Appendix 5: Biodiversity Assessment (BBAM) (Biosis 2012)

Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment

DRAFT REPORT

Prepared for Martin Morris and Jones on behalf of Spinitu Pty Ltd

21 December 2012

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Biosis project no.:	15634

File name: 15634.CrestRd.FFA.BBAM.DRFT.20121219.docx

Citation: Biosis (2012). Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment. Report for Martin Morris and Jones on behalf of Spinitu Pty Ltd. Authors: B Morrisey & N Garvey, Biosis Pty Ltd, Wollongong.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Jane Murray	-
Draft version 02	-	21/12/2012
Final version 01	TBA	TBA

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Martin Morris and Jones: Luke Rollinson
- Spinitu Pty Ltd: Peter Robertson
- NSW Office of Environment and Heritage Department of for access to the NSW Wildlife Atlas

The following Biosis staff were involved in this project:

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Summary

Biosis Pty Ltd was commissioned by Spinitu Pty Ltd to undertake a BioBanking Assessment for Lot 101 DP 785139, Crest Rd, Albion Park (Figure 1). Spinitu Pty Ltd, with the assistance of Martin Morris Jones (MMJ) are preparing a rezoning application for the subject site to include R2 Low Density Residential across the western section of the subject site and E3 Environmental Management across the eastern section of the subject site (Figure 2).

To inform the rezoning application a BioBanking Assessment, including review of previous studies, subject site survey, mapping of vegetation and calculation of credits requirements using the BioBanking Assessment methodology (BBAM) was undertaken.

Ecological values

Key ecological values identified within the subject site include:

- 8.36 hectares (ha) of native vegetation, including 5.76 ha of *Illawarra Lowlands Grassy Woodland* (ILGW) Endangered Ecological Community (EEC).
- The presence of seven *Cynanchum elegans* White-flowered Wax Plant, listed under both the *Threatened Species Conservation Act 1995* (TSC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), at two locations.
- Potential habitat for an additional threatened flora species *Zieria granulata* Illawarra Zieria.
- Thirty-one hollow bearing trees providing potential habitat for a number of general and threatened flora and fauna species, including roosting habitat for two threatened microchiropteran bats.

Government legislation and policy

An assessment of the project against key biodiversity legislation and policy is provided and summarised below.

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required	Notes
EPBC Act	*Cynanchum elegans* recorded within the subject site.	Significant Impact Criteria assessment and/or a Referral may be required, subject to further survey.	Targeted survey recommended.
TSC Act	Threatened species and ecological communities including *Cynanchum elegans* Zieria granulata Illawarra Zieria and ILGW recorded within the subject site.	Assessment of Significance required, unless a BioBanking Agreement is entered into. 143 ecosystem credits are required to be retired.	Red flag variation required for BioBanking Agreement.
Environmental Planning & Assessment Act	Threatened species and ecological communities	Assessment of Significance required under S.5A of the EP&A Act unless a	

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required	Notes
1979 (EP&A Act)		BioBanking Agreement is entered into. 143 ecosystem credits are required to be retired.	
State Environmental Protection Policy (SEPP) No. 44	Koala habitat	Habitat not considered Core Koala Habitat. No management plan required.	

Note: Guidance provided in this report does not constitute legal advice.

Recommendations

The primary measure for the development in order to minimise impacts to ecological values identified within the subject site is to avoid and minimise the removal of native vegetation and habitat.

Targeted survey is recommended for *Cynanchum elegans* to resolve the distribution of this species across the subject site and determine whether a referral under the EPBC Act is required.

Biosis recommends that a management plan for the area of retained vegetation in the proposed E3 zoning is developed. The management plan should seek to improve quality of retained vegetation and ensure appropriate management of threatened species, particularly *Cynanchum elegans*.

If Spinitu Pty Ltd wishes to enter into a BioBanking they can avoid the need for Assessments of Significance as required by Section 5A of the EP&A Act. A red flag variation will be required if a BioBanking Agreement is entered into.

1. Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Spinitu Pty Ltd to undertake a BioBanking Assessment for Lot 101 DP 785139, Crest Rd, Albion Park (subject site) in the Shellharbour Local Government Area (LGA). The subject site (Figure 1) encompasses approximately 9.69 ha of privately owned land at the end of Crest Rd, Albion Park which is currently zoned for rural and environmental protection according to the *Shellharbour Local Environment Plan 2000*. Further to the current zoning the draft *Shellharbour Local Environment Plan 2011* (draft LEP 2011) proposes revised zonings according to the NSW Local Environment plan Standard instrument including the following:

- R2 Low Density Residential, incorporating the south west sector and access track extending from Crest Rd; and
- E3 Environmental Management, incorporating two areas that encompass the remainder of the subject site.

The proposed zonings from draft LEP 2011 are based in part on 'potential development area' described and mapped by Mills (2007) as part of a Local Environmental Study including the subject site. Subsequently, Martin Morris Jones (MMJ) has prepared a Planning Submission for Spinitu Pty Ltd (MMJ, 2011) that provides an analysis of the proposed zoning for the subject site from the draft LEP 2011. The MMJ (2011) report considers the zonings from the draft LEP 2011 and suggests alternate zonings in light of key environmental constraints, including ecological values and bushfire hazard identified in detailed flora and fauna and bushfire hazard assessments by ELA (2011a & b) appended to the Planning Submission (MMJ, 2011). The main constraints to future development identified by ELA (2011a) in the flora and fauna assessment included threatened biodiversity listed under the TSC Act and EPBC Act. A summary of the ELA (2011a) findings is provided in following sections.

The outcome of the MMJ (2011) analysis was a recommendation for a site rezoning to include R2 over approximately two thirds of the subject site incorporating the flatter plateau from the western boundary to Crest Road with the remaining eastern slope proposed for E3 (Figure 2).

In response to further representations regarding the rezoning, Shellharbour City Council (Council) has deferred the subject site from the draft LEP 2011. Following recent consultation Council has determined to consider rezoning of the subject site as part of a bundle of rezoning's in a broader planning proposal. In this instance Council has requested a number of site investigations including "*preliminary studies on flora and fauna*".

1.2 Scope of assessment

The objectives of this investigation are to:

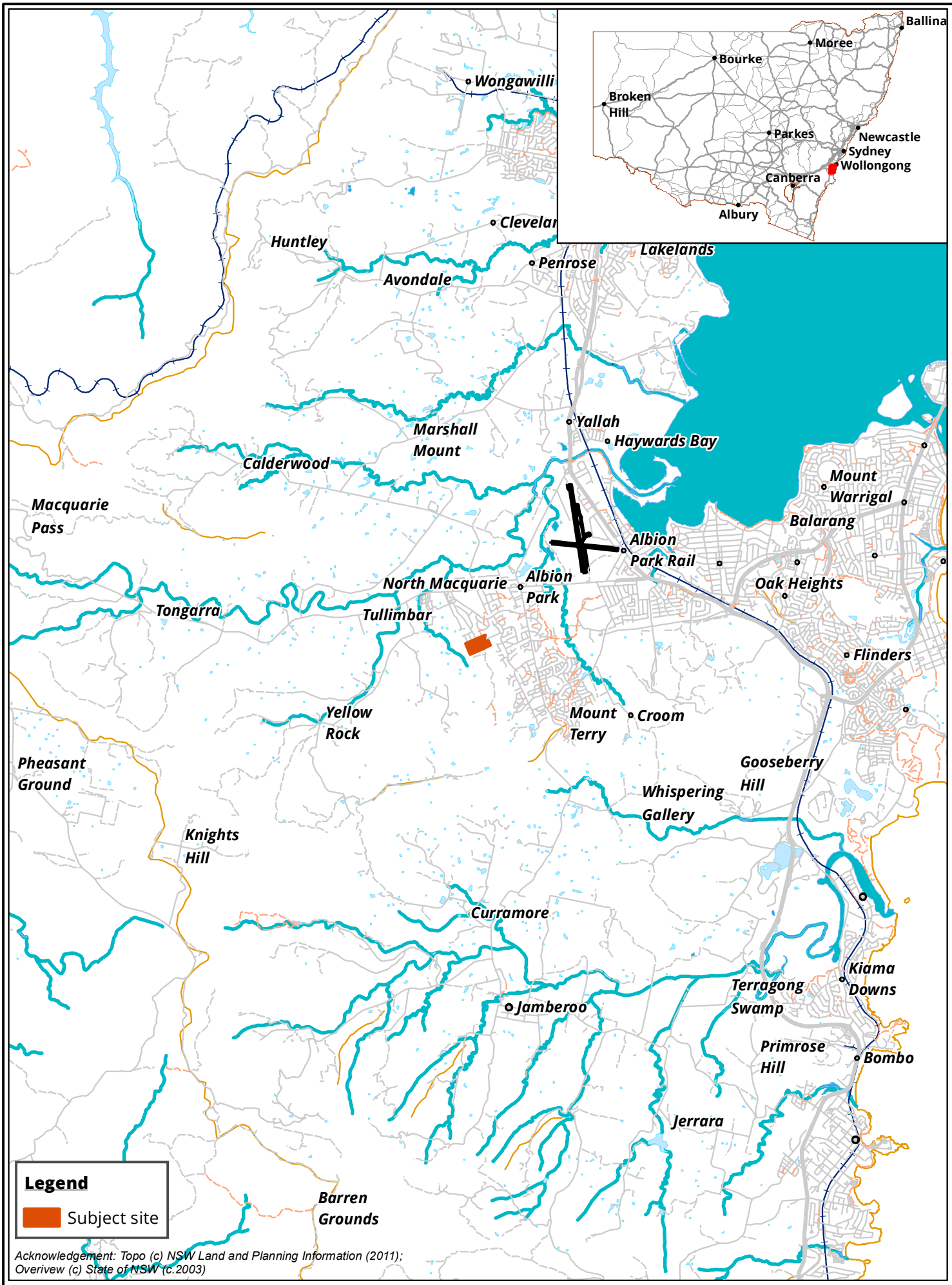
- Review previous terrestrial biodiversity surveys and assessments of the subject site;
- Undertake a survey and assessment of the subject site the according to the BioBanking Assessment Methodology (BBAM) as described by DECC (2009), including an assessment of species diversity and habitat condition from select locations on the subject site;

- Carry out detailed vegetation mapping including determining the presence and distribution of Threatened Ecological Communities (TEC's) and vegetation types according to the NSW Vegetation Types Database (OEH 2012a);
- Confirm the presence or absence of threatened flora species and potential habitats for threatened flora and fauna species assessed from previous ecological surveys of the subject site;
- Utilise the BioBanking Credit Calculator Version 2 (OEH, 2012b) to determine what biodiversity credits will need to be offset as a result of removal of, and impacts to, native vegetation associated with possible future development;
- Review the implications of relevant biodiversity legislation and policy; and
- Recommend any further assessments of the site that may be required (such as targeted searches for threatened terrestrial biodiversity).

1.3 Location of the study area

The subject site is located at Albion Park in the Shellharbour LGA (Figure 1) and encompasses approximately 9.69 ha of privately owned land at the end of Crest Rd, Albion Park. The subject site is currently zoned for rural uses and conservation and falls within the:

- Illawarra Subregion of the Sydney Basin Bioregion;
- Lake Illawarra catchment;
- Southern Rivers Catchment Management Authority area; and
- Shellharbour LGA.



biosis

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangarratta & Wollongong

Figure 1: Location of the Subject Site - Crest Road, Albion Park, New South Wales

Matter: 15643
Date: 21 December 2012, Checked By: JMS, Drawn By: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F1_20121221.mxd

0 1,000 2,000 3,000 4,000
Metres
N
Scale 1:100,000 @ A4, GDA 1994 MGA Zone 55

Acknowledgements: Imagery (c) Nearmap 2012

Legend

StudyArea

Proposed rezoning

E3 Zone

R2 Zone

Figure 2: Proposed rezoning of Lot 101 DP 785139 (Courtesy of Martin Morris and Jones)

0 20 40 60 80 100

Metres

Scale: 1:2,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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2. Methods

2.1 Literature and database review

In order to provide a context for the subject site, information about flora and fauna from within 5 km of the study site (the 'local area') was obtained from relevant public databases. Records from the following databases were collated and reviewed:

- NSW National Parks and Wildlife Service (NPWS) Wildlife Atlas © The State of New South Wales, (OEH, 2012c);
- PlantNET (The Royal Botanic Gardens and Domain Trust, 2012); and
- Protected Matters Search Tool of the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) for matters protected by the EPBC Act.

Other sources of biodiversity information:

- Relevant vegetation mapping, including:
  - *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands (SCIVI).* (Tozer et al. 2006); and
  - Vegetation Types Database (OEH, 2012a).

The following reports were also reviewed:

- *Draft Illawarra Biodiversity Strategy. Volume 2 Background Information.* (WCC *et al*, 2010);
- *Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study*. (Mills, 2007);
- *Planning Submission. Draft Shellharbour Local Environmental Plan 2011. Lot 101 DP 785139, Crest Road, Albion Park.* (MMJ, 2011); and
- *Flora and Fauna Assessment. Lot 1011 DP 785139 Crest Road, Albion Park.* (ELA, 2011).

A summary of the ELA (2011) survey and assessments is provided in Section 3.1.

2.2 Definitions of significance

2.2.1 Species and ecological communities

Significance of a species or community is determined by their listing as rare or threatened under Commonwealth or State legislation / policy. The sources used to categorise significance of species and communities in this report are summarised below in Table 1.

Table 1: Criteria for determining significance of species & ecological communities

Significance	
National	Listed as threatened (critically endangered, endangered, vulnerable or conservation dependent) under the EPBC Act.
State	Listed as threatened (critically endangered, endangered, vulnerable) according to the TSC Act

2.3 Likelihood of occurrence

The likelihood of occurrence is a broad categorisation used by Biosis to indicate the potential for a species to occur within the subject site, it is based on expert opinion and implies the relative value of a site for a particular species.

The likelihood of species occurring within the subject site is ranked as negligible, low, medium or high. The rationale for the rank assigned is provided for each species in Appendix 3 (flora) and Appendix 4 (fauna).

Species which have a medium or higher likelihood of occurrence are given further consideration in this report. The need for targeted survey for these species is also considered.

2.4 Site investigation

2.4.1 General flora and fauna

Diurnal flora and fauna surveys were carried out over the subject site on 11 December 2012. A general flora and fauna assessment was incorporated as part of the more formal BBAM surveys. Flora surveys included;

- Random meanders over the subject site in the main landscape stratification units targeting threatened flora species and populations previously recorded in the locality and with potential to occur on the subject site. Species targeted included:
  - *Chorizema parviflorum* Eastern Flame Pea (threatened population);
  - *Cynanchum elegans* White-flowered Wax Plant;
  - *Solanum celatum*; and
  - *Zieria granulata* Illawarra Zieria.
- Searches to locate and confirm the continued presence of threatened flora species recorded in previous surveys by ELA (2011); and
- Assessment to confirm the presence and extent of the of the TSC Act listed TEC Illawarra Lowlands Grassy Woodland as previously mapped by ELA (2011) and determine the vegetation type according to OEH (2012a).

General fauna surveys focused on the types and qualities of habitat(s) present. All species of fauna observed during the assessment were noted and active searching for fauna was undertaken. This included direct observation, searching under rocks and logs, examination of tracks and scats and identifying calls. All trees on the site were inspected and the presence of hollow-bearing trees noted. Particular attention was given to searching for significant species recorded by ELA (2011) or identified during database review and their habitats. Fauna species were recorded with a view to characterising the values of the site and the investigation was not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

A list of flora and fauna species was compiled as part of the general BBAM surveys. Records of threatened flora species will be submitted to OEH for incorporation into the NSW Wildlife Atlas.

2.5 BioBanking

The current survey and assessment is primarily based on the BBAM. BBAM field surveys have been carried out according to 'Appendix 2 Field methodology for measuring condition' from *BioBanking Assessment*

Methodology and Credit Calculator Operational Manual (BBAM) (DECC, 2009). This section outlines the methodology and inputs into the BioBanking Credit Calculator (Version 2.0).

The subject site, Lot 1 DP 785139, is located within the:

- Southern Rivers Catchment Management Authority (CAM);
- Illawarra CMA Subregion;
- Kiama Coastal Slopes Mitchell Landscape; and,
- Shellharbour Local Government Area (LGA).

2.5.1 Landscape Value

2.5.1.1 Assessment Circles

Native vegetation cover was assessed using Tozer *et al.* (2010), the Vegetation Types Database (2012a), the results of prior assessments and the Biosis survey effort.

As per the (BBAM), one assessment circle was required. This assessment circle is shown in Figure 3. The assessment circle information is outlined in Table 2.

Table 2: Assessment Circle Information

BioBanking Component	Before development	After development
Catchment Management Area (CMA) Subregion	Illawarra	Illawarra
Native vegetation cover		
1000 ha	21 – 30%	21 – 30%
100 ha	51 – 60%	41 – 50%
Connectivity value		
Width	> 100 m – 500 m	> 100 m – 500 m
Over storey condition	Percent Foliage Cover (PFC) at Benchmark (BM)	PFC at BM
Mid storey / ground cover condition	PFC of mid storey / ground cover at BM	PFC of mid storey / ground cover at BM

2.5.2 Vegetation Zones and Threatened Species Subzones

Vegetation communities across the subject site were mapped during the current assessment using Tozer et al. (2010). One vegetation community, South Coast Grassy Woodland was mapped as occurring within the subject site.

As the BBAM uses vegetation types (Keith 2004) as the basis for the BBAM assessment, vegetation communities were matched with corresponding vegetation types using the NSW Office of Environment and Heritage (OEH) Vegetation Types Database (OEH 2012a). South Coast Grassy Woodland (SCGW) is defined by the broad scale vegetation mapping of southeast NSW by Tozer *et al* (2010) and corresponds with Forest Red Gum – Thin-Leaved Stringybark Grassy Woodland (FRGTLSGW; SR545) of Keith (2004). FRGTLSGW is referred to throughout the remainder of this report.

To determine vegetation zones, vegetation types were stratified by:

- condition (low or moderate / good); and
- ancillary code.

Threatened species subzones were determined by further stratifying vegetation zones by:

- adjacent remnant vegetation; and
- patch size.

According to the BBAM, Adjacent Remnant Vegetation is defined as the area of moderate / good condition vegetation of which the threatened species subzone is a part. The Patch Size is defined as the area of low and moderate / good condition vegetation of which the Threatened Species Subzone is a part. Areas of woody vegetation are considered connected provided they are separated by less than 100 m.

Patch Size was calculated by joining all native vegetation communities within these datasets that were separated by less than 100 m until a maximum Patch Size of 500 ha was reached. Adjacent Remnant Vegetation was calculated by removing areas of low condition from Patch Size.

Three threatened species subzones were delineated, as outlined in Table 3 and Figure 4.

Table 3: Threatened species subzones

Vegetation type	Threatened species subzone	Area (ha)	Adjacent remnant vegetation (ha)	Patch size (ha)	Vegetation type	Vegetation formation	Condition
SR545_Low	1	2.60	0	> 500	Grassy woodlands	Forest Red Gum - Thin-leaved Stringybark Grassy Woodland	Low
SR545_Mod/ Good	2	3.95	> 500	> 500	Grassy woodlands	Forest Red Gum - Thin-leaved Stringybark Grassy Woodland	Moderate / Good
SR545_mod/ Good_Lanata	3	1.81	> 500	> 500	Grassy woodlands	Forest Red Gum - Thin-leaved Stringybark Grassy Woodland	Moderate / Good

As all vegetation zones were within 100 m of each other, vegetation zones matched threatened species subzones and stratification was not required.

2.5.3 Geographic and Habitat Features

Geographic and habitat features were used to refine threatened species, requiring assessment. The BBAM questions and answers provided are outlined in Table 4.

Table 4: Geographic and habitat feature questions and answers

Question	Answer
land within 40 m of heath, woodland or forest with sandy or friable soils?	No Soils clay based
land within 40 m of rainforest, coastal scrub, riparian or estuarine communities?	No Subject site located on top of ridge greater than 40 m from these communities
land containing caves or similar structures?	No No caves within the subject site
hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone?	No Subject site not located within 200 m of a riparian zone
land north of Batemans Bay in Bateman CMA subregion?	No Subject site located within the Illawarra CMA subregion
land within Shellharbour and Wollongong LGAs in Illawarra CMA subregion?	Yes
land within Wollongong LGA in Illawarra CMA subregion?	Yes

The answers to the questions regarding geographic habitat features indicated potential for the threatened population *Chorizema parviflorum* Benth. Eastern Flame Pea TSC Act listed endangered population, Wollongong and Shellharbour local government areas, and *Lespedeza juncea* subsp. *sericea* TSC Act listed endangered population, Wollongong Local Government Area to occur within the subject site. Targeted surveys failed to locate these species, either during the current survey or ELA (2011) and both assessments consider the likelihood of these species occurring as low. Thus they were deemed not to be impacted by the proposed development and were excluded from further consideration.

2.5.4 Site Survey Details

Table 5 outlines a generated a list of species predicted to occur in the subject site, or that may potentially utilise the subject site. This list was refined based on the flora and fauna assessment undertaken (Biosis 2012a). Where species were known not to occur in the subject site, or where suitable habitat for such species did not exist, they were excluded.

Table 5: Predicted threatened species assessment

Scientific name	Common name	On site	Justification
Burhinus grallarius	Bush Stone-curlew	No	Surveys undertaken.
Calyptorhynchus lathami	Glossy Black-cockatoo	No	Preferred foraging habitat not

			present.
Cercartetus nanus	Eastern Pygmy-possum	No	Suitable habitat not present.
Glossopsitta pusilla	Little Lorikeet	Yes	Assumed due to presence of suitable habitat. Potential to occur.
Lathamus discolor	Swift Parrot	Yes	Assumed due to presence of suitable habitat. Potential to occur.
Myotis macropus	Large-footed Myotis	No	Survey. Targeted surveys did not record this species. Subject site not located in proximity to preferred foraging habitat.
Neophema pulchella	Turquoise Parrot	Yes	Assumed due to presence of suitable habitat. Potential to occur.
Ninox connivens	Barking Owl	No	No potential breeding sites or suitable foraging habitat
Petroica boodang	Scarlet Robin	Yes	Assumed due to presence of suitable habitat. Potential to occur.
Petroica phoenicea	Flame Robin	Yes	Recorded by ELA (2011).
Phascolarctos cinereus	Koala	No	No recent records from the Illawarra floodplain. No evidence of occupation.
Pteropus poliocephalus	Grey-headed Flying-fox	No	Suitable habitat not present.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	No	Survey. Targeted surveys did not record this species.
Tyto novaehollandiae	Masked Owl	No	No potential breeding sites or suitable foraging habitat.
Xanthomyza phrygia	Regent Honeyeater	No	Assumed. Subject site does not support significant habitat.

2.5.5 Site Values

Six quadrats / transects were established across all vegetation zones / threatened species subzones, with the following number of quadrats / transects undertaken in each vegetation zone:

- SR545_Low: 1.
- SR545_Moderate/Good: 2.
- SR545_moderate/good_Lanatana: 3.

Location of quadrats / transects is shown in Figure 4. Data from each quadrats / transect is shown in Appendix 1. Methodology for collection of data is outlined in Appendix 2.

Threatened Species Subzones were further stratified based on whether the project will result in the loss or retention of vegetation, and the type of management to be undertaken in areas of retained vegetation. Eight management zones were created as outlined in Table 6 and shown in Figure 5.

Table 6: Management zones

Management zone	Threatened species subzone	Vegetation zone	Area (ha)	Type of management
MZ1	1	SR545_Low	2.60	Loss
MZ2	2	SR545_Moderate/Good	3.45	Loss
MZ3	2	SR545_Moderate/Good	0.50	Assisted regeneration
MZ4	3	SR545_Moderate/Good_Lantana	0.09	Loss
MZ5	3	SR545_Moderate/Good_Lantana	1.72	Natural regeneration

2.5.6 Threatened Species Survey Results

Targeted flora surveys were undertaken on the by ELA (2011) and during the current assessment in areas likely to be impacted by the proposed rezoning (areas of R2 as shown in Figure 2). Due to difficult of access and the proposed E3 zoning of these areas targeted surveys did not focus on areas dominated by *Lantana camara* Lantana.

Targeted surveys did not record any threatened flora species in areas proposed for R2 zoning. Seven individual *Cynanchum elegans* White-flowered Wax Plants were recorded at two locations in areas proposed for E3 zoning. As these areas are not proposed for development it was deemed that these plants would not be impacted by the proposed rezoning due to their location in an area proposed for conservation (see Section 5).

Other species predicted to occur, requiring further survey are outlined in Table 5

Table 7: Threatened species surveys results for the BioBanking Assessment

Scientific name	Common name	Impacted by development?	Justification
Pimelea spicata	Spiked Rice-flower	No	Targeted surveys failed to locate this species. Habitat not present on site.
Pterostylis gibbosa	Illawarra Greenhood	No	Targeted surveys failed to locate this species. Only marginal habitat present on site.
Zieria granulata	Illawarra Zieria	No	Potential habitat in areas proposed for E3 zoning. Species habitat will not be impacted

Lophoictinia isura	Square-tailed Kite	No	Targeted surveys failed to locate this species. Preferred habitat not present on site.
Sminthopsis leucopus	White-footed Dunnart	No	Targeted surveys failed to locate this species. Suitable habitat not present.
Callocephalon fimbriatum	Gang-gang Cockatoo	No	Targeted surveys failed to locate this species. Preferred habitat not present. No suitable breeding hollows.
Hieraaetus morphnoides	Little Eagle	No	Targeted surveys failed to locate this species. Preferred habitat not present.

2.6 Permits and Licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage (OEH) under the *National Parks and Wildlife Act* (SL100758, expiry date 31 March 2013). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee.

2.7 Qualifications

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, ephemeral status of waterbodies and migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The current flora and fauna assessment was conducted over one day in summer 2012. The survey effort was based on the nature of the proposal, the scope and the objectives of this project. In relation to the amount of survey effort and its timing, a reasonable sample of the spectrum of flora and fauna species and assessment of the ecological processes that are likely to occur on the subject site and in the study area have been made from desktop assessments, background research the current 2012 surveys and previous site inspections by ELA (2011).

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

2.8 Legislation and policy

The implications for the project were assessed in relation to key biodiversity legislation and policy including:

- EPBC Act;
- EP&A Act;
- TSC Act; and

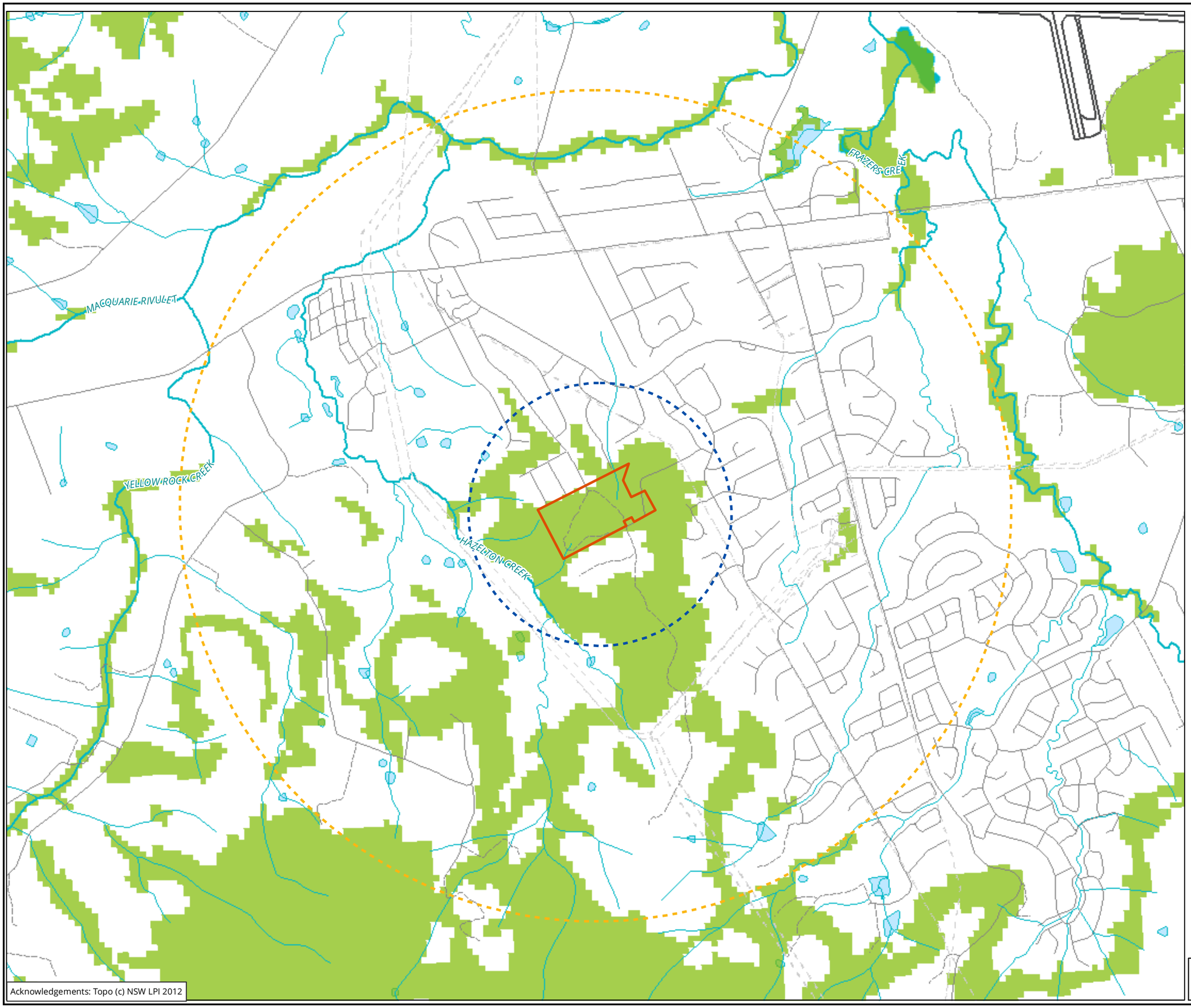
- *Draft Shellharbour Local Environment Plan 2011.*

2.9 Mapping

MMJ has provided a site concept plan to inform the current assessment showing proposed zonings, indicative Lot and Asset Protection Zone (APZ) layout and roads. The subject site boundary and proposed zonings were digitised from this concept plan using a Geographic Information System (GIS).

Mapping was conducted using a combination of hand-held (uncorrected) GPS units (WGS84), aerial photo interpretation and a tablet personal computer (PC) with GPS capability. The accuracy of the hand held GPS mapping is subject to the accuracy of the GPS units (generally ± 3 to 7 metres) and dependent on the limitations of aerial photo rectification and registration. Mapping in the field using tablet (PC) provides a higher level of accuracy and has been used to map vegetation condition polygons, fauna habitat features and the extent of TEC's.

Mapping has been produced using a GIS including spatial data collected in the field and site information transposed from non-spatially referenced plans.



Legend

- StudyArea
- Vegetation mapping (SCIVI)

Assessment Circles

- 1000 ha
- 100 ha

Figure 3: Landscape assessment circles showing vegtetation cover in 100 ha and 1000 ha assessments circles (Tozer et al. 2010)

0 150 300 450 600 750

Metres
Scale: 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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Date: 21 December 2012,
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Legend

StudyArea

Vegetation zones and threatened species subzone

- SR545 - Low, 1
- SR545 - Moderate/Good, 2
- SR545 - Moderate/Good Lantana, 3

Figure 4: Vegetation zones and threatened species subzones, showing location of quadrats / transects

0 20 40 60 80 100

Metres

Scale: 1:2,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Acknowledgements: Imagery (c) Nearmap 2012

Legend

StudyArea

Management zones

- MZ1
- MZ2
- MZ3
- MZ4
- MZ5

Figure 5: Management zones

0 20 40 60 80 100

Metres
Scale: 1:2,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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3. Results

The key ecological features of the subject site are described below and mapped in Figure 7. Species recorded during the flora and fauna assessment are listed in Appendix 3 (flora) and Appendix 4 (fauna). Unless of particular note, these species are not discussed further.

A list of significant species recorded or predicted to occur in the local area is also provided in those appendices, along with an assessment of the likelihood of the species occurring within the study area.

3.1 Site context

Two previous ecological surveys and assessments have been carried out on the subject site as summarised below.

3.1.1 *Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study, City of Shellharbour* (Mills, 2007)

The subject site was included as part of a Local Environmental Study by Mills (2007). The objective of this study was primarily to 'further investigate, identify the boundaries of and assess the importance of the ILGW on certain properties' included in the Shellharbour Urban Fringe Local Environment Plan. The subject site is referred to by Mills (2007) as 'Study Area 2'. The Mills (2007) investigation was restricted to flora surveys over only part of the subject site. In summary Mills (2007) states that of the approximate three hectares surveyed the *'eastern half of the study area is well treed and has a diverse native understorey*', the '*area represents a relatively good quality stand of IGLW compared to other areas of the community in the vicinity*' and '*the western half of the study area is less well treed and most of the ground cover is exotic grassland, dominated by perennial exotic species*'. A 'potential development area' is described and mapped by Mills (2007) for the subject site.

3.1.2 *Flora and Fauna Assessment, Lot 1011 DP 785139 Crest Road, Albion Park* (ELA, 2009)

ELA (2011) undertook a more detailed terrestrial flora and fauna assessment and constraints analysis of the subject site. The main constraints to future rezoning and development identified by ELA included threatened biodiversity listed under the TSC Act and EPBC Act including:

- ILGW EEC listed under the TSC Act;
- *Cynanchum elegans* White-flowered Wax Plant, listed under the TSC and EPBC Act;
- Flame Robin *Petroica phoenicea,* listed under the TSC Act;
- Grey-headed Flying-fox *Pteropus poliocephalus,* listed under the TSC and EPBC Act; and
- Several EPBC Act and TSC Act listed microchiropteran bat species.

In summary ELA (2011) outlined that the condition of ILGW is variable and that this primarily reflects the level of environmental constraints present within the subject site. ELA (2011) also suggest the variable levels of constraint are only indicative and that there is *'some scope for further adjustment of these boundaries, particularly where offsets are provided to compensate for any loss of ecological values'*. ELA (2011) also state that *'any submission to adjust the proposed zoning boundaries to increase the area of R2 zone while reducing the area of E3 zone, should ensure that key ecological values of the site are not adversely affected without appropriate compensatory offsets'*. Offsets suggested by ELA include:

- restoration of ILGW EEC guided by a Vegetation management Plan;

- enhancement of habitat for threatened plant species *Cynanchum elegans* White-flowered Wax Plant; and,
- replacement or replication of hollows to compensate for the loss of hollow bearing trees.

3.2 Vegetation Communities and Fauna Habitat

The subject site is mapped as supporting South Coast Grassy Woodland (SCGW) in the broad scale vegetation mapping of southeast NSW by Tozer *et al* (2010) as shown in Figure 6. This area of vegetation is part of a relativity narrow northern lobe of tree cover extending from the better vegetated slopes of Stockyard Mountain in the south. According to Tozer *et al.* (2010) SCGW is considered to form one of two sub-units of the TSC Act listed TEC ILGW. SCGW corresponds with the Forest Red Gum – Thin-leaved Stringybark grassy woodland (FRGTLSGW) vegetation type according to Keith (2004) and the Vegetation Types Database (2012a). Mills (2007) surveys identify ILGW over at least a portion of the subject site, whist ELA (2011) describe Red Gum – Stringybark Forest community, corresponding with ILGW, over the majority of the subject site.

The current survey identifies FRGTLSGW as occurring over the majority of the subject site (Figure 7). Currently the subject site is used for horse adjistment, and is subject to grazing, nutrient loading, erosion and trampling by horses. Areas that have been heavily trampled, contain buildings or access tracks and therefore do not support a viable form of this vegetation community, and are not mapped as supporting native vegetation.

Vegetation communities present in the subject site are described in Table 8 and Table 9.

Table 8: Forest Red Gum - Thin-leaved Stringybark Grassy Woodland

Forest Red Gum - Thin-leaved Stringybark grassy woodland (Keith 2004)	
Extent within subject site	2.60 ha of low condition 3.95 ha of moderate / good condition 1.81 ha of moderate / good condition (Lantana dominated) 8.36 ha total
Description	Briefly canopy of the native vegetation in the subject site is dominated by *Eucalyptus tereticornis* Forest Red Gum over both the flatter plateau area and north east slopes with *Eucalyptus eugenioides* Thin-leaved Stringybark also present. Both areas have a very sparse midstorey of regenerating canopy species with occasional *Acacia implexa* Hickory Wattle, *Acacia maidenii* Maiden's Wattle, *Alphitonia excelsa* Red Ash, *Dodonaea viscosa* ssp. *angustifolia* Sticky Hop-bush and *Myrsine variabilis* Muttonwood. The understorey on the higher plateau is absent as a result of intensive grazing from horse adjistment (Plate 1), whilst understorey on the north east slopes is entirely dominated by *Lantana camara* Lantana with occasional native shrubs on the higher slopes (Plate 2). The groundcover stratum of the FRGTLSGW is in a moderate condition supporting a range of native grasses and herbs including *Commelina cyanea* Scurvy Weed, *Cyperus gracilis* Slender Flat-sedge, *Desmodium varians* Slender Tick-trefoil, *Dichondra repens* Kidney Weed, *Microlaena stipoides* var. *stipoides* Weeping Grass and *Oplismenus imbecillis* Oplismenus. Groundcover under the thickets of *Lantana camara* on the north east slopes is virtually absent with sparse cover of native and exotic grasses, herbs and scramblers such as *Asparagus aethiopicus* Asparagus Fern, *Centella asiatica* Indian Pennywort, *Commelina cyanea* Scurvy Weed, *Delairea*

	odorata Cape Ivy, *Ehrharta erecta* Panic Veldtgrass and *Eustrephus latifolius* Wombat Berry.
Condition	Areas where canopy cover is less than 25% of the benchmark for the vegetation type were assessed as low. Other areas were assessed as moderate to good. These areas were further classified dependent upon the cover of *Lantana camara*. The overall resilience and recovery potential of the FRGTLSGW is assessed as poor in low condition areas and moderate in other areas.
Fauna habitat	Fauna habitat across the site varies in condition dependent upon the undertrsorey and presence of hollow bearing trees. Trees across are generally immature. Thirty-one hollow bearing trees were mapped as occurring across the subject site. These hollow bearing trees generally support only small hollows between 5 and 20 cm in diameter. Upper slopes contained little to no understorey, whilst slopes in the eastern section of the subject site support a dense understorey of *Lantana camara*. This provides significant foraging habitat for a number of woodland birds. Groundcover in areas where *Lantana camara* dominates is largely absent, while in other areas it is dominated by grasses and herbs. There is little leaf litter or coarse woody debris present.
Threatened species	Seven *Cynanchum elegans* were recorded at two locations in FRGTLSGW. *Zieria granulata* Illawarra Zieria considered a Medium likelihood of occurrence in areas if FRGTLSGW. One threatened bird (Flame Robin *Petroica phoenicea*) was recorded by ELA (2011). One additional bird (Varied Sitella *Daphoenositta chrysoptera*) is considered a medium likelihood of occurrence. One megachiropteran bat (Grey-headed Flying-fox *Pteropus poliocephalus*) was recorded overflying the subject site by ELA (2011). Three microchiropteran bats (Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*, Little Bentwing-bat *Miniopterus australis* and Eastern False Pipistrelle *Falsistrellus tasmaniensis*) were recorded within the Subject Site by ELA (2011). One additional microchiropteran bat (Greater Broad-nosed Bat *Scoteanax rueppellii*) is considered a medium likelihood of occurrence within the subject site. Two of these species (Eastern False Pipistrelle and Greater Broad-nosed Bat) roost in tree hollows and the subject site supports potential roosting habitat for these two species.
Threatened community	FRGTLSGW is consistent with the ILGW TEC
Plates	**Plate 1: ILGW, higher plateau area**

Plate 2: ILGW, north east slopes

Table 9: Closed Grassland

Closed Grassland	
Extent within subject site	Approximately 1.20 ha
Description	The Closed Grassland is dominated by exotic pasture grasses and annual and perennial weeds. Exotic grasses such as *Paspalum dilatatum* Paspalum, *Pennisetum clandestinum* Kikuyu Grass dominate with other common exotic herbs and grasses including *Acetosella vulgaris* Sorrel, *Bidens pilosa* Cobblers Pegs, *Cirsium vulgare* Spear Thistle, *Conyza* sp. Fleabane, *Oxalis corniculata*, *Senecio madagascariensis* Fireweed, *Euphorbia peplus* Petty Spurge and *Sida rhombifolia* Paddy's Lucerne. Native grasses and herbs also occur mixed through the exotic groundcovers and common species are *Cotula australis* Common Cotula, *Einadia trigonos* ssp. *trigonos* Fishweed, *Geranium homeanum* Native Geranium, *Microlaena stipoides* var. *stipoides* Weeping Grass and *Poa labillardierei* Tussock Grass.
Condition	The current survey and assessment has mapped a Closed Grassland community in places on the subject site that have been cleared and

	modified and are being intensively grazed by horses (Plate 3). Due to previous disturbance and the continuing land management the Closed Grassland community of the subject site is assessed as having a low resilience and low natural recovery potential.
Threatened species	None recorded. Low likelihood of occurrence for all species.
Threatened community	Closed grassland does not correspond with any TEC.
Plates	**Plate 3: Closed grassland** 

3.3 Significant Species - EPBC Act & TSC Act listed species

Lists of significant species recorded or predicted to occur within 5 km of the subject site are provided in Appendix 3 (flora) and Appendix 4 (fauna). An assessment of the likelihood of these species occurring in the study area and specifically the subject site (i.e. which habitats or features of relevance to the species) is included. A summary of those species recorded or with a medium or higher likelihood of occurring in the study area is provided in Table 10.

Table 10: Summary of significant species most likely to occur in the subject site

Species name	Area of value within the study area
EPBC Act listed species	
Cynanchum elegans **White-flowered Wax Plant**	FRGTLSGW on north east facing slopes; the location of records of this species are provided in Figure 7. Discussed further below.
Zieria granulata **Illawarra Zieria**	FRGTLSGW on the upper rocky north east facing slopes; the location of records of this species are provided in Figure 7.
Grey-headed Flying-fox ***Pteropus poliocephalus***	Species recorded by ELA (2011) over-flying the subject site. Subject site does not support significant habitat. Some individuals may forage on flowering Red Gum on occasion.
TSC Act listed species	
Varied Sitella ***Daphoenositta chrysoptera***	Potential for this species to occur within the subject site on occasion, particularly areas of *Lantana camara* where high

	habitat complexity provides shelter.
Flame Robin ***Petroica phoenicea***	This species was recorded by ELA (2011) along the northern boundary of the subject site.
Hollow roosting microchiropteran bats **Greater Broad-nosed Bat** ***Scoteanax rueppellii*** **Eastern False Pipistrelle** ***Falsistrellus tasmaniensis***	Hollow bearing trees provide potential roosting habitat for these species. If present species likely to forage widely across the subject site.
Cave roosting microchiropteran bats **Eastern bentiwng-bat** ***Miniopterus schreibersii oceanensis*** **Little Bentwing-bat** ***Miniopterus australis***	Species likely to forage widely across the subject site. Suitable roosting habitat not present. (Note: The record of the Little Bentwing-bat is questionable. There is only one record of this species south of Sydney)

Cynanchum elegans White-flowered Wax Plant is listed as an endangered species under both the TSC and EPBC Acts. The species was recorded in the surveys by ELA (2011) at one location on the subject site. Targeted searches for the species in the current surveys located six plants at the previously recorded location by ELA (2011) as well as one plant at an additional located along the eastern fenceline in proximity to quadrat 2 (Figure 7).

Cynanchum elegans White-flowered Wax Plant is a climber or twiner with a highly variable form. It is a clonal species with underground suckering stems that are rarely stoloniferous and can grow to 10 m high. The species occurs mainly at the ecotone between dry subtropical rainforest and sclerophyll forest/woodland communities and has been recorded in Dry Subtropical Rainforest, Littoral Rainforest, *Eucalyptus tereticornis* aligned Open Forest and Woodland (NPWS 2002a). In addition to the know locations of the species on the subject site FRGTLSGW on northeast facing slopes, particularly the higher areas, is considered to be potential habitat for the species.

The viable population size for the species is unknown and NPWS (2002b) state that in the absence of a detailed assessment demonstrating otherwise, all populations should be assumed to be viable. In addition NPWS (2002b) suggest that determining a significant area of habitat requires consideration of:

- Number of genetic individuals present;
- Location in relation to the current distributional limits of the species and proximity to the nearest reserved population;
- Uniqueness, size, condition and connective importance of the habitat; and,
- Management potential including the likelihood of ameliorating any existing threatening processes.

The population of *Cynanchum elegans* White-flowered Wax Plant within the subject site is considered a viable population.

3.4 Significant ecological communities

As described in Section 3.2 above SCGW, corresponding to ILGW, is mapped in the Study Area by Tozer *et al.* (2010). Mapping by Tozer *et al.* (2010) estimated 3100ha of extant SCGW in the area from Wollongong to Milton and west to Yalwal including approximately 180ha in conservation reserves.

The current survey mapped a total of 8.36 ha of FRGTLSGW, corresponding with ILGW, within the subject site, 2.6 ha of which is considered to be in low condition and of poor resilience.

ILGW of the subject site is part of a broader stand of the community extending to the south. Other large stands of SCGW are mapped by Tozer *et al* (2006) over the alluvial flats and low hills in nearby areas. ILGW is recorded in the Wollongong, Shellharbour, Kiama and Shoalhaven LGAs. ILGW occurs on relatively gently sloping to undulating lands less than about 200 m elevation on Berry Siltstone, Budgong Sandstone and Quaternary alluvium. Characteristic tree species include but are not limited to *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus eugenioides* Thin-leaved Stringybark, *Eucalyptus longifolia* Woollybutt, *Eucalyptus bosistoana* Coast Grey Box and *Melaleuca decora* White Feather Honeymyrtle. The species composition of any stand is influenced by the size of the site and by recent disturbance history. As such the number of species and the above-ground floristic composition of the community will change with time since fire, and may also change in response to changes in fire frequency (NSW Scientific Committee 2008a). Species composition of the stand of the community in the Study Area and on the Subject Site, as described earlier is an example of structural and floristic variation that reflects a recent disturbance history.

3.5 Further survey recommendations

Seven plants of the threatened flora species *Cynanchum elegans* White-flowered Wax Plant has been recorded at two locations within the subject site. There is potential for additional plants to occur at additional locations in the eastern section of the subject site, in areas dominated by *Lantana camara* Lantana. Due to the difficulty in undertaking targeted surveys in this area during the current assessment additional targeted surveys are recommended prior to the disturbance of vegetation in this area, either for development of weed removal. Surveys can be undertaken year round.

3.6 BioBanking – Credit Requirements

The credits requirements generated by the BioBanking Assessment are outlined in Table 11.

Table 11: Credit requirements, Lot 101 DP785139, Crest Road, Albion Park

Management zone	Vegetation type	Red flag	Management zone area (ha)	Site value score	Credits req for biodiversity	Credits req for threatened speciesS	Final credits requirement
MZ1	Forest Red Gum - Thin-leaved Stringybark grassy woodland	No	2.60	26.56	26	0	26
MZ2	Forest Red Gum - Thin-leaved Stringybark grassy woodland	Yes	3.45	35.42	42	108	108
MZ3	Forest Red	Yes	0.50	35.42	2	0	2

	Gum - Thin-leaved Stringybark grassy woodland						
MZ4	Forest Red Gum - Thin-leaved Stringybark grassy woodland	Yes	0.09	43.75	1	0	1
MZ5	Forest Red Gum - Thin-leaved Stringybark grassy woodland	Yes	1.72	43.75	6	6	6
						TOTAL	**143**

The vast majority of credit requirements are generated by management zone MZ2. This management zone supports moderate / good quality FRGTLSGW and contains habitat for a number of threatened species, as illustrated by generation of the higher credit requirements for threatened species.

Management zones MZ2, MZ3, MZ4 and MZ5 are 'red flags' as they support an EEC and the vegetation is not in low condition. Management zone MZ1 is not a 'red flag' as it is in low condition. In order to obtained a BioBanking Agreement for a development site a variation must be sought from the Director General. When seeking a 'red flag' variation proponents must consider a number of criteria. These criteria and their relevance to the current assessment are illustrated in Table 12.

Table 12: Red flag variation criteria and their relevance to the current assessment

Factors to be considered	Relevance to current assessment
Options to avoid impacts on 'red flag' areas must be considered	The proposed rezoning will result in the removal of 3.54 ha of the ILGW EEC and retention of 2.22 ha of ILGW EEC through covenant or similar protection.
Highly cleared vegetation types have been considered	FRGTLSGW is listed in OEH (2012a) as having an 85% distribution within the CMA when compared with the pre-1750 distribution.
Contribution to regional biodiversity values must be low	Tozer *et al*. (2010) maps 3100 ha of SCGW (corresponding with FRGTLSGW) including 180 ha in conservation reserves. The cleared estimate within the Sothern Rivers CMA is 85%. Habitat for threatened species will be retained, protected and management within the E3 zoning and via covenant.
Viability must be low or not viable	Given the current pressures on the subject site, including grazing by domestic stock, weed invasion, development pressure and the location of the subject site at the dead end of

	a tongue of vegetation extending from the south the long term viability of the EEC on the subject site must be considered low. Without future management, as proposed by this rezoning, it is likely that the resilience of this site will be significantly reduced.
Other matters, including: **Regional plans** **Consistency with plans** **Environmental contributions**	The subject site is not specifically mentioned in the regional plan, but a large section of the proposed R2 zoning is mapped by Mills (2007) as "potential land" for development. Spinitu Pty Ltd may wish to make additional contribution, either financial or additional credits.

Based on the data above there is potential that the removal of vegetation marked as a 'red flag' could still meet the *improve or maintain* criteria as defined within the BBAM. This would need to be discussed with OEH.

Legend

StudyArea

Tozer et al. (2010)

South Coast Grassy Woodland

Figure 6: Vegetation mapping of the subject site (Tozer et al. 2010)

0 20 40 60 80 100

Metres
Scale: 1:2,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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Legend

- Study Area
- *Cynanchum elegans*
- Hollow bearing trees

Vegetation type

- Forest Red Gum - Thin-leaved Stringybark grassy woodland

Figure 7: Vegetation mapping of the subject site (Biosis), including locations of C.elegans and hollow bearing trees

0 20 40 60 80 100

Metres
Scale: 1:2,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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4. Biodiversity Legislation and Government Policy

This section provides an assessment of the project against key biodiversity legislation and government policy.

Where available, links to further information are provided. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

4.1 Commonwealth

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (NES) protected under the Act.

Link for further information including a guide to the referral process is available at:
http://www.environment.gov.au/epbc/index.html

Matters of National Environmental Significance relevant to the project are summarised in Table 13. It includes an assessment against the EPBC Act policy statements published by the Australian Government which provide guidance on the practical application of EPBC Act.

Table 13: Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Assessment against Guidelines
Threatened species and ecological communities	One flora (*Cynanchum elegans* White-flowered Wax Plant) and one fauna (Grey-headed Flying-fox *Pteropus poliocephalus*) species have been recorded within the subject site. An additional 11 flora and 33 fauna species are predicted to occur in the project search area. The likelihood of these species occurring in the subject site is assessed in Appendix 3 (flora) and Appendix 4 (fauna).	Most of these species are not likely to occur and development unlikely to constitute a significant impact. The retention of *Cynanchum elegans* White-flowered Wax Plant in the proposed E3 zone and protection via a covenant will provide some protection; however the retention of these plants in private lots does not guarantee a negligible level of impact. Additional surveys, and development of an appropriate management plan, that may include translocation into a secure conservation area, are recommended to ensure the proposed future development does not result in a significant impact on this species. Once these recommendations have been implemented a significance of assessment to determine the need for a referral to the Federal Environment Minister is recommended.
Migratory	24 migratory species have been recorded	While some of these species would be

species	or are predicted to occur in the project search area (Appendix 4).	expected to use the subject site on occasions, and some of them may do so regularly or may be resident, it does not provide important habitat for an ecologically significant proportion of any of these species.
Wetlands of international importance (Ramsar sites)	The subject site is not identified as being within the catchment of any Ramsar sites.	Not required.

Based on current information and on criteria outlined in the relevant *Significant Impact Guidelines* it is considered unlikely that a significant impact on a Matter of National Environmental Significance would result from the proposed action.

However, Spinitu Pty Ltd may wish to undertake further targeted surveys for *Cynanchum elegans* White-flowered Wax Plant and develop a comprehensive management plan that could include translocation of plants to secure conservation reserves or offsetting impacts by securing a suitable offset site containing the plant prior to deciding whether to refer the proposed action to the Australian Government Minister for the Environment to determine whether the action requires approval under the EPBC Act.

4.2 State

4.2.1 Threatened Species Conservation Act 1995

The TSC Act provides for the protection and conservation of biodiversity in NSW through the listing of threatened species, populations and communities; key threatening processes; and critical habitat for threatened species, populations and communities.

Native vegetation within the subject site is a listed community (ILGW) and contains threatened flora or fauna species, or habitat for them (particularly *Cynanchum elegan* and *Zieria granulata*). Impacts to the threatened species, populations and communities must be assessed through the Assessment of Significance (known as the "7-part test") process under Section 5A of the EP&A Act (refer to Section 4.2.2 below), unless the proponent wishes to enter into a BioBanking Agreement. If the development meets the *improve or maintain* criteria, Section 5A of the EP&A Act is then switched off.

Habitat critical to the survival of an endangered or critically endangered species, population or ecological community can be identified under the TSC Act and listed on the Register of Critical Habitat kept by the OEH. The subject site does not contain declared 'critical habitat'.

A licence to harm/pick/damage habitat of a threatened species, population or community or damage critical habitat is not required.

4.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The Act is administered by the NSW Department of Planning and Infrastructure

Link for further information: http://www.legislation.nsw.gov.au/viewtop/inforce/act+203+1979+FIRST+0+N/

Sections of the EP&A Act of primary relevance to the natural environment are considered further below in relation to the current proposal.

4.2.2.1 Assessment of Significance (Section 5A)

Section 5A of the EP&A Act requires proponents and consent authorities to consider if a development will have a significant effect on threatened species, populations or communities listed under the TSC Act and FM Act. Section 5A (and Section 9A of the TSC Act) outlines seven factors that must be taken into account in an Assessment of Significance (known as a "7-part test"). Where any Assessment of Significance determines that a development will result in a significant effect to a threatened species, population or community a Species Impact Statement (SIS) is required.

Under Section 127ZP of the TSC Act, if a development described in a BioBanking statement supplied to a consent authority is development for which consent is required under Part 4 or Part 5 of the EP&A Act, the development is taken, for the purposes of that Part, to be development that is not likely to significantly affect any threatened species, population or ecological community under this Act, or its habitat. Thus am Assessment of Significance and resultant SIS are not required.

Assessments of Significance were not within the scope of the current assessment. Dependent upon the decision as to whether to enter into a BioBanking Agreement, Biosis recommends that Assessments of Significance be undertaken for those species, populations or communities listed as medium to high likelihood in Appendix 3 and Appendix 4 as well as the ILGW EEC

4.2.2.2 State Environmental Planning Policies (Part 3 Division 2)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. SEPPs relevant to the current development are:

SEPP No. 44 Koala Habitat Protection

SEPP 44 applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP. On the basis of the criteria for determination of Potential Koala Habitat and Core Koala Habitat, the study area supports Potential Koala Habitat. However as the Koala has rarely been recorded in the Illawarra floodplain and not in recent times the subject site is not considered to support Core Koala Habitat and a Plan of Management is not required.

4.2.3 Native Vegetation Act 2003

The NV Act provides for, encourages and promotes the management of native vegetation on a regional basis. Under the NV Act no clearing of native vegetation is allowed except in accordance with prior development consent from the relevant Council or under a Property Vegetation Plan (PVP) approved by the relevant Catchment Management Authority.

Link for further information: http://www.nwc.gov.au/www/html/2100-catchment-and-land-protection-act-1994.asp

This assessment has been prepared to inform a rezoning application only. No native vegetation is proposed to be cleared.

5. Recommendations

This section identifies the potential implications of proposed development on the ecological values of the subject site and includes recommendations to assist Spinitu Pty Ltd to design a development to avoid and minimise impacts on biodiversity.

The current assessment has been prepared to inform a rezoning application only, and thus recommendations contained within this assessment are preliminary and provided as a guide only. A summary of potential implications of the proposed rezoning and recommendations to avoid and minimise impacts is provided in Table 14.

Table 14: Summary of potential implications of proposed rezoning and recommendations to avoid and minimise ecological impacts

Ecological feature (Error! Reference source not found.)	**Implications of development**	**Recommendations**
Native vegetation including trees and TECs	The permanent removal of up to 6.14 ha of native vegetation, including 3.54 ha of ILGW EEC. Removal of up to 23 hollow bearing trees.	Avoid and minimise removal of native vegetation. Retained trees, particularly hollow bearing trees, in road reserves and private allotments where possible.
Threatened species	Removal of known habitat for *Cynanchum elegans* and potential habitat for *Zieria granulata*. Removal of potential roosting habitat for two significant microchiropteran bat species (Eastern False Pipistrelle and Greater broad-nosed Bat) and known and potential foraging habitat for a number of other significant fauna species.	Undertake further targeted survey for *Cynanchum elegans* and *Zieria granulata* to inform the management plan and determine the need for a referral under the EPBC Act. Incorporate management of threatened species into the management plan (see below). The management of *Cynanchum elegans* may consider philanthropic translocation of specimens into conservation areas, or other measures, to contribute to the recovery of this species. The management plan should include habitat improvement for fauna species through measures such as the placement of logs on the ground to provide habitat as well as compensatory measures for loss of hollow bearing trees (such as nest boxes).
Retained areas	Reduced viability of flora and fauna species in the retained areas in the longer term due to reductions in habitat area	Put in place a conservation agreement / covenant over areas of retained native vegetation in the proposed E3 zone.

Ecological feature (Error! Reference source not found.)	Implications of development	Recommendations
	and influence of adjacent land use/s e.g. encroachment of weeds, increased predation by domestic pets.	Prepare and implement a management plan to manage areas of retained native vegetation within the E3 zone. The management plan will need to take into account Asset Protection Zones and provide for the management of *Cynanchum elegans*. The management plan should outline measures to improve the quality of retained vegetation, including staged approach to the removal of *Lantana camara* starting in areas with a higher resilience and native understorey and groundcover. The management plan should include measures to stimulate resilience in the retained flatter areas that have a low weed cover (MZ3) by light ripping to aerate the soils with re-vegetation to commence if no significant regeneration occurs within two years. The management plan should have an operational period of at least five years and be reviewed on the third year following assessment of site response.

The principal means to reduce impacts on biodiversity values within the subject site will be to minimise removal of native vegetation and habitat.

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Appendices

Appendix 1: Quadrat / Transect Data

Table 15: Quadrat / transect data

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q1	21	19	0	14	0	34	12	0	0	0	294900	6171072	56
Q2	19	14	9.5	24	2	6	11.2	0	0	0	295241	6171600	56
Q3	4	24	1	6	0	6	28.6	1	0	0	295173	6171226	56
Q4	14	20	7	4	0	2	33.1	3	0	0	295292	6171148	56
Q5	13	22.5	0	34	0	34	12	1	0	0	295132	6171036	56
Q6	7	2.5	0	30	0	12	52	1	0	0	295043	6171025	56

Appendix 2: BioBanking Data Collection Methods

Data collection for the BBAM was undertaken according to 'Appendix 2 Field methodology for measuring condition' from *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECC, 2009).

A preliminary assessment of the subject site was undertaken using mapping of vegetation by Tozer *et al.* (2010) to determine the number of quadrats / transects required in each vegetation zone.

In the field a total of six quadrats / transects were established (Figure 4). At each site a 20 m x 20 m quadrat and 50 m line transect were established. Location of quadrats in each vegetation zone were established by random selection using a blind folded ecologist. At each quadrat / transect data was collected on the attributes listed in Table 16.

Table 16: Attributes and data collection method for the BBAM

Attribute	Data collection method
Native plant species richness	Determined by counting all plant species within the 20 m x 20 m quadrat.
Native overstorey cover	Determined by scoring the percentage foliage cover (PFC) at ten points along the 50 m transect.
Native midstorey cover	Determined by scoring the PFC at ten points along the 50 m transect.
Native ground cover (grasses)	Determined by scoring the PFC at 50 points along the 50 m transect.
Native ground cover (shrubs)	Determined by scoring the PFC at 50 points along the 50 m transect.
Native ground cover (other)	Determined by scoring the PFC at 50 points along the 50 m transect.
Exotic plant cover	Determined by scoring the PFC at ten points along the 50 m transect if exotics were in the overstorey or midstorey and at 50 points along the 50 m transect if exotics were in the ground stratum.
Number of trees with hollows	The number of trees with hollows at least 5 cm diameter was scored within the 50 m x 20 m plot.
Regeneration	The proportion of overstorey species with regenerating individuals with a diameter at breast height of < 5 cm.
Total length of fallen logs	The total length of fallen logs (diamater greater than 10 cm and length greater than 50 cm) in the 50 m x 20 m plot.

Appendix 3: Flora

EPBC Act:	**TSC Act:**
CR - Critically Endangered EN - Endangered VU - Vulnerable	C1 – critically endangered E1 – endangered (Part 1, Schedule 1) E2 – endangered (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) V1 – vulnerable (Part 1, Schedule 2) **Bold** denotes characteristic flora species from Final Determinations for TEC's
General status:	**Noxious weed status:**
# - Native species outside natural range * - Exotic (not native to Australia) ** - Noxious weed species declared under the *Noxious Weeds Act* 1993	SP State prohibited species (Class 1) RP Regionally prohibited species (Class 2) RC Regionally controlled species (Class 3) RR Regionally restricted species (Class 4) R Restricted plant (Class 5)
Modified Braun Blanquet Cover Abundance	**Other Abundance**
1 <5% - 3 or less individuals	# Presence only
2 <5% - more than 3 sparsely scattered	

3 <5% - common throughout plot	
4 5% - 25%	
5 25% - 50%	
6 50% - 75%	
7 75% - 100%	

A3.1 Flora species recorded from the subject site

Table 17: Flora species recorded from the study area.

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Fabaceae - Mimosoideae	*Acacia binervata*	Two-veined Hickory					1		#	#
	Fabaceae - Mimosoideae	*Acacia fimbriata*	Fringed Wattle							#	
	Fabaceae - Mimosoideae	*Acacia implexa*	Hickory Wattle							#	#
	Fabaceae - Mimosoideae	*Acacia maidenii*	Maiden's Wattle	1						#	#
	Fabaceae - Mimosoideae	*Acacia mearnsii*	Black Wattle							#	#
	Fabaceae - Mimosoideae	*Acacia parramattensis*	Sydney Green Wattle							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Fabaceae - Mimosoideae	*Acacia podalyriifolia*	Queensland Silver Wattle							#	
	Fabaceae - Mimosoideae	*Acacia saliciformis*								#	
*	Polygonaceae	*Acetosella vulgaris*	Sorrel							#	
	Myrtaceae	*Acmena smithii*	Lilly Pilly							#	
	Sapindaceae	*Alectryon subcinereus*	Native Quince							#	
	Rhamnaceae	*Alphitonia excelsa*	Red Ash			1				#	
	Loranthaceae	*Amyema pendulum ssp*								#	
*	Primulaceae	*Anagallis arvensis*	Scarlet Pimpernel	2						#	
	Commelinaceae	*Aneilema acuminatum*								#	
	Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine				1				
*	Apocynaceae	*Araujia sericifera*	Moth Vine	1						#	
*	Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	1	1					#	
**RR	Asparagaceae	*Asparagus asparagoides*	Bridal Creeper		1					#	
	Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Asteraceae	*Bidens pilosa*	Cobblers Pegs							#	
	Poaceae	*Bothriochloa macra*	Red Grass								#
	Sterculiaceae	*Brachychiton populneus*	Kurrajong								#
	Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush		1			1		#	#
*	Poaceae	*Briza subaristata*								#	
*	Poaceae	*Bromus catharticus*	Praire Grass	3				3	2	#	
	Myrtaceae	*Callistemon salignus*	Willow Bottlebrush							#	
	Cyperaceae	*Carex inversa*								#	#
	Cyperaceae	*Carex longebrachiata*								#	#
	Vitaceae	*Cayratia clematidea*	Native Grape		1					#	
	Apiaceae	*Centella asiatica*	Indian Pennywort	1						#	#
*	Chenopodiaceae	*Chenopodium album*	Fat Hen	1				2		#	
	Chenopodiaceae	*Chenopodium pumilio*	Small Crumbweed								#
*	Poaceae	*Chloris gayana*	Rhodes Grass				2			#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Anthericaceae	*Chlorophytum comosum*	Spider Plant							#	
	Vitaceae	*Cissus hypoglauca*	Water Vine		2						
	Ranunculaceae	*Clematis aristata*	Old Man's Beard							#	#
	Verbenaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum	1	1					#	#
	Commelinaceae	*Commelina cyanea*	Scurvy Weed	2	2	2	2	3		#	#
*	Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	3							
*	Crassulaceae	*Crassula multicava*								#	
	Cyatheaceae	*Cyathea australis*	Black Tree-fern							#	
	Rubiaceae	*Cyclophyllum longipetalum*	Coast Canthium							#	
EN, E1	Apocynaceae	*Cynanchum elegans*								#	
	Poaceae	*Cynodon dactylon*	Couch						3	#	#
	Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	4				4	4		
	Cyperaceae	*Cyperus imbecillis*								#	
*	Cyperaceae	*Cyperus sp*		1							

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Asteraceae	*Delairea odorata*	Cape Ivy		3	3	2			#	
	Fabaceae - Faboideae	*Desmodium varians*	Slender Tick-trefoil	2				2		#	#
	Phormiaceae	*Dianella revoluta ssp revoluta*	Blueberry Lily							#	
	Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass							#	
	Convolvulaceae	*Dichondra repens*	Kidney Weed	3	2			2		#	#
*	Poaceae	*Digitaria sanguinalis*	Summer Grass	2							
	Sapindaceae	*Dodonaea viscosa* ssp *angustifolia*	Sticky Hop-bush		1		1			#	#
*	Poaceae	*Echinochloa crus-galli*	Barnyard Grass							#	
	Poaceae	*Echinopogon caespitosus var caespitosus*	Tufted Hedgehog-grass							#	#
	Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass								#
*	Poaceae	*Ehrharta erecta*	Panic Veldtgrass	1	2	2	2			#	
	Chenopodiaceae	*Einadia hastata*	Berry Saltbush	2				1		#	#
	Chenopodiaceae	*Einadia trigonos ssp trigonos*	Fishweed	3				3		#	#

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Celastraceae	*Elaeodendron australe*									#
	Poaceae	*Entolasia marginata*	Bordered Panic							#	
	Poaceae	*Entolasia stricta*	Wiry Panic							#	
	Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass							#	
	Myrtaceae	*Eucalyptus amplifolia* ssp *amplifolia*	Cabbage Gum							#	
	Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	1			2	1		#	#
	Myrtaceae	*Eucalyptus quadrangulata*	White-topped Box							#	
	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	1	1	3	3	4	1	#	#
	Asteraceae	*Euchiton involucratus*	Star Cudweed							#	
	Asteraceae	*Euchiton sphaericus*									#
*	Euphorbiaceae	*Euphorbia peplus*	Petty Spurge							#	
	Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		2		2			#	
	Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart							#	#

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Moraceae	*Ficus macrophylla*	Moreton Bay Fig							#	
*	Fumariaceae	*Fumaria bastardii*	Bastards Fumitory							#	
	Cyperaceae	*Gahnia aspera*	Rough Saw-sedge		1					#	
*	Asteraceae	*Gamochaeta americana*	Cudweed	2					3		
*	Asteraceae	*Gamochaeta* sp								#	
	Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	1	2	2	2			#	#
	Geraniaceae	*Geranium homeanum*	Native Geranium							#	
	Geraniaceae	*Geranium solanderi* ssp *solanderi*	Native Geranium							#	#
	Poaceae	*Glyceria* sp								#	
	Fabaceae - Faboideae	*Glycine clandestina*			2			2		#	#
	Fabaceae - Faboideae	*Glycine microphylla*	Small-leaf glycine								#
	Fabaceae - Faboideae	*Glycine tabacina*		2					2	#	#
*	Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Fabaceae - Faboideae	*Hardenbergia violacea*	Purple Coral Pea							#	#
	Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower							#	#
	Malvaceae	*Hibiscus heterophyllus* ssp *heterophyllus*	Native Rosella							#	
	Clusiaceae	*Hypericum japonicum*								#	
*	Asteraceae	*Hypochaeris radicata*	Catsear					2		#	
*	Asteraceae	*Hypochaeris* sp	White Flatweed							#	
	Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass								#
*	Balsaminaceae	*Impatiens walleriana*								#	
	Fabaceae - Faboideae	*Indigofera australis*	Australian Indigo							#	#
	Poaceae	*Joycea pallida*	Silvertop Wallaby Grass							#	
	Juncaceae	*Juncus usitatus*	Common Rush							#	
	Fabaceae - Faboideae	*Kennedia rubicunda*	Dusky Coral Pea							#	
**RR	Verbenaceae	*Lantana camara*	Lantana		7	7	7			#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Menispermaceae	*Legnephora moorei*	Round-leaf Vine							#	
*	Brassicaceae	*Lepidium* sp		2				2			
	Ericaceae - Styphelioideae	*Leucopogon juniperinus*	Prickly Beard-heath							#	
*	Oleaceae	*Ligustrum lucidum*	Large Leaved Privet							#	
	Arecaceae	*Livistona australis*	Cabbage Fan-palm							#	
*	Poaceae	*Lolium perenne*	Perennial Ryegrass							#	
	Moraceae	*Maclura cochinchinensis*	Cockspur Thorn		1		1			#	
	Apocynaceae	*Marsdenia rostrata*	Milk Vine				1			#	
*	Fabaceae - Faboideae	*Medicago lupulina*	Black Medic	1							
	Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree							#	
	Meliaceae	*Melia azedarach*	White Cedar							#	#
	Violaceae	*Melicytus dentatus*	Tree Violet							#	
	Poaceae	*Microlaena stipoides* var *stipoides*	Weeping Grass	3				6	4	#	#

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	3				3	3		
	Myrsinaceae	*Myrsine variabilis*		1	2					#	
	Oleaceae	*Notelaea ovata*								#	
	Oleaceae	*Notelaea venosa*	Veined Mock-olive							#	#
	Asteraceae	*Olearia viscidula*	Wallaby Weed							#	
	Poaceae	*Oplismenus aemulus*	Oplismenus	2						#	#
	Poaceae	*Oplismenus imbecillis*	Oplismenus		3						#
*	Oxalidaceae	*Oxalis corniculata*		2				2	2	#	
	Oxalidaceae	*Oxalis exilis*									#
	Oxalidaceae	*Oxalis perennans*								#	
	Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine		2		2			#	#
*	Caryophyllaceae	*Paronychia brasiliana*	Chilean Whitlow Wort							#	
	Apocynaceae	*Parsonsia straminea*	Common Silkpod				1			#	#
*	Poaceae	*Paspalum dilatatum*	Paspalum						3	#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Passifloraceae	*Passiflora subpeltata*	White Passionflower		1		2			#	
*	Poaceae	*Pennisetum clandestinum*	Kikuyu Grass						3	#	
*	Phytolaccaceae	*Phytolacca octandra*	Inkweed							#	
*	Pinaceae	*Pinus radiata*	Radiata Pine							#	
	Pittosporaceae	*Pittosporum multiflorum*	Orange Thorn		1		1			#	#
	Pittosporaceae	*Pittosporum revolutum*	Wild Yellow Jasmine							#	#
	Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum							#	#
*	Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	2				3		#	
	Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower							#	
	Poaceae	*Poa affinis*	Poa						2		
	Poaceae	*Poa labillardierei*	Tussock Grass							#	
	Euphorbiaceae	*Poranthera microphylla*								#	
	Portulacaceae	*Portulaca oleracea*	Pigweed								#
	Lobeliaceae	*Pratia purpurascens*	Whiteroot							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	3	2		2		2	#	#
	Rosaceae	*Rubus parvifolius*	Native Raspberry							#	
	Santalaceae	*Santalum obtusifolium*	Blunt Sandalwood							#	
*	Asteraceae	*Senecio madagascariensis*	Fireweed	3				3	2	#	
*	Fabaceae - Caesalpinioideae	*Senna pendula* var *glabrata*				1				#	
*	Poaceae	*Setaria gracilis*	Slender Pigeon Grass							#	
*	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	4				4	3	#	
	Asteraceae	*Sigesbeckia orientalis* ssp *orientalis*								#	#
*	Solanaceae	*Solanum linnaeanum*								#	
*	Solanaceae	*Solanum mauritianum*		1		1					
*	Solanaceae	*Solanum nigrum*	Black-berry Nightshade							#	
*	Asteraceae	*Sonchus oleraceus*	Common Sowthistle	2						#	
*	Poaceae	*Sporobolus africanus*	Parramatta Grass							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass								#
*	Caryophyllaceae	*Stellaria media*	Common Chickweed							#	
*	Poaceae	*Stenotaphrum secundatum*	Buffalo Grass							#	
	Moraceae	*Streblus brunonianus*	Whalebone Tree							#	
*	Asteraceae	*Tagetes minuta*	Stinking Roger							#	
*	Asteraceae	*Taraxacum officinale*	Dandelion					2		#	
*	Bignoniaceae	*Tecoma capensis*	Cape Honeysuckle							#	
	Poaceae	*Themeda australis*	Kangaroo Grass							#	
*	Commelinaceae	*Tradescantia fluminensis*	Wandering Jew							#	
*	Fabaceae - Faboideae	*Trifolium repens*	White Clover							#	
	Apocynaceae	*Tylophora barbata*	Bearded Tylophora		2		2			#	
*	Verbenaceae	*Verbena bonariensis*	Purpletop	2						#	
	Asteraceae	*Vernonia cinerea* ssp *cinerea*								#	
	Scrophulariaceae	*Veronica calycina*	Hairy Speedwell							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	1				1		#	#
*	Poaceae	*Vulpia muralis*								#	
	Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell								#
	Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell							#	#
*	Asteraceae	*Xanthium occidentale*	Noogoora Burr							#	
	Asteraceae	*Xerochrysum bracteatum*	Golden Everlasting							#	#
	Fabaceae - Faboideae	*Zornia dyctiocarpa*	Zornia								#

A3.2 Significant flora species

The following table includes a list of the significant flora species that have potential to occur within the study area. The list of species is sourced from the Atlas of NSW Wildlife and the Protected Matters Search Tool (DSEWPaC; accessed on 10/12/12).

Likelihood of occurrence	Potential criteria
High	• Species recorded on site during current or previous assessment/s. • Sufficient good quality habitat is present on site.
Medium	• Records of species within 5 km of the site • Site is within species natural distributional range. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 5 km of the site. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present on site • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 18: Significant flora species recorded / predicted to occur within 5 km of the study area.

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Boronia deanei	Deane's Boronia	VU	V	#		Negligible	Habitat not present on site	Occurs in Hawkesbury/Nepean and Southern Rivers Catchments. There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains. The species grows on the margins of high altitude swamps, in wet heath and in drier open forest on low nutrient, poorly drained peaty soils on sandstone or granite.
Caladenia tessellata	Thick Lip Spider Orchid	VU	E1	#		Low	Marginal habitat present (low quality & extent).	*Caladenia tessellata* is found in the following Catchment Management Regions Sydney Metropolitan, Southern Rivers, Hawkesbury/Nepean, and Hunter/Central Rivers. Currently known from three disjunct areas: Braidwood on southern tablelands, Ulladulla on the south coast and three populations in Wyong area on the Central Coast. It is generally found in grassy, dry sclerophyll forests/woodland, particularly those associated with clay loam, or sandy soils. However, there is one population at Braidwood in lowland on stony soil. This species only grows in very dense shrubbery in coastal areas. Flowers appear between September and November, but generally late September or early October in extant southern populations.

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Chorizema parviflorum	Eastern Flame Pea		E2	2007		Low	Marginal habitat present (low quality & extent).	Heath and sclerophyll woodland and forest on heavy soils. The endangered population has been recorded from between Austinmer and Albion Park in the local government areas of Wollongong and Shellharbour. All known sites (excluding the site at Austinmer) occupy woodland or forest dominated by Forest Red Gum *Eucalyptus tereticornis* and/or Woollybutt *E. longifolia*. At Austinmer, the species is recorded from a coastal headland.
Cryptostylis hunteriana	Leafless Tongue Orchid	VU	V	#		Low	Marginal habitat present (low quality & extent).	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts but has also been recorded on steep bare hillsides. Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland. This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *E.sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis*; appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata*. It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers. Inconsistent flowering times Dec-February; Jan-February (in Victoria)

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Cynanchum elegans	White-flowered Wax Plant	EN	E1	2005/#		Recorded	Species recorded on site in the current and previous surveys	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan. *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum, Banksia integrifolia subsp. integrifolia*; *E. tereticornis* open forest and woodland; *E. maculata* open forest and woodland; and *Melaleuca armillaris* scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific.
Daphnandra johnsonii		EN		2001/#		Low	Marginal habitat present (low quality & extent).	Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest.

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Irenepharsus trypherus	Illawarra Irene	EN	E1	2001/#		Negligible	Habitat not present on site	Occurs on coast and escarpment between Wollongong and the Shoalhaven River. Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River. Associated vegetation includes moist sclerophyll forest, Ironwood *Backhousia myrtifolia* thicket, and rainforest.
Melaleuca biconvexa	Biconvex Paperbark	VU	V	#		Negligible	Habitat not present on site	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Catchment regions include: Hunter/Central Rivers, Hawkesbury/Nepean, Southern Rivers, and Northern River Catchments. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October.

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pimelea spicata	Spiked Rice-flower	EN	E1	#		Negligible	Habitat not present on site	Once widespread on the Cumberland Plain, *Pimelea spicata* occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment. In western Sydney, *P. spicata* occurs on an undulating topography of substrates derived from Wianamatta Shale in areas supporting, or that previously supported, the Cumberland Plain Woodland Vegetation Community. Associated species include: *E. moluccana, E. tereticornis, E.crebra, Bursaria spinosa*, and *Themeda australis*. In the Illawarra region, *P. spicata* is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *E. tereticornis, E. eugenioides, Themeda australis*, and *Lomandra longifolia*. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pterostylis gibbosa	Illawarra Greenhood	EN	E1	2007/#		Low	Marginal habitat present (low quality & extent).	Known from a small number of populations in the Hunter region, the Illawarra region and the Shoalhaven region. It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by *Eucal* White-flowered Wax Plant *yptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E.tereticornis* and *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by *E. crebra*, Forest Red Gum and *Callitris endlicherii*. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. The Illawarra Greenhood can survive occasional burning and grazing because of its capacity to reshoot from an underground tuber.
Solanum celatum			E1	2010		Low	Marginal habitat present (low quality & extent).	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forest

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Streblus pendulinus	Sia's Backbone	EN		#		Negligible	Habitat not present on site.	Sia's Backbone occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island. Occurs In warmer rainforest, chiefly along watercourses.
Thesium australe	Austral Toadflax	VU	V	#		Low	Marginal habitat present (low quality & extent).	Found in very small to large populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. *Thesium australe* is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass. It is often found in damp sites in association with *Themeda australe*, but also found on other grass species at inland sites. Occurs on clay soils in grassy woodlands or coastal headlands.
Zieria granulata	Illawarra Zieria	EN	E1	2010/#		Medium	Records of species adjacent to the site. Habitat present on site.	Occurs in the Kiama district where it grows on dry rocky ridges in sclerophyll forest to rainforest margins. The species primarily occupies the coastal lowlands between Oak Flats and Toolijooa, in the local government areas of Shellharbour and Kiama. The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments. Associated vegetation includes *Melaleuca armillaris* scrub, *E. tereticornis* woodland and rainforest margins, although the species has been recorded from a number of other vegetation types

Appendix 4: Fauna

Below is a list of fauna species recorded from the study area during the present assessment and a list of significant fauna species recorded or predicted to occur within 5km of the study area.

Notes to tables:

EPBC Act:	**TSC Act:**
EX - Extinct CR - Critically Endangered EN - Endangered VU - Vulnerable CD - Conservation dependent	C1 – critically endangered E1 – endangered (Part 1, Schedule 1) E2 – endangered (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) V1 – vulnerable (Part 1, Schedule 2)
* - introduced species	

Fauna species in these tables are listed in alphabetical order within their taxonomic group.

A4.1 Fauna species recorded from the study area

Table 19: Vertebrate fauna recorded from the study area (present assessment)

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		Alisterus scapularis	Australian King-parrot		#
		Cracticus tibicen	Australian Magpie	#	
		Corvus coronoides	Australian Raven	#	#
		Ceyx azureus	Azure Kingfisher	#	
		Elanus axillaris	Black-shouldered Kite		#
		Acanthiza pusilla	Brown Thornbill	#	
		Scythrops novaehollandiae	Channel-billed Cuckoo	#	#
		Sturnus tristis	Common Myna *	#	#
		Ocyphaps lophotes	Crested Pigeon	#	#
		Platycercus elegans	Crimson Rosella		#
		Eudynamys orientalis	Eastern Koel	#	
		Platycercus eximius	Eastern Rosella		#
		Acanthorhynchus tenuirostris	Eastern Spinebill	#	
		Psophodes olivaceus	Eastern Whipbird	#	
	V	*Petroica phoenicea*	Flame Robin		#
		Eolophus roseicapillus	Galah	#	#
		Cracticus torquatus	Grey Butcherbird	#	#
		Rhipidura albiscapa	Grey Fantail	#	#
		Dacelo novaeguineae	Laughing Kookaburra	#	#
		Grallina cyanoleuca	Magpie-lark	#	#
		Vanellus miles	Masked Lapwing		#
		Philemon corniculatus	Noisy Friarbird		#
		Manorina melanocephala	Noisy Miner	#	#
		Strepera graculina	Pied Currawong		#
		Trichoglossus haematodus	Rainbow Lorikeet		#
		Anthochaera carunculata	Red Wattlebird		#
		Todiramphus sanctus	Sacred Kingfisher		#
		Zosterops lateralis	Silvereye	#	
		Pardalotus punctatus	Spotted Pardalote		#

		Streptopelia chinensis	Spotted Turtle-Dove *	#	#
		Pardalotus striatus	Striated Pardalote		#
		Acanthiza lineata	Striated Thornbill	#	#
		Cacatua galerita	Sulphur-crested Cockatoo	#	#
		Malurus cyaneus	Superb Fairy-wren	#	
		Rhipidura leucophrys	Willie Wagtail		#
		Lichenostomus chrysops	Yellow-faced Honeyeater	#	
		Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	#	#
		Felis catus	Cat *		#
		Chalinolobus morio	Chocolate Wattled Bat		#
		Trichosurus vulpecula	Common Brushtail Possum		#
	V	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat		#
	V	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle		#
		Macropus giganteus	Eastern Grey Kangaroo		#
		Rhinolophus megaphyllus	Eastern Horseshoe Bat		#
		Vulpes vulpes	Fox *		#
		Mormopterus sp. 2	Freetail Bat		#
VU	V	*Pteropus poliocephalus*	Grey-headed Flying-fox		#
		Equus caballus	Horse *	#	#
		Vespadelus darlingtoni	Large Forest Bat		#
		Nyctophilus geoffroyi	Lesser Long-eared Bat		#
	V	*Miniopterus australis*	Little Bentwing-bat		#
		Vespadelus vulturnus	Little Forest Bat		#
		Oryctolagus cuniculus	Rabbit *	#	#
		Wallabia bicolor	Swamp Wallaby	#	
		Tadarida australis	White-striped Freetail-bat		#
		Litoria dentata	Bleating Tree Frog		#
		Crinia signifera	Common Eastern Froglet		#
		Lampropholis delicata	Dark-flecked Garden Sunskink	#	
		Amphibolurus muricatus	Jacky Lizard		#

A4.2 Significant fauna species

The following table includes a list of the significant fauna species that have potential to occur within the study area. The list of species is sourced from the Atlas of NSW Wildlife and the Protected Matters Search Tool (DSEWPaC; accessed on 10.12.2012).

The most recent record relates to:

#	species predicted to occur by the DSEWPaC database (not recorded on other databases)
##	species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched
Year	recorded on databases listed above
2012	recorded during current survey

Examples of criteria for determining the likelihood of occurrence for significant species as a guide for writing the rationale for likelihood

Likelihood of occurrence	Potential criteria
High	• Species recorded on site during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the site during current or previous assessment/s. • Sufficient good quality habitat is present on site or in connected waterbodies in close proximity to the site (aquatic species). • Site is within species natural distributional range (if known). • Species has been recorded within 5 km or from the relevant catchment/basin.
Medium	• Records of terrestrial species within 5 km of the site or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 5 km of the site or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present on site • Habitat for aquatic species not present in connected waterbodies in close proximity to the site.

Likelihood of occurrence	Potential criteria
	• Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 20: Significant fauna species recorded, or predicted to occur, within 5 km of the study area.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Birds							
Botaurus poiciloptilus	Australasian Bittern	EN	E1	#	Negligible	Suitable habitat not present.	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including Typha spp. and Eleoacharis spp.. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Rostratula australis	Australian Painted Snipe	VU	E1	1970/#	Negligible	Suitable habitat not present.	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
							permanent, although they have been recorded in brackish waters.
Ninox connivens	Barking Owl		V	1988	Low	The Barking owl may forage within the study area on occasion. Suitable breeding habitat, in the form of large hollows, not present.	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Territories are typically 2000 ha in NSW habitats.
Ixobrychus flavicollis	Black Bittern		V	1983	Negligible	Suitable habitat not present.	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
							constructed of reeds and sticks in branches overhanging the water.
Ephippiorhynchus asiaticus	Black-necked Stork		E1	1962	Negligible	Suitable habitat not present.	Found in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated lands and occasionally forages in open grassy woodland. Nests in live or dead trees usually near water.
Dasyornis brachypterus	Eastern Bristlebird	EN	E1	#	Negligible	Suitable habitat not present.	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.
Sternula nereis nereis	Fairy Tern	VU		#	Negligible	Suitable habitat not present.	A small piscivorous (fish-eating) bird, the Fairy Tern is approximately 22–27 cm in length, 70 g in weight and has a wingspan of 44–53 cm. The Fairy Tern is bulky and round bodied. Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Petroica phoenicea	Flame Robin		V	2011	Recorded	This species was recorded by ELA (2011) along the northern boundary of the site.	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes moist eucalyptus forests and open woodlands, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.
Stictonetta naevosa	Freckled Duck		V	2003	Negligible	Suitable habitat not present.	The Freckled Duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.
Calyptorhynchus lathami	Glossy Black-Cockatoo		V, E2	1999	Low	Although indviduals may overfly the study area on occasion significanthabitat features, including breeding habitat and foraging resources, not present	Inhabits forest with low nutrients, characteristically with key *Allocasuarina* species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Neophema chrysogaster	Orange-bellied Parrot	CE	E4A	#	Negligible	Suitable habitat not present.	A single breeding population of fewer than 200 individuals occurs in a narrow coastal strip of south-west Tasmania. Adult birds depart Tasmania for the mainland in February. The first adults begin leaving the mainland for Tasmania in September with the last birds having departed by November. It is a coastal species inhabiting saltmarshes, sedgeplains, coastal dunes, pastures, shrublands and moorlands, generally within 10 km of the coast. Critical winter habitat for the species includes natural saltmarshes dominated by *Sarcocornia quinqueflora* Beaded Glasswort and *Sclerostegia arbuscula* Shrubby Glasswort, as well as the associated grassy or weedy pastures. Historical records indicate that the Orange-bellied Parrot was formerly more abundant and widespread in NSW than it is now, however the species' distribution continues to extend into south-eastern NSW where suitable habitat is still available.
Erythrotriorchis radiatus	Red Goshawk	VU	E4A	#	Negligible	Suitable habitat not present.	Occur in forest and woodland habitat near permanent water. In NSW prefer *Melaleuca* swamp forest and open eucalypt woodland. Require greater than 20 m tall trees for

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
							nesting.
Anthochaera phrygia	Regent Honeyeater	EN	E4A	#	Low	Study area does not support significant foraging habitat. Migrating individuals may overfly or forage within the study area on occasion.	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: *E. microcarpa, E. punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E. mckieana, E. macrorhyncha, E. laevopinea* and *Angophora floribunda*. Nectar and fruit from the mistletoes *A. miquelii, A. pendula, A. cambagei* are also eaten during the breeding season. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Lathamus discolor	Swift Parrot	EN	E1	#	Low	Study area does not support significant foraging habitat.Migrating individuals may overfly or forage within the study area on occasion, particularly when Forest Red Gum is in flower.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany E. robusta, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens.* Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis.* This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Daphoenositta chrysoptera	Varied Sittella		V	2009	Medium	Suitable habitat present. The Varied Sitella, although rare, is occassionally found at a wide variety of sites.	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.
Reptiles							
Hoplocephalus bungaroides	Broad-headed Snake	VU	E1	#	Negligible	Suitable habitat not present.	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Amphibians							
Mixophyes iteratus	Giant Barred Frog	EN	E1	#	Negligible	Suitable habitat not present.	Occurs along coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. Found in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m, often hiding in leaf litter near permanent fast-flowing streams. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. When not breeding the frogs disperse hundreds of metres away from streams.
Heleioporus australiacus	Giant Burrowing Frog	VU	V	#	Negligible	Suitable habitat not present.	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water. Spends the majority of its time in non-breeding habitat 20-250m from breeding sites.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Litoria aurea	Green and Golden Bell Frog	VU	E1	1971/#	Negligible	Suitable habitat not present.	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks, although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Litoria littlejohni	Littlejohn's Tree Frog	VU	V	#	Negligible	Suitable habitat not present.	The species is distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern VIC. It is not known from coastal habitats. Occurs in wet and dry sclerophyll forests and heath communities associated with sandstone outcrops between 280 and 1000 m. Littlejohn's Tree Frog prefers permanent and semi-permanent rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation. Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. The species breeds in autumn but will also breed after heavy rainfall in spring and summer. The species has been recorded calling in all seasons with variously reported peak calling periods. Eggs are laid in loose gelatinous masses attached to submerged twigs; eggs and tadpoles are most often recorded in slow-flowing pools that receive extended exposure to sunlight.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Mixophyes balbus	Stuttering Frog	VU	E1	#	Negligible	Suitable habitat not present.	This species is usually associated with mountain streams, wet mountain forests and rainforests. It rarely moves very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains.
Mammals							
Petrogale penicillata	Brush-tailed Rock-wallaby	VU	E1	#	Negligible	Suitable habitat not present.	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V	2009	Recorded	This species was recorded by ELA (2011) within the study area.Study area provides foraging habitat. Breeding or roosting habitat not present.	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	2011	Recorded	This species occurs in a wide range of habitats. The study area does not support preferred wet sclerophyll habitat but may forage within the study area on occasion.	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at lower altitudes. Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
							forests with an open structure, or along trails. Has a large foraging range, up to 136 ha. Records show movements of up to 12 km between roosting and foraging sites.
Scoteanax rueppellii	Greater Broad-nosed Bat		V	2009	Medium	This species has been recorded a number of times recently in the local area. The study area does not provide significant habitat but may ofrage within the study area on occasion	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pteropus poliocephalus	Grey-headed Flying-fox	VU	V	#	Recorded	This species was recorded by ELA (2011) overlying the study area. The study area does not support significant breeding or roosting habitat.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	VU	V	#	Low	There are few records of the Koala from the Illawarra floodplain and the species is considered unlikely to occur.	Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include *E. robusta, E. tereticornis, E. punctata, E. haemostoma* and *E. signata*. They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	#	Low	Whilst individuals may forage over the study area on occasion the study area does not provide roosting habitat.	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing maternity roost is in a sandstone cave near Coonabarabran.
Miniopterus australis	Little Bentwing-bat		V	2011	Recorded (?)	This species was purpoertedly recorded by ELA (2011) within the study area. This species has only been recorded once south of Sydney (at Eden) and this identification is	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer. Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
						considered questionable.	canopy of densely vegetated habitats.
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V, E2	#	Negligible	Suitable habitat not present.	Cobaki Lakes and Tweed Heads West population: Occurs from Queensland to Victoria, normally within 50 km of the coast. Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer. This species appears to benefit from a lack of recent disturbance.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pseudomys novaehollandiae	New Holland Mouse	VU		#	Negligible	Suitable habitat not present.	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4 ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn.
Pseudomys fumeus	Smoky Mouse	EN	E4A	#	Negligible	Suitable habitat not present.	Appears to prefer heathy ridgetops and slopes within sclerophyll forests, heathland and open forest from the coast to sub-alpine regions of up to 1800 m.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	EN	E1	#	Negligible	Suitable habitat not present.	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.
Dasyurus maculatus	Spotted-tailed Quoll	EN	V	#	Low	There is only a few records from the Illawarra floodplain for this species. The study area does not contribute to a significant movement ocrridor for this species and is unlikely to support significant habitat for this species.	Occurs along the east coast of Australia and the Great Dividing Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (NPWS 1999k). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage. Seventy per cent of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage. The home range of a female is between 180 and 1000 ha, while males have larger home ranges of between 2000 and 5000 ha. Breeding occurs from May to August.

A4.3 Migratory species (EPBC Act listed)

Includes records from the following sources:

- Atlas of NSW Wildlife (refer to Section 2.1)
- DSEWPaC database (accessed on 10.12.2012)
- Current survey

Bold denotes species recorded in the study area during the current assessment.

Table 21: Migratory fauna species recorded or predicted to occur within 5 km of the study area.

Scientific Name	Common Name
Anthochaera phrygia	Regent Honeyeater
Apus pacificus	Fork-tailed Swift
Ardea ibis	Cattle Egret
Ardea modesta	Eastern Great Egret
Calidris acuminata	Sharp-tailed Sandpiper
Calidris melanotos	Pectoral Sandpiper
Caretta caretta	Loggerhead Turtle
Chelonia mydas	Green Turtle
Danaus plexippus	Monarch Butterfly
Dermochelys coriacea	Leathery Turtle
Eretmochelys imbricata	Hawksbill Turtle
Gallinago hardwickii	Latham's Snipe
Haliaeetus leucogaster	White-bellied Sea-Eagle
Hirundapus caudacutus	White-throated Needletail
Lamna nasus	Porbeagel, mackerel shark
Merops ornatus	Rainbow Bee-eater
Monarcha melanopsis	Black-faced Monarch
Myiagra cyanoleuca	Satin Flycatcher
Neophema chrysogaster	Orange-bellied Parrot
Plegadis falcinellus	Glossy Ibis
Pluvialis fulva	Pacific Golden Plover
Rhipidura rufifrons	Rufous Fantail
Rostratula australis	Australian Painted Snipe
Tringa stagnatilis	Marsh Sandpiper