during the flowering period of this species. Due to the abundance of suitable habitat in the local area (ie. Brisbane Waters National Park), the loss of some onsite poor quality habitat is considered to be not significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Calyptorhynchus lathami* – Glossy Black-cockatoo**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. As only two *Allocasuarina torulosa* trees were present on the site, the site is unlikely to provide foraging habitat for this species. As there were no suitable nesting sites present, the site is unlikely to provide suitable nesting habitat. Therefore no potential habitat for this species will be affected by this proposal. As a result, the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Cercartetus nanus* – Eastern Pygmy-possum**

This species was not recorded onsite. The habitats within the site offer only marginal opportunities for this species. The ecological value of habitat within the site is compromised by the degraded nature of most of the vegetation. Due to the abundance of high quality habitat near the site (Brisbane Waters National Park), it is possible that this species may occasionally occur within the site. However, due to the low quality of onsite habitat and an abundance of more suitable habitat offsite, the loss of a small amount of onsite habitat is not considered to be significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Dasyurus maculatus maculatus* – Spotted-tailed Quoll**

This species was not recorded onsite. The habitats within the site offer only marginal habitat opportunities for this species. The ecological value of habitat within the site is compromised by the degraded nature of most of the vegetation. Due to the abundance of high quality habitat near the site (Brisbane Waters National Park), it is possible that this species may occasionally occur within the site. However, due to the low quality of onsite habitat and an abundance of more suitable habitat offsite, the loss of a small amount of onsite habitat is not considered to be significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Heleioporus australiascus* – Giant Burrowing Frog**

This species was not recorded during field surveys. Habitat within the site may potentially provide permanent habitat for this sedentary species although there are limited opportunities within the locality (centred around the drainage line) will occur. Given that the current proposal is unlikely to affect potential breeding habitat for this species and the extent of more suitable habitat ion the general area, the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Myotis adversus* – Large Footed Myotis**

This species was probably recorded onsite where suitable foraging (adjacent dam) and roosting habitat (hollows) occurs. The ecological value of habitat within the site is compromised by the degraded nature of the site vegetation. Due to the low quality of onsite habitat and an abundance of more suitable habitat within the locality the loss of a small amount of onsite habitat is not considered to be significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Ninox strenua* – Powerful Owl**

This species was not recorded within the site with the site offering only marginal habitat opportunities for this species. The ecological value of habitat within the site is compromised by the degraded nature of the site vegetation. However, due to the mobile habits of this species in search of foraging habitat and the abundance of high quality habitat within the locality, it is possible that this species may occasionally forage within the site. However, the loss of onsite habitat is not considered to be significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Pseudophryne australis* – Red-crowned Toadlet**

An unconfirmed recording of this species was made during field surveys. Habitat within the site may potentially provide permanent habitat for this sedentary species though limited in extent to the immediate area surrounding a 1st order drainage stream which bisects the site for a distance of about 30m. Given that the current proposal will avoid this potential breeding habitat, and given the extent of more suitable habitat in the wider area, the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

***Tyto tenbricosa* – Sooty Owl**

This species was not recorded within the site with the site offering only marginal habitat opportunities for this species. The ecological value of habitat within the site is compromised by the degraded nature of the site vegetation. However, due to the mobile habits of this species in search of foraging habitat and the abundance of high quality habitat within the locality, it is possible that this species may occasionally forage within the site. However, the loss of onsite habitat is not considered to be significant to this species. Therefore the current proposal is unlikely to affect this species such that it might place a viable local population at a greater risk of extinction.

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

No population of any species in the area has been identified under Schedule 1, Part 2 of the TSC Act 1995.

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

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

No critically endangered or endangered ecological communities occur within the site.

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

No critically endangered or endangered ecological communities occur within the site.

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

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

***Hibbertia procumbens* – Spreading Guinea Flower**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Within these areas poor quality habitat exists for this species, as this species is disturbance-tolerant but represents only a small proportion of this species' habitat within in the local area. Whilst this proposal will remove potential habitat for this species, no individuals were recorded during targeted seasonal searches.

***Prostanthera junonis* – Somersby Mintbush**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Within these areas poor quality habitat exists for this species, with the condition of this habitat considered low-moderate and represents only a small proportion of this species' habitat within in the local area. Whilst this proposal will remove potential habitat for this species, no individuals were recorded during targeted seasonal searches.

***Calyptorhynchus lathami* – Glossy Black-cockatoo**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. As only two *Allocasuarina torulosa* trees were present on the site, the site is unlikely to provide foraging habitat for this species. As there were no suitable nesting sites present, the site is unlikely to provide suitable nesting habitat. Therefore no potential habitat for this species will be affected by this proposal.

***Cercartetus nanus* – Eastern Pygmy-possum**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. As this species relies on substantial hollows and stumps for breeding and areas high in banksias, myrtaceous shrubs and trees for foraging, it is considered that this proposal is unlikely to have a significant impact on the habitat of this species.

***Dasyurus maculatus maculatus* – Spotted-tailed Quoll**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. This species requires suitable den sites (e.g. hollow-bearing trees, rocky outcrops or caves) and an abundance of food (e.g. birds and small mammals), which is considered low throughout the site. Therefore the proposal is unlikely to have a significant impact on the habitat of this species, as these areas are considered low throughout the site.

***Heleioporus australiacus* – Giant Burrowing Frog**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Areas most suitable for this species (associated with the drainage line) are not likely to be affected by the proposed development.

***Myotis adversus* – Large Footed Myotis**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. The dam is located to the south of the proposed quarry extension area and as such will not be removed or affected by the proposal. Therefore it is considered that there will be a significant impact on the habitat of this species.

***Ninox strenua* – Powerful Owl**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Within these areas a limited number of prey species exist with larger more substantial areas foraging areas in the adjacent Brisbane Waters National Park. Therefore it is considered that there will be a significant impact on the habitat of this species.

***Pseudophryne australis* – Red-crowned Toadlet**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Breeding areas most suitable for this species (associated with the drainage line) are not likely to be affected by the proposed development.

***Tyto tenebricosa* – Sooty Owl**

Within the site less than half a hectare of Somersby Plateau Open Forest will be removed, most of which is degraded. Within these areas a limited number of prey species exist with larger more substantial areas within the site and locality. Therefore it is considered that there will be a significant impact on the habitat of this species.

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

No areas of known habitat for the threatened species considered here are likely to be isolated as a result of the proposal. The site is located between the quarry and adjacent agricultural lands, with broken links in the north to Brisbane Waters National Park. The construction of a minor dirt access track to the south is not considered to be a substantial break in vegetation connectivity that would inhibit the movement of any of subject fauna species.

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

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act 1995.

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

Recovery Plans exist for Large Forest Owl species (Sooty Owl and Powerful Owl) and *Prostanthera junonis*. This proposal is generally consistent with the objectives and actions of these plans, however where inconsistencies occur it is unlikely that the proposal will affect the local population of these species due to the small amount of habitat being removed and the lack of critical and substantial habitat within the site.

No Recovery Plan or Threat Abatement Plan exists for the other species examined.

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

- The proposal is likely to contribute to the Key Threatening Process 'Clearing of Native Vegetation' as the quarry extension would involve clearing of small areas of Somersby Plateau Open Forest. This KTP is, however, not believed to be of significance to any of the threatened species addressed due to the presence of larger tracts of similar habitat opportunities south within the immediate area and west within the Brisbane Rivers National Park.

- The proposal is not likely to contribute to the Key Threatening Process "Invasion, establishment and spread of *Lantana camara* (Lantana)". Provided great care is taken when clearing commences, so as to not allow the spread of Lantana into the surrounding area, the opportunities for weed invasion will be reduced as a result of the quarry extension.

- The proposal is likely to contribute to the Key Threatening Process "Loss of hollow-bearing trees". A small number (2) of hollow-bearing trees occur within the quarry extension area; however it is considered that clearing is unlikely to be of major significance to locally occurring fauna or threatened species due to the low numbers and the presence of larger more substantial hollow bearing trees south within the immediate area and west within the Brisbane Rivers National Park.

- The proposal is likely to contribute to the Key Threatening Process "Removal of dead wood and dead trees" as the proposal will involve the removal of ground debris. A limited amount of dead wood and dead trees occurs within the quarry extension area; however it is considered that clearing is unlikely to be of significance to any threatened fauna species due to the low numbers of hollow dead wood or dead trees and the presence of larger tracts of similar habitat opportunities south within the immediate area and west within the Brisbane Rivers National Park.

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

Appendix 2

Flora Species List

Flora Species List

The following list includes all species of vascular plants observed on site during fieldwork. It should be noted that such a list couldn't be considered comprehensive, but rather indicative of the flora present on the site. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list as indicated:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation "sp.", indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark ("?") placed in front of the generic, which is followed by the abbreviation "sp." and;
- specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a ("?") placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

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Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated by an asterisk "*".

Threatened species listed under the *Threatened Species Conservation Act 1995* (TSC Act 1995) or *the Environmental Protection of Biodiversity and Conservation* (EPBC Act 1999) and / or Rare or Threatened Australian Plant (ROTAP) listed species are indicated in **bold font** and marked as:

(V) = Vulnerable Species listed under the TSC Act
(E) = Endangered Species listed under the TSC Act
(EE) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(EV) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(R) = ROTAP as per Briggs and Leigh (1996)

The following standard abbreviations are used to indicate subspecific taxa:

ssp. -	subspecies
var.-	variety
agg.	aggregate
× -	hybrid between the two indicated species

Class / Subclass	Family	Scientific Name	Common Name	Quadrat 1	Quadrat 2	Transect 1	Transect 2
Filicopsida	Dicksoniaceae	*Calochlaena dubia*	Flase Bracken	**1**			
Filicopsida	Gleicheniaceae	*Gleichenia rupestris*	Coral Fern	**3**			
Filicopsida	Lindsaeaceae	*Lindsaea linearis*	Screw Fern			**x**	
Filicopsida	Davalliaceae	*Nephrolepis cordifolia**	Fish-bone Fern			**x**	
Filicopsida	Dennstaedtiaceae	*Pteridium esculentum*	Bracken	**1**	**3**		
Coniferopsida	Pinaceae	*Pinus radiata**	Radiata or Monterey Pine		**3**	**x**	
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia decurrens*	Black Wattle		**3**		**x**
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia elata*	Cedar Wattle		**1**		
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia linifolia*	White Wattle	**1**			
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle	**2**			**x**
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia myrtifolia*	Red Stem Wattle	**1**			**x**
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia podalyriifolia*	Queensland Silver Wattle	**1**		**x**	
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia suaveolens*	Sweet Scented Wattle			**x**	
Magnoliidae	Fabaceae / faboideae / Mimosoideae	*Acacia terminalis* subsp. *Terminalis*	Sunshine Wattle	**2**			
Magnoliidae	Epacridaceae	*Acrotriche divaricata*	-				**x**
Magnoliidae	Asteraceae	*Actinotus minor*	Lesser Flannel Flower	**1**			
Magnoliidae	Asteraceae	*Ageratina adenophora**	Crofton Weed	**4**			**x**
Magnoliidae	Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		**2**		
Magnoliidae	Myrtaceae	*Angophora costata*	Smooth-barked Apple	**3**	**2**		
Magnoliidae	Myrtaceae	*Angophora hispida*	Dwarf Apple			**x**	
Magnoliidae	Epacridaceae	*Astroloma pinifolium*	Pine Heath	**1**			
Magnoliidae	Proteaceae	*Banksia ericifolia* var. *ericifolia*	Heath-leaved Banksia			**x**	
Magnoliidae	Proteaceae	*Banksia serrata*	Old Man Banksia	**2**	**2**		**x**
Magnoliidae	Baueraceae	*Bauera rubioides*	River Rose	**1**			

Class / Subclass	Family	Scientific Name	Common Name	Quadrat 1	Quadrat 2	Transect 1	Transect 2
Magnoliidae	Asteraceae	*Bidens pilosa**	Cobbler's Pegs	**1**			**x**
Magnoliidae	Pittosporaceae	*Billardiera scandens*	Hairy Appleberry			**x**	
Magnoliidae	Fabaceae/faboideae	*Bossiaea heterophylla*	Variable Bossiaea	**1**			
Magnoliidae	Fabaceae/faboideae	*Bossiaea obcordata*	Spiny Bossiaea	**1**			**x**
Magnoliidae	Fabaceae/faboideae	*Bossiaea scolopendria*	-				**x**
Magnoliidae	Fabaceae/faboideae	*Bossiaea sp.*	-	**2**			**x**
Magnoliidae	Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush			**x**	
Magnoliidae	Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush			**x**	
Magnoliidae	Myrtaceae	*Callistemon* sp.	-	**1**			
Magnoliidae	Apiaceae	*Centella asiatica*	Swamp Pennywort				**x**
Magnoliidae	Cunoniaceae	*Ceratopetalum gummiferum*	NSW Christmas Bush			**x**	
Magnoliidae	Asteraceae	*Conyza albida**	Tall Fleabane	**2**			**x**
Magnoliidae	Myrtaceae	*Corymbia gummifera*	Red Bloodwood		**2**	**x**	
Magnoliidae	Sapindaceae	*Dodonaea triquetra*	Hop-bush		**2**	**x**	
Magnoliidae	Epacridaceae	*Epacris pulchella*	Wallum Heath	**1**		**x**	
Magnoliidae	Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark			**x**	**x**
Magnoliidae	Myrtaceae	*Eucalyptus haemastoma*	Scribbly Gum		**2**	**x**	
Magnoliidae	Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	**6**			**x**
Magnoliidae	Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash		**4**	**x**	
Magnoliidae	Fumariaceae	*Fumaria sp.*				**x**	
Magnoliidae	Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree		**1**		
Magnoliidae	Proteaceae	*Grevillea buxifolia* subsp. *buxifolia*	Grey Spider Flower	**1**			**x**
Magnoliidae	Proteaceae	*Grevillea sericea*	Pink Spider Flower			**x**	
Magnoliidae	Proteaceae	*Grevillea speciosa*	Red Spider Flower			**x**	
Magnoliidae	Proteaceae	*Hakea teretifolia*	Dagger Hakea	**1**		**x**	**x**
Magnoliidae	Dilleniaceae	*Hibbertia acicularis*	Prickly Guinea Flower			**x**	
Magnoliidae	Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	**1**		**x**	**x**
Magnoliidae	Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea Flower			**x**	
Magnoliidae	Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower			**x**	

Class / Subclass	Family	Scientific Name	Common Name	Quadrat 1	Quadrat 2	Transect 1	Transect 2
Magnoliidae	Dilleniaceae	*Hibbertia sp.*		1			
Magnoliidae	Malvaceae	*Hibiscus sp.*	Hibiscus				x
Magnoliidae	Asteraceae	*Hypochaeris radicata**	Flatweed	2			x
Magnoliidae	Proteaceae	*Lambertia formosa*	Mountain Devil		2	x	x
Magnoliidae	Verbenaceae	*Lantana camara**	Lantana		2	x	x
Magnoliidae	Myrtaceae	*Leptospermum polygalifolium*	Tantoon	2	2		x
Magnoliidae	Epacridaceae	*Leucopogon ericoides*	Pink Beard-heath	1			
Magnoliidae	Proteaceae	*Lomatia silaifolia*	Crinkle Bush		1		x
Magnoliidae	Rubiaceae	*Morinda jasminoides*	Sweet Morinda	1			
Magnoliidae	Apocynaceae	*Parsonsia straminea*	Common Silkpod	5			
Magnoliidae	Passifloraceae	*Passiflora edulis**	Common Passionfruit		1		
Magnoliidae	Proteaceae	*Persoonia levis*	Broad-leaved Geebung	1			
Magnoliidae	Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	1			
Magnoliidae	Proteaceae	*Petrophile pulchella*	Conesticks			x	
Magnoliidae	Euphorbiaceae	*Phyllanthus gunnii*	Scrubby Spurge				x
Magnoliidae	Phytolaccaceae	*Phytolacca octandra**	Inkweed	3			
Magnoliidae	Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower	2			x
Magnoliidae	Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	1		x	x
Magnoliidae	Plantaginaceae	*Plantago lanceolata**	Ribwort			x	
Magnoliidae	Araliaceae	*Polyscias sambucifolia*	Elderberry Panax			x	
Magnoliidae	Rhamnaceae	*Pomaderris intermedia*	-		1		
Magnoliidae	Rhamnaceae	*Pomaderris sp.*			4		
Magnoliidae	Rosaceae	*Rubus ulmifolius**	Blackberry				x
Magnoliidae	Selaginallaceae	*Selaginella uliginosa*	Swamp Selaginella				x
Magnoliidae	Asteraceae	*Senecio linearifolius*	Fireweed			x	
Magnoliidae	Caryophyllaceae	*Stellaria media**	Common Chickweed			x	
Magnoliidae	Commelinaceae	*Tradescantia fluminensis**	Wandering Jew	1			
Magnoliidae	Verbenaceae	*Verbena bonariensis**	Purpletop			x	
Magnoliidae	Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia	1			

Class / Subclass	Family	Scientific Name	Common Name	Quadrat 1	Quadrat 2	Transect 1	Transect 2
Magnoliidae	Apiaceae	*Xanthosia tridentata*	Rock Xanthosia			x	
Magnoliidae	Rutaceae	*Zieria smithii*	Sandfly Zieria				x
Liliidae	Poaceae	*Andropogon virginicus**	Whisky Grass			x	
Liliidae	Poaceae	*Austrodanthonia sp.*			1		
Liliidae	Poaceae	*Briza maxima**	Quaking Grass				x
Liliidae	Cyperaceae	*Caustis recurvata* var. *recurvata*	-			x	
Liliidae	Poaceae	*Cortaderia selloana**	Pampas Grass	1			
Liliidae	Poaceae	*Cynodon dactylon*	Common Couch			x	
Liliidae	Cyperaceae	*Cyperus congestus**	-			x	
Liliidae	Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax Lily			x	
Liliidae	Phormiaceae	*Dianella prunina*	-			x	
Liliidae	Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily		3		
Liliidae	Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass			x	
Liliidae	Doryanthaceae	*Doryanthes excelsa*	Gymea Lily	3	5		x
Liliidae	Poaceae	*Ehrharta erecta**	Panic Veldtgrass		2		
Liliidae	Poaceae	*Entolasia marginata*	Bordered Panic	2			
Liliidae	Poaceae	*Entolasia stricta*	Wiry Panic	1	2		
Liliidae	Poaceae	*Eragrostis brownii*	Brown's Lovegrass			x	x
Liliidae	Cyperaceae	*Gahnia sieberiana*	Red-fruited Saw-sedge	2			
Liliidae	Poaceae	*Imperata cylindrica*	Blady Grass			x	
Liliidae	Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush		2		x
Liliidae	Lomandraceae	*Lomandra glauca*	Pale Mat-rush			x	
Liliidae	Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush	2			
Liliidae	Lomandraceae	*Lomandra sp.*	-	2			
Liliidae	Poaceae	*Melinus repens**	Red Natal Grass			x	
Liliidae	Poaceae	*Paspalum dilatatum**	Paspalum			x	
Liliidae	Poaceae	*Paspalum urvillei**	Vasey Grass			x	
Liliidae	Asparagaceae	*Protasparagus*	Asparagus Fern		1		

Class / Subclass	Family	Scientific Name	Common Name	Quadrat 1	Quadrat 2	Transect 1	Transect 2
		*densiflorus**					
Liliidae	Poaceae	*Setaria gracilis**	Slender Pigeon Grass	**1**			**x**
Liliidae	Poaceae	*Sporobolus africanus**	Parramatta Grass			**x**	
Liliidae	Xanthorrhoaceae	*Xanthorrhoea sp.*			**2**	**x**	

Appendix 3

Regional Fauna Species List

Regional Fauna Species List

Below is a list of fauna species that could be *reasonably* expected to be found within the study area at some occurrence. Such an approach has been taken given the unlikelihood to record *all* potentially occurring species within an area during formal fauna surveys (due to seasonality, climatic limitations, crypticism etc).

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (1994).

Herpetofauna - Cogger (1996).

Mammals - Strahan (ed) (1995) and Churchill (1998).

Regional Bird List

Appendix Key:

✓ = Species Detected
* = Introduced species
(E) = Species listed under NSW TSC Act 1995 as Endangered.
(V) = Species listed under NSW TSC Act 1995 as Vulnerable.
(V*) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(E*) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(M*) = Species listed under the Commonwealth EPBC Act as Migratory
(C) = Species listed under CAMBA
(J) = Species listed under JAMBA
Species indicated in **BOLD** font are those threatened species known from within 10km of site (Atlas of NSW Wildlife 2005)

Detection code:
(Use only on FF inventories!)

o = observed
h = heard call
s = secondary indication (eg feathers, nests)
ov = observed overhead and unlikely to utilise the site

Family Name	Scientific Name	Common Name	Somersby
Megapodiidae (Mound Builders)	*Alectura lathami*	Australian Brush-turkey	
Phasianidae (True Quails, Pheasants and Fowls)	*Coturnix pectoralis*	Stubble Quail	
	Coturnix ypsilophora	Brown Quail	
	Excalfactoria chinensis	King Quail	
Podicipedidae (Grebes)	*Tachybaptus novaehollandiae*	Australasian Grebe	
	Poliocephalus poliocephalus	Hoary-headed Grebe	
	Podiceps cristatus	Great Crested Grebe	
Sphenicidae (Penguins)	*Eudyptula minor*	Little Penguin	
Anhingidae (Darters)	*Anhinga novaehollandiae*	Australasian Darter	
Phalacrocoracidae (Cormorants)	*Phalacrocorax carbo*	Great Cormorant	

Family Name	Scientific Name	Common Name	Somersby
	Microcarbo melanoleucos	Little Pied Cormorant	
	Phalacrocorax sulcirostris	Little Black Cormorant	
	Phalacrocorax varius	Pied Cormorant	
Pelecanide (Pelicans)	*Pelecanus conspicillatus*	Australian Pelican	
Ardeidae (Herons, Bitterns and Egrets)	*Ardea pacifica*	White-necked Heron	
	Egretta novaehollandiae	White-faced Heron	
	Ardea intermedia	Intermediate Egret	
	Nycticorax caledonicus	Nankeen Night Heron	
	Ixobrychus dubius	Australian Little Bittern	
	Butorides striatus	Striated Heron	
Threskiornithidae (Ibises and Spoonbills)	*Threskiornis molucca*	Australian White Ibis	
	Threskiornis spinicollis	Straw-necked Ibis	
	Platalea flavipes	Yellow-billed Spoonbill	
	Platalea regia	Royal Spoonbill	
Rallidae (Crakes, Rails and Gallinules)	*Gallinula philippensis*	Buff-banded Rail	
	Lewinia pectoralis	Lewin's Rail	
	Porzana pusilla	Baillon's Crake	
	Porzana fluminea	Australian Spotted Crake	
	Porzana tabuensis	Spotless Crake	
	Porphyrio porphyrio	Purple Swamphen	
	Gallinula tenebrosa	Dusky Moorhen	
	Tribonyx ventralis	Black-tailed Native-hen	
	Fulica atra	Eurasian Coot	

Family Name	Scientific Name	Common Name	Somersby
Burhinidae (Stone-curlews))	*Esacus magnirostris*	Beach Stone-curlew	
Turnicidae (Button-Quails)	*Turnix varius*	Painted Button-quail	
Laridae (Gulls and Terns)	*Chroicoephalus novaehollandiae*	Silver Gull	
Columbidae (Pigeons and Doves)	**Columba livia*	Rock Dove	
	Chalcophaps indica	Emerald Dove	
	Columba leucomela	White-headed Pigeon	
	Geopelia humeralis	Bar-shouldered Dove	
	Geopelia striata	Peaceful Dove	
	Leucosarcia picata	Wonga Pigeon	
	Macropygia amboinensis	Brown Cuckoo-Dove	
	Ocyphaps lophotes	Crested Pigeon	
	Phaps chalcoptera	Common Bronzewing	
	Phaps elegans	Brush Bronzewing	
	**Streptopelia chinensis*	Spotted Dove	
Cacatuidae (Cockatoos)	***Calyptorhynchus lathami***	**Glossy Black-Cockatoo (V)**	
	Calyptrohynchus funereus	Yellow-tailed Black-Cockatoo	**o**
	Callocephalon fimbriatum	**Gang-gang Cockatoo (V)**	
	Eolophus roseicapillus	Galah	
	Cacatua tenuirostris	Long-billed Corella	
	Cacatua sanguinea	Little Corella	
	Cacatua galerita	Sulphur-crested Cockatoo	**o**
Psittacidae (Parrots)	*Alisterus scapularis*	Australian King Parrot	

Family Name	Scientific Name	Common Name	Somersby
	Lathamus discolor	**Swift Parrot (E*)**	
	Neophema pulchella	**Turquoise Parrot (V)**	
	Platycercus elegans	Crimson Rosella	
	Platycercus eximius	Eastern Rosella	
	Psephotus haematonotus	Red-rumped Parrot	
	Trichoglossus haematodus	Rainbow Lorikeet	
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	
	Glossopsitta concina	Musk Lorikeet	
	Glossopsitta pusilla	Little Lorikeet	
Cuculidae (Old World Cuckoos)	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	
	Cacomantis variolosus	Brush Cuckoo	
	Chalcites basalis	Horsfield's Bronze-Cuckoo	
	Chalcites lucidus	Shining Bronze-Cuckoo	
	Cacomantis pallidus	Pallid Cuckoo	
	Eudynamys orientalis	Eastern Koel	
	Scythrops novaehollandiae	Channel-billed Cuckoo	
Centropodidae (Coucals)	*Centropus phasianinus*	Pheasant Coucal	
Strigidae (Hawk Owls)	***Ninox strenua***	**Powerful Owl (V)**	
	Ninox connivens	**Barking Owl (V)**	
	Ninox boobook	Southern Boobook	
Tytonidae (Barn Owls)	*Tyto javanica*	Eastern Barn Owl	
	Tyto novaehollandiae	**Masked Owl (V)**	
	Tyto tenebricosa	**Sooty Owl (V)**	

Family Name	Scientific Name	Common Name	Somersby
Podargidae (Frogmouths)	*Podargus strigoides*	Tawny Frogmouth	
Caprimulgidae (Nightjars)	*Eurostopodus mystacalis*	White-throated Nightjar	
Aegothelidae (Owlet-nightjars)	*Aegotheles cristatus*	Australian Owlet-nightjar	
Alcedinidae (True Kingfishers)	*Alcedo azureus*	Azure Kingfisher	
Halcyonidae (Kingfishers and Kookaburras)	*Dacelo novaeguineae*	Laughing Kookaburra	**o**
	Todiramphus sanctus	Sacred Kingfisher	
	Todiramphus macleayii	Forest Kingfisher	
Coraciidae (Typical Rollers)	*Eurystomus orientalis*	Dollarbird	
Menuridae (Lyrebirds)	*Menura novaehollandiae*	Superb Lyrebird	
Climacteridae (Australo-Papuan Treecreepers)	*Cormobates leucophaea*	White-throated Treecreeper	
Maluridae (Fairy-Wrens and Emu-Wrens)	*Malurus cyaneus*	Superb Fairy-wren	
	Malurus lamberti	Variegated Fairy-wren	
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	*Pardalotus punctatus*	Spotted Pardalote	
	Paradalotus striatus	Striated Pardalote	
	Sericornis frontalis	White-browed Scrubwren	
	Sericornis magnirostra	Large-Billed Scrubwren	
	Gerygone mouki	Brown Gerygone	
	Gerygone albogularis	White-throated Gerygone	

Family Name	Scientific Name	Common Name	Somersby
	Gerygone levigaster	Mangrove Gerygone	
	Acanthiza pusilla	Brown Thornbill	
	Acanthiza reguloides	Buff-rumped Thornbill	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	
	Acanthiza nana	Yellow Thornbill	
	Acanthiza lineata	Striated Thornbill	
Meliphagidae (Honeyeaters)	*Anthochaera carunculata*	Red Wattlebird	
	Grantiella picta	**Painted Honeyeater (V)**	
	Plectrhyncha lanceolata	Striped Honeyeater	
	Anthochaera chrysoptera	Little Wattlebird	
	Philemon corniculatus	Noisy Friarbird	
	Anthochaera phrygia	**Regent Honeyeater (E*)**	
	Manorina melanophrys	Bell Miner	
	Manorina melanocephala	Noisy Miner	
	Meliphaga lewinii	Lewin's Honeyeater	
	Lichenostomus chrysops	Yellow-faced Honeyeater	
	Lichenostomus melanops	Yellow-tufted Honeyeater	
	Lichenostomus fuscus	Fuscous Honeyeater	
	Lichenostomus penicillatus	White-plumed Honeyeater	
	Melithreptus brevirostris	Brown-headed Honeyeater	
	Melithreptus lunatus	White-naped Honeyeater	
	Entomyzon cyanotis	Blue-faced Honeyeater	
	Lichmera indistincta	Brown Honeyeater	
	Phylidonyris novaehollandiae	New Holland Honeyeater	
	Phylidonyris niger	White-cheeked Honeyeater	

Family Name	Scientific Name	Common Name	Somersby
	Acanthorhynchus tenuirostris	Eastern Spinebill	
	Myzomela sanguinolenta	Scarlet Honeyeater	
	Epthianura albifrons	White-fronted Chat	
Eopsaltriidae (Robins)	*Microeca fascinans*	Jacky Winter	
	Petroica boodang	Scarlet Robin	
	Petroica rosea	Rose Robin	
	Eopsaltria australis	Eastern Yellow Robin	
Pomatostomidae (Australo-Papuan Babblers)	***Pomatostomus temporalis***	**Grey-crowned Babbler (V)**	
Cinclosomidae (Quail-thrushes and allies)	*Psophodes olivaceus*	Eastern Whipbird	
	Cinclosoma punctatum	Spotted Quail-thrush	
Neosittidae (Sittellas)	*Daphoenositta chrysoptera*	Varied Sittella	
Pachycephalidae (Whistlers, Shrike-tit, Shrike-thrushes)	*Falcunculus frontatus*	Crested Shrike-tit	
	Pachycephala pectoralis	Golden Whistler	
	Pachycephala rufiventris	Rufous Whistler	
	Colluricincla harmonica	Grey Shrike-thrush	
Dicruridae (Monarchs, Fantails and Drongo)	*Monarcha melanopsis*	Black-faced Monarch	
	Myiagra rubecula	Leaden Flycatcher	
	Myiagra inquieta	Restless Flycatcher	
	Grallina cyanoleuca	Magpie-lark	**o**
	Rhipidura rufifrons	Rufous Fantail	
	Rhipidura albiscarpa	Grey Fantail	

Family Name	Scientific Name	Common Name	Somersby
	Rhipidura leucophyrs	Willie Wagtail	**o**
	Dicrurus bracteatus	Spangled Drongo	
Campephagidae (Cuckoo-shrikes and Trillers)	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	
	Coracina papuensis	White-bellied Cuckoo-shrike	
	Coracina tenuirostris	Cicadabird	
	Lalage sueurii	White-winged Triller	
Oriolidae (Orioles and Figbird)	*Oriolus sagittatus*	Olive-backed Oriole	
	Sphecotheres vieilloti	Australasian Figbird	
Artamidae (Woodswallows, Butcherbirds, Currawongs)	*Artamus leucorynchus*	White-breasted Woodswallow	
	Artamus cyanopterus	Dusky Woodswallow	
	Cracticus torquatus	Grey Butcherbird	
	Cracticus nigrogularis	Pied Butcherbird	
	Cracticus tibicen	Australian Magpie	**h**
	Strepera graculina	Pied Currawong	
Corvidae (Crows and allies)	*Corvus coronoides*	Australian Raven	
Cororacidae (Mud-nesters)	*Corcorax melanorhamphos*	White-winged Chough	
Ptilinorhynchidae (Bowerbirds)	*Ptilonorhynchus violaceus*	Satin Bowerbird	
Motacillidae (Old World Wagtails,Pipits)	*Anthus novaeseelandiae*	Australasian (Richard's) Pipit	
	Alauda arvensis	Eurasian Skylark	
Passeridae (Sparrows,	**Passer domesticus*	House Sparrow	

Family Name	Scientific Name	Common Name	Somersby
Weaverbirds, Waxbills)			
	Taeniopygia guttata	Zebra Finch	
	Taeniopygia bichenovii	Double-barred Finch	
	Neochmia temporalis	Red-browed Finch	
Dicaeidae (Flowerpeckers)	*Dicaeum hirundinaceum*	Mistletoebird	
Hirundinidae (Swallows and Martins)	*Cheramoeca leucosterna*	White-Backed Swallow	
	Hirundo neoxena	Welcome Swallow	
	Petrochelidon nigricans	Tree Martin	
	Petrochelidon ariel	Fairy Martin	
Sylviidae (Old World Warblers)	*Acrocephalus australis*	Australian Reed Warbler	
	Cincloramphus mathewsi	Rufous Songlark	
	Cisticola exilis	Golden-headed Cisticola	
	Megalurus gramineus	Little Grassbird	
	Megalurus timorensis	Tawny Grassbird	
Zosteropidae (White-eyes)	*Zosterops lateralis*	Silvereye	
Sturnidae (Starlings and allies)	*Sturnus vulgaris*	*Common Starling	
	Sturnus tristis	*Common Mynah	
Procellariiidae	***Pterodroma nigripennis***	**Black-winged Petrel (V)**	
Anatidae	*Anas superciliosa*	Pacific Black Duck	**o**
	Chenonetta jubata	Australian Wood Duck	**o**
Charadriidae	*Vanellus miles*	Masked Lapwing	**o**

Regional Mammal List

Appendix Key:
✓ = Species Detected
* = Introduced species
(E) = Species listed under NSW TSC Act 1995 as Endangered.
(V) = Species listed under NSW TSC Act 1995 as Vulnerable.
(V*) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(E*) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(M*) = Species listed under the Commonwealth EPBC Act as Migratory
Species indicated in **BOLD** font are those threatened species known from within 10km of site (Atlas of NSW Wildlife 2005)

Detection code:
(Only use within FF inventories)
o = observed
h = heard call
s = secondary indication (eg. scats, scratches etc)
hr = hair analysis
a = Anabat detection
t = trapped

Family Name	Scientific Name	Common Name	Somersby
Tachyglossidae (Echidnas)	*Tachyglossus aculeatus*	Short-beaked Echidna	
Dasyuridae (Dasyurids)	*Antechinus stuartii*	Brown Antechinus	**hr**
	Antechinus swainsonii	Dusky Antechinus	**hr**
	Dasyurus maculatus	**Spotted-tailed Quoll (V, E*)**	
Peramelidae (Bandicoots and Bilbies)	*Isoodon macrourus*	Northern Brown Bandicoot	
	Peremeles nasuta	Long-nosed Bandicoot	
Phascolarctidae (Koala)	***Phascolarctos cinereus***	**Koala (V)**	
Vombatidae (Wombats)	*Vombatus ursinus*	Common Wombat	
Petauridae (Wrist-winged Gliders)	*Petaurus breviceps*	Sugar Glider	

Family Name	Scientific Name	Common Name	Somersby
	Petaurus norfolcensis	**Squirrel Glider (V)**	
	Petaurus australis	**Yellow-bellied Glider (V)**	
Pseudocheiridae (Ringtail Possums, Greater Glider)	*Petauroides volans*	Greater Glider	
	Pseudocheirus peregrinus	Common Ringtail Possum	**o**
Acrobatidae (Feathertail Glider)	*Acrobates pygmaeus*	Feathertail Glider	
Phalangeridae (Brushtail Possums and Cuscuses)	*Trichosurus vulpecula*	Common Brushtail Possum	**o**
Burramyidae	**Cercartetus nanus**	**Eastern Pygmy-possum (V)**	
Potoroidae (Potoroos and Bettongs)	***Potorous tridactylus***	**Long-nosed Potoroo (V, V*)**	
Macropodidae (Wallabies and Kangaroos)	*Macropus giganteus*	Eastern Grey Kangaroo	
	Macropus robustus	Common Wallaroo	
	Macropus rufogriseus	Red-necked Wallaby	
	Petrogale penicillata	**Brush-tailed Rock-Wallaby (V*)**	
	Wallabia bicolor	Swamp Wallaby	
Pteropodidae (Flying-foxes, Blossom-bats)	***Pteropus poliocephalus***	**Grey-headed Flying-fox (V, V*)**	
	Pteropus scapulatus	Little Red Flying-fox	
Rhinolophidae (Horseshoe-bats)	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	**a**
Molossidae (Freetail-bats)	***Mormopterus norfolkensis***	**East Coast Freetail-bat (V)**	

Family Name	Scientific Name	Common Name	Somersby
	Mormopterus sp.1	Little Freetail-bat	
	Mormopterus sp.2	Eastern Freetail-bat	**a**
	Tadarida australis	White-striped Freetail-bat	
Vespertilionidae (Vespertilionid Bats)	***Miniopterus australis***	**Little Bentwing-bat (V)**	**a**
	Miniopterus schreibersii	**Eastern Bentwing-bat (V)**	**a**
	Nyctophilus geoffroyi	Lesser Long-eared Bat	
	Nyctophilus gouldii	Gould's Long-eared Bat	
	Chalinolobus dwyeri	**Large-eared Pied Bat (V*)**	
	Chalinolobus gouldii	Gould's Wattled Bat	
	Chalinolobus morio	Chocolate Wattled Bat	
	Falsistrellus tasmaniensis	**Eastern Falsistrelle (V)**	
	Myotis adversus	**Large-footed Myotis (V)**	**a**
	Scoteanax rueppellii	**Greater Broad-nosed Bat (V)**	
	Scotorepens greyii	Little Broad-nosed Bat	
	Scotorepens orion	Eastern Broad-nosed Bat	
	Vespadelus darlingtoni	Large Forest Bat	
	Vespadelus regulus	Southern Forest Bat	
	Vespadelus pumilus	Eastern Forest Bat	**a**
	Vespadelus vulturnus	Little Forest Bat	**a**
Muridae (Murids)	*Hydromys chrysogaster*	Water Rat	
	Melomys burtoni	Grassland Melomys	
	**Mus domesticus*	House Mouse	**o**
	Pseudomys novaehollandiae	New Holland Mouse	
	Rattus fuscipes	Bush Rat	

Family Name	Scientific Name	Common Name	Somersby
	Rattus lutreolus	Swamp Rat	
	**Rattus norvegicus*	Brown Rat	
	**Rattus rattus*	Black Rat	**o**
Canidae (Dogs)	**Canis familiaris*	Dog	
	Canis familiaris dingo	Dingo	
	**Vulpes vulpes*	Red Fox	
Felidae (Cats)	**Felis catus*	Feral Cat	
Leporidae (Rabbit and Hare)	**Oryctolagus cuniculus*	European Rabbit	**o**
	**Lepus capensis*	Brown Hare	

Regional Reptile List

Appendix Key: ✓ = Species Detected
(E) = Species listed under NSW TSC Act 1995 as Endangered.
(V) = Species listed under NSW TSC Act 1995 as Vulnerable.
(V*) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(E*) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(M*) = Species listed under the Commonwealth EPBC Act as Migratory
Species indicated in **BOLD** font are those threatened species known from within 10km of site (Atlas of NSW Wildlife data 2005)

Detection code: **o** = observed

Only use for FF Inventorys **s** = secondary indication (eg. scats, scratches etc)

Family Name	Scientific Name	Common Name	Somersby
Chelidae (Tortoises)	*Chelodina longicollis*	Long-necked Tortoise	
Agamidae (Dragons)	*Amphibolurus muricatus*	Jacky Lizard	
	Amphibolurus nobbi	Nobbi	
	Physignathus lesuerii	Eastern Water Dragon	
	Pogona barbata	Eastern Bearded Dragon	
Pygopodidae (Legless Lizards)	*Lialis burtonis*	Burton's Snake Lizard	
	Pygopus lepidopus	Common Scaly-foot	
	Delma plebeia	Leaden Delma	
Gekkonidae (Geckoes)	*Diplodactylus vittatus*	Wood Gecko	
	Phyllurus platurus	Southern Leaf-tailed Gecko	
	Oedura lesueurii	Lesueur's Velvet Gecko	
	Underwoodisaurus milii	Thick-tailed Gecko	
Varanidae (Monitors)	*Varanus gouldii*	Gould's Monitor	
	Varanus varius	Lace Monitor	
Scincidae	*Carlia tetradactyla*		

Family Name	Scientific Name	Common Name	Somersby
(Skinks)			
	Cryptoblepharus virgatus		
	Ctenotus taeniolatus	Copper-tailed Skink	
	Ctenotus robustus	Striped Skink	
	Cyclodomorphus casuarinae	She-oak Skink	
	Egernia cunninghamii	Cunningham's Skink	
	Egernia major	Land Mullet	
	Egernia modesta		
	Egernia striolata	Tree-crevice Skink	
	Egernia saxatilis	Black Rock Skink	
	Egernia whitii	White's Skink	
	Eulamprus quoyii	Eastern Water Skink	
	Eulamprus tenuis		
	Lampropholis delicata	Grass Skink	
	Lampropholis guichenoti	Garden Skink	
	Lygisaurus foliorum	Tree-base Litter-skink	
	Morethia boulengeri	South-eastern Morethia	
	Pseudomoia platynota	Red-throated Skink	
	Saiphos equalis		
	Saproscincus mustelinus	Weasel Skink	
	Tiliqua scincoides	Eastern Blue-tongued Lizard	
Typhlopidae (Blind Snakes)	*Ramphotyphlops bituberculatus*	Prong-snouted Blind Snake	
	Ramphotyphlops weidii	Brown-snouted Blind Snake	
	Ramphotyphlops nigrescens	Black Blind Snake	
Boidae (Pythons)	*Morelia spilota*	Diamond Python	
Colubridae (Tree Snakes)	*Boiga irregularis*	Brown Tree Snake	

Family Name	Scientific Name	Common Name	Somersby
	Dendralaphis punctulata	Green Tree Snake	
Elapidae (Venomous Snakes)	*Furina diadema*	Red-naped Snake	
	Acanthopis antarcticus	Death Adder	
	Cacophis krefftii	Dwarf Crowned Snake	
	Cacophis squamulosus	Golden Crowned Snake	
	Demansia psammophis	Yellow-faced Whip Snake	
	Furina diadema	Red-naped Snake	
	Hoplocephalus bungaroides	**Broad-headed Snake (V*)**	
	Notechis scutatus	Eastern Tiger Snake	
	Pseudonaja textilis	Eastern Brown Snake	
	Rhinoplocephalus nigrescens	Eastern Small-eyed Snake	
	Vermicella annulata	Bandy Bandy	
	Hemiaspis signata	Black-bellied Swamp Snake	
	Pseudechis porphyriacus	Red-bellied Black Snake	

Regional Frog List

Appendix Key: ✓ = Species Detected
(E) = Species listed under NSW TSC Act 1995 as Endangered.
(V) = Species listed under NSW TSC Act 1995 as Vulnerable.
(V*) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable
(E*) = Species listed under the Commonwealth EPBC Act 1999 as Endangered
(M*) = Species listed under the Commonwealth EPBC Act as Migratory
Species indicated in **BOLD** font are those threatened species known from within 10km of site (Atlas of NSW Wildlife data 2005)

Detection code: **o** = observed

Only use for FF Inventorys **h** = heard call

Family Name	Scientific Name	Common Name	Somersby
Hylidae (Tree Frogs)	***Litoria aurea***	**Green and Golden Bell Frog (V*)**	
	Litoria brevipalmata	**Green-thighed Frog (V)**	
	Litoria caerulea	Green Tree Frog	
	Litoria chloris	Red-eyed Green Tree Frog	
	Litoria dentata	Bleating Tree Frog	
	Litoria fallax	Eastern Dwarf Tree Frog	
	Litoria latopalmata	Broad-palmed Frog	
	Litoria lesueuri	Lesueur's Frog	
	Litoria littlejohni	**Littlejohn's Tree Frog (V*)**	
	Litoris nasuta	Rocket Frog	
	Litoria peronii	Peron's Tree Frog	
	Litoria phyllochroa	Green Leaf Tree Frog	
	Litoria tyleri	Tyler's Tree Frog	
	Litoria verreauxii	Whistling Tree Frog	**h**
Myobatrachidae (Ground Frogs)	*Adelotus brevis*	Tusked Frog	
	Crinia signifera	Common Eastern Froglet	**h**

Family Name	Scientific Name	Common Name	Somersby
	Crinia tinnula	**Wallum Froglet (V)**	
	Heleioporus australiacus	**Giant Burrowing Frog (V, V*)**	
	Limnodynastes dumerilli	Eastern Banjo Frog	
	Limnodynastes ornatus	Ornate Burrowing Frog	
	Limnodynastes peronii	Striped Marsh Frog	
	Limnodynastes tasmaniensis	Spotted Grass Frog	
	Mixophyes balbus	**Stuttering Frog (E, V*)**	
	Mixophyes iterates	**Giant Barred Frog (E, E*)**	
	Mixophyes fasciolatus	Great Barred Frog	
	Pseudophryne australis	**Red-crowned Toadlet (V)**	**?**
	Pseudophryne coriacea	Red-backed Toadlet	
	Pseudophryne bibroni	Brown Toadlet	**?**
	Uperoleia fusca	Dusky Toadlet	
	Uperoleia laevigata	Smooth Toadlet	

Appendix 4

Bat Call Analysis

INTRODUCTION

This Appendix presents the methods and results of the echolocation bat call identification undertaken for data collected during surveys as discussed within this report.

METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 3.5g) software. The identification of calls was undertaken with reference to *Bat Calls of NSW: region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- **Definite** - Pass identified to species level and could not be confused with another species
- **Probable** - Pass identified to species level and there is a low chance of confusion with another species
- **Possible** - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- **Species group** - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- **Unknown** - Either background 'noise' files or passes by bats which are too short and / or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

Description of the Characteristics Used to Differentiate Species

Miniopterus australis was differentiated from *Vespadelus pumilus* which it overlaps with, by the presence of a down-sweeping tail on pulses. Call sequences which had a majority of pulses containing an up-sweeping tail were assigned to *Vespadelus pumilus*. Call sequences which appear to have been recorded in more open habitats had pulses where the tail was difficult to differentiate and these were assigned to the *Vespadelus pumilus* / *Miniopterus australis* species complex.

Miniopterus schreibersii oceanensis was differentiated by *Vespadelus regulus* by a combination of uneven consecutive pulses and the presence of a down-sweeping tail. Calls recorded within the site were above 43kHz frequency which also allowed *Vespadelus darlingtoni* to be excluded.

Mormopterus Species 2 was differentiated from *Chalinolobus gouldii* by the presence of mainly flat calls in the two good call sequences obtained. The length of the call sequence which showed flat pulses with little to no alternation allowed *Mormopterus* Species 2 to be identified over *Mormopterus norfolkensis* which has alternative flat pulses, often with a downward sloping tail. One call sequence was unable to be identified to species level due to the presence of steep pulses and the overall short length of the sequence. This call was assigned as a *Chalinolobus gouldii* / *Mormopterus* 2 species group.

Myotis adversus was often not able to be differentiated from *Nyctophilus* species since calls did not display characteristics that allow the genus to be separated such as pulse interval less than 75ms or greater than 95 ms, the absence of a central kink and slope between 300-400 OPS.

Vespadelus vulturnus was identified from *Chalinolobus morio* by the absence of a down-sweeping tail.

Results

A total of 168 call sequences were recorded at three sites over two nights, of which 140 call sequences bat calls (ie were not 'noise' files). Of the bat calls, 19 call sequences (14%) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 1). Species recorded confidently within the site include:

- *Miniopterus schreibersii oceanensis* (Large bentwing bat)
- *Miniopterus australis* (Little bentwing bat)
- *Mormopterus* sp. 2 (Eastern freetail bat)
- *Rhinolophus megaphyllus* (Eastern Horseshoe bat)
- *Vespadelus pumilus* (Eastern forest bat)
- *Vespadelus vulturnus* (Little forest bat)

Additional bat species that are known to exist within the locality of the site, but could not be confidently identified to species (those classified as possible or as a species group), include:

- *Chalinolobus gouldii* (Gould's Wattled bat)
- *Myotis adversus* (Large-footed Myotis)
- *Nyctophilus geoffroyi* (Lesser long-eared bat)
- *Nyctophilus gouldi* (Gould's long-eared bat)

Note that *Nyctophilus* species (Long-eared Bats) cannot currently be distinguished by bat call analysis as their call parameters overlap almost completely.

Table 1 below summarises the results of the bat call analysis

Table 1: Results of bat call analysis (number of passes per site per night)

IDENTIFICATION	Unit 1 23/06/2009	Unit 1 24/06/2009	Unit 2 23/06/2009	Unit 2 24/06/2009
DEFINITE				
Miniopterus australis	1	-	-	-
Miniopterus schreibersii oceanensis	-	-	2	-
Mormopterus Species 2	1	-	1	-
Rhinolophus megaphyllus	-	-	5	2
Vespadelus pumilus	1	-	14	
Vespadelus vulturnus	-	-	-	1
PROBABLE				
Miniopterus australis	1	-	3	-
Miniopterus schreibersii oceanensis	2	-	5	-
Myotis adversus	-	-	-	1
Vespadelus pumilus	-	-	12	-
POSSIBLE				
Miniopterus schreibersii oceanensis	2	-	6	-
SPECIES GROUPS				
Vespadelus pumilus / Miniopterus australis	-	-	24	-
Chalinolobus gouldii / Mormopterus Species 2	-	-	-	1
Nyctophilus geoffroyi / Nyctophilus gouldii	-	-	-	1
Nyctophilus geoffroyi / Nyctophilus gouldii / Myotis macropus	-	-	-	9
UNKNOWN				
Unknown	3	-	6	17
'Noise' files	19	-	7	2
TOTAL	**48**	**0**	**85**	**35**

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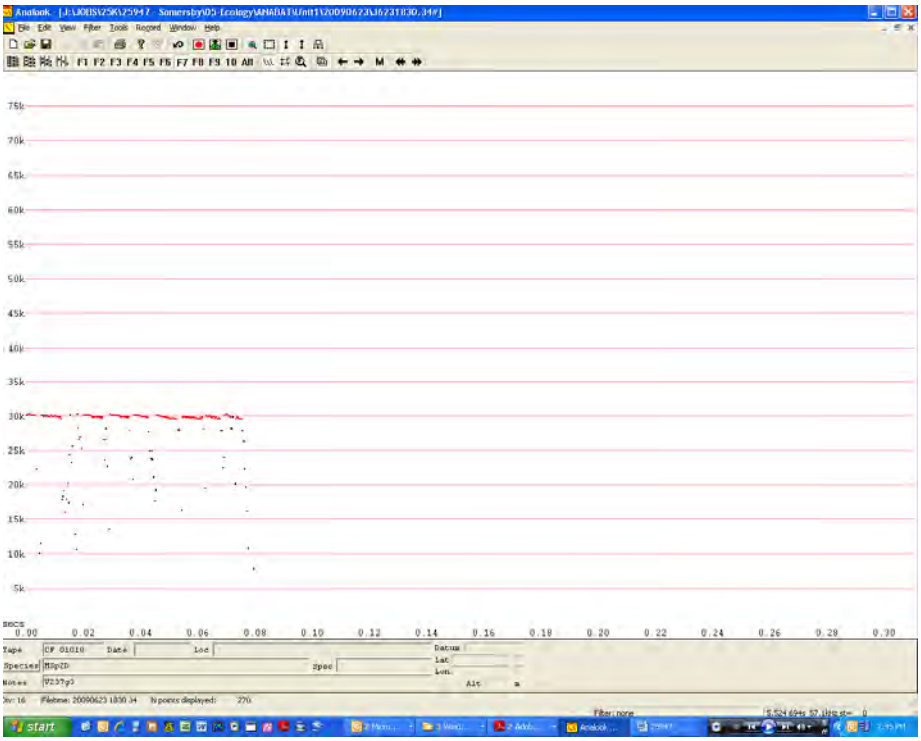
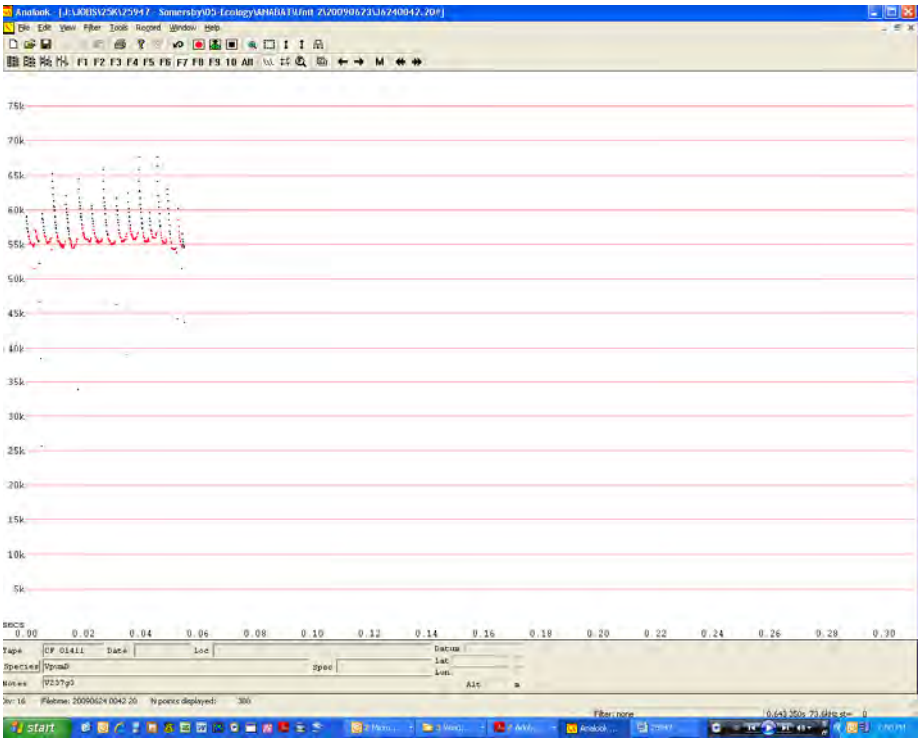
Sample Calls

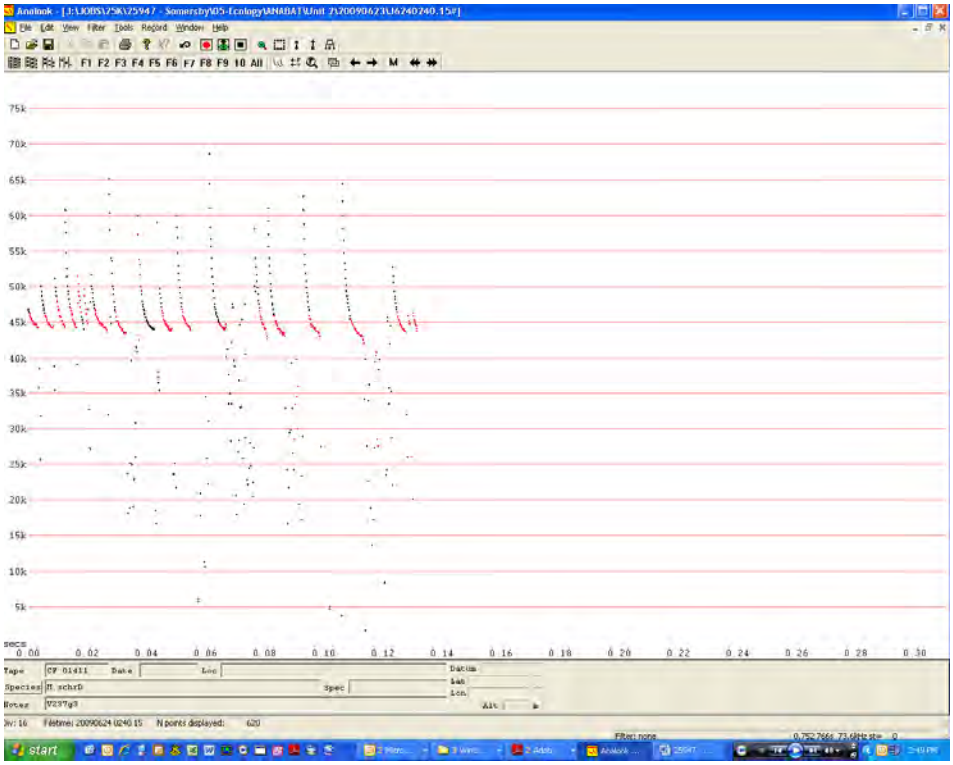
A sample of the calls actually identified from the site for each species is given below.



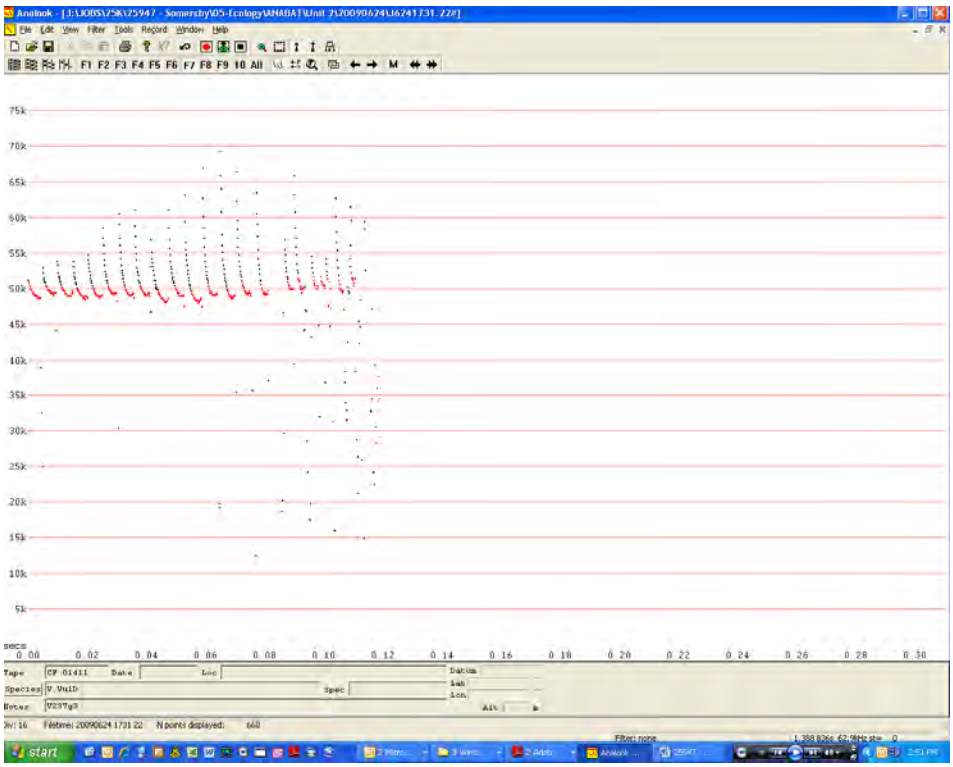
Mormopterus Species 2 – Definite



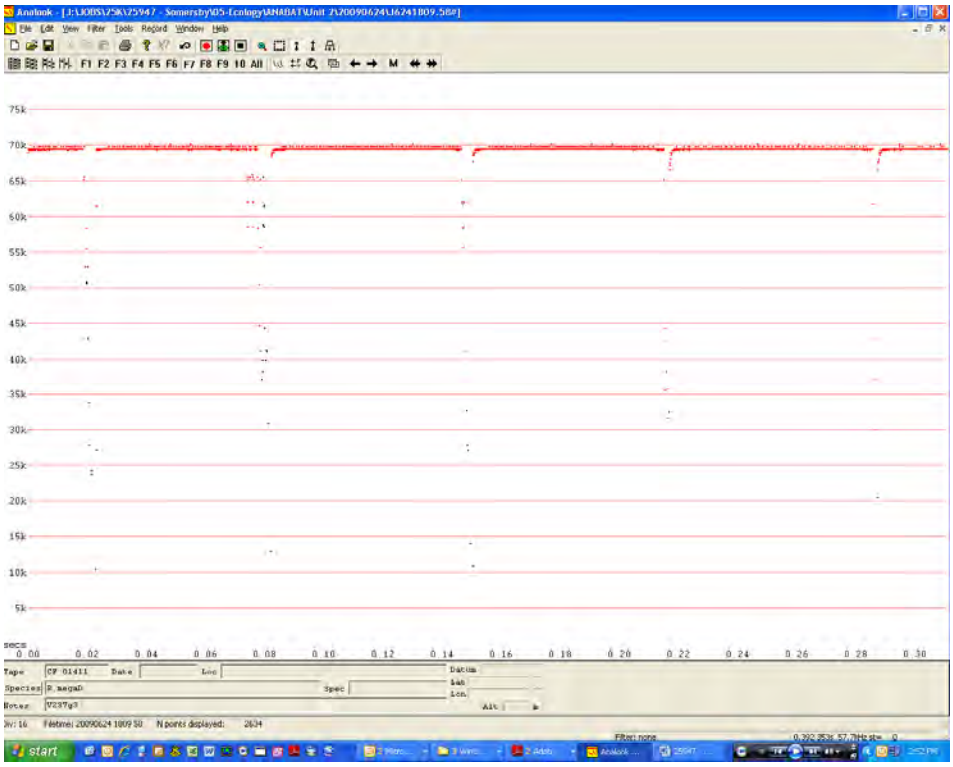
Vespadelus pumilus – Definite



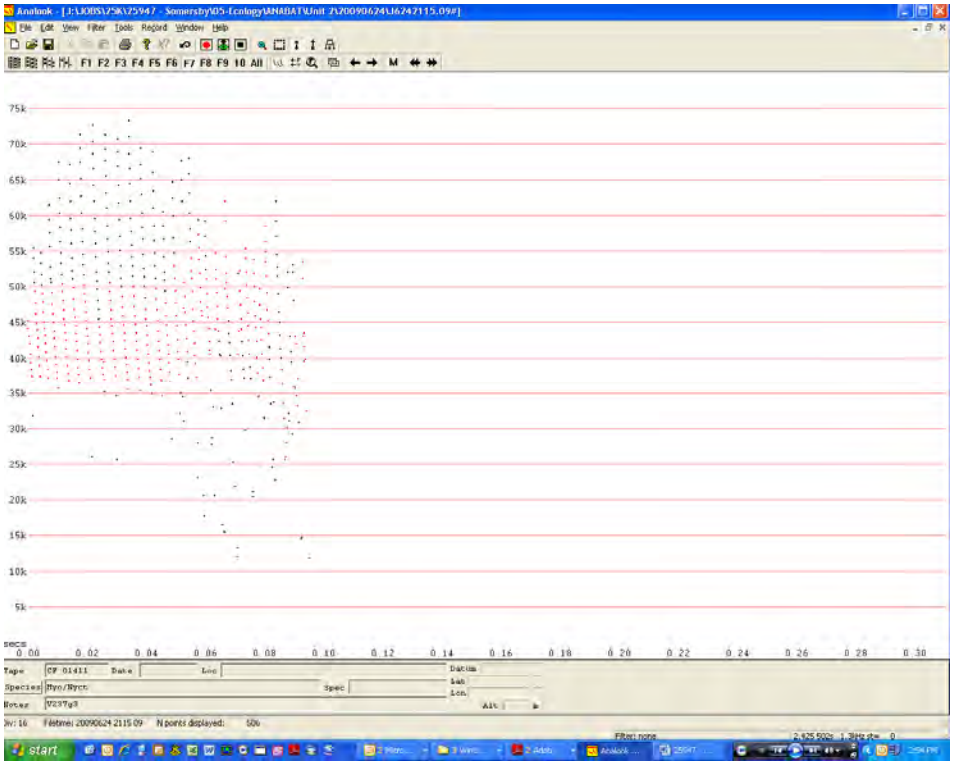
Miniopterus schreibersii oceanensis – Definite



Vespadelus vulturnus - Definite



Rhinolophus megaphyllus – Definite



Nyctophilus gouldii / Nyctophilus geoffroyi / Myotis adversus