



Preliminary documentation:
Residential development, Lot 101 DP 785139,
Crest Road, Albion Park, NSW
(EPBC Ref: 2017/8048)

FINAL REPORT

Prepared for Spinitu Pty Ltd

12 July 2019

Biosis offices

NEW SOUTH WALES

Albury

Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle

Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne

Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta

Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

Report to: Spinitu Pty Ltd

Prepared by: Bianca Klein

Biosis project no.: 25345

File name: 25345.Crest.Rd.PD.DFT01.20190412

Citation: Biosis 2019. Preliminary documentation: Residential development, Lot 101 DP 785139 Crest Rd, Albion Park, NSW. Report for Spinitu Pty Ltd. Author: Klein B, Biosis Pty Ltd, Wollongong. Project no. 25345

Document control

Version	Internal reviewer	Date issued
Draft Report	Rebecca Dwyer	12/4/2019
Final Report	Rebecca Dwyer	12/07/2019

Acknowledgements

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

- MMJ Real Estate: Luke Rollinson
- Spinitu Pty Ltd
- Biosis staff: Rebecca Dwyer, Mathew Misdale, Craig Dunne and Nathan Garvey for previous work on the project.
- Department of the Environment and Energy for access to the Protected Matters Search Tool of the Australian Government
- NSW Office of Environment and Heritage for access to the BioNet Atlas of NSW Wildlife.

© Biosis Pty Ltd

This document is and shall remain the property of Biosis Pty Ltd. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

1	Introduction	5
1.1	Previous studies	6
2	Description of the action	8
2.1	Location of the action	8
2.2	Surrounding land use	9
2.3	Description of the action	9
2.4	Measures adopted to avoid and minimise impacts from the proposed action	10
2.4.1	Consideration of feasible alternatives	10
2.4.2	Avoidance and minimisation of impacts	10
3	Description of the existing environment and MNES	14
3.1	General description of the referral boundary and study area	14
3.2	Matters of National Significance	16
3.2.1	<i>Illawarra and south coast lowland forest and woodland</i>	16
3.2.2	EPBC Act threatened flora and fauna	19
3.2.3	Migratory species	21
4	Impacts arising from proposed action	23
4.1	Potential direct and indirect impacts to MNES	23
4.2	Potential cumulative impacts to MNES	26
4.2.1	Potential cumulative impacts to Illawarra and South Coast Lowland Forest and Woodland	26
4.2.2	Potential cumulative impacts to White-flowered Wax Plant	26
4.2.3	Potential cumulative impacts to Illawarra Zieria	27
4.2.4	Potential cumulative impacts to Grey-headed Flying-fox	27
5	Proposed avoidance, mitigation and management measures	28
5.1	MNES	28
5.1.1	Avoidance	28
5.1.2	Mitigation and management	29
5.1.3	Effectiveness of mitigation and management measures	34
6	Residual impacts and significance of impacts	37
6.1	Matters of National Environmental Significance	37
7	Proposed offset measures	38
7.1	Overview of offset requirements	38
7.2	Commonwealth offset requirements	38
7.2.1	The proposed offset site	39
7.3	Consistency with EPBC Act Environmental Offsets Policy	39
7.4	Environmental offset contingency	44

8	Outcomes-based conditions.....	45
9	Economic and social matters	46
9.1	Cost/benefit analysis.....	46
9.2	Consideration of different scales	46
9.3	Specific dollar value of the proposed action.....	46
10	Environmental record of person(s) proposing to take the action	47
11	Conclusion	48
	Appendix 1: Fauna recorded from the study area (Biosis 2012)	52
	Appendix 2: BBAM Quadrat / Transect Data	79
	Appendix 3: Flora plot data including a comparison against EPBC listing diagnostic criteria	80
	Appendix 4: VMP (Biosis 2017c).....	106
	Appendix 5: Biodiversity Assessment (BBAM) (Biosis 2012)	163
	Appendix 6: Flora and fauna assessment (Biosis 2017c).....	254
	Appendix 7: Offset site BAR – RedGum Ridge (Biosis 2016b)	379
	Appendix 8: Referral	494
	Appendix 9: Referral variation.....	526
	Appendix 10: Department of the Environment and Energy request for additional informatio.....	531

Tables

Table 1	Previous ecological studies undertaken in the study area.....	7
Table 3	Potential direct and indirect impacts to MNES	24
Table 4	Avoidance, mitigation and management measures	31
Table 5	Expected or predicted effectiveness of measures to mitigate and manage potential impacts to MNES	35
Table 6	EPBC Act listed Illawarra Lowlands Grassy Woodland offset calculations and requirements for the proposed action	38
Table 7	Summary of the Illawarra Lowlands Grassy Woodland and EPBC Act listing criteria at the proposed offset site (Biosis 2016b)	41
Table 8:	Vertebrate fauna recorded from the study area (Biosis 2012).....	52
Table 9:	Threatened fauna species recorded, or predicted to occur, within five kilometres of the study area (Biosis 2017b).....	56
Table 10	Migratory fauna species recorded or predicted to occur within 5 kilometres of the study area	77
Table 11:	Quadrat / transect data	79
Table 12:	Flora species recorded from the study area (Biosis 2012).....	81
Table 13:	Threatened flora species recorded / predicted to occur within five kilometres of the study area (Biosis 2017b).....	97

Figures

Figure 1	Location of the proposed action.....	12
Figure 2	Proposed action area	13
Figure 3	Ecological features within the study area.....	22

Plates

Plate 1	Illawarra Lowlands Grassy Woodland, higher plateau area	17
Plate 2	Illawarra Lowlands Grassy Woodland, north east slopes	17

1 Introduction

Spinitu Pty Ltd is proposing to develop a residential subdivision at Lot 101 DP 785139 Crest Road, Albion Park, NSW (referral boundary). The proposal is to subdivide the land into 71 residential lots and one environmental lot with dwelling provision, within the referral boundary (the proposed action). The development will include public reserves, access roads, other public infrastructure and asset protection zones (APZ) that will be associated with provision of low density residential development.

The proposed action has the potential to significantly impact Matters of National Environmental Significance (MNES). The proposed action was therefore referred to the Commonwealth Minister of the Environment (the Minister) via the Department of Environment and Energy (DEE) in September 2017 for a decision regarding whether it constituted a 'controlled action' and would require approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The original referral documentation is included as Attachment 1.

The Minister deemed the proposed action to be a controlled action on 30 November 2017 and determined that the project would be assessed by preliminary documentation under the EPBC Act. Relevant controlling provisions for the proposed action were deemed to be:

- Listed threatened species and communities.

A variation was sought and approved under Section 156B of the EPBC Act during the referral period to excise the proposed public road from the referred action. The proposed road is subject to a separate Development Application (DA) (DA 119/2016).

Biosis Pty Ltd was commissioned by Spinitu Pty Ltd to prepare Preliminary Documentation to assess the potential impacts to listed threatened species and communities, referred to as MNES resulting from the proposed residential development at Lot 101 DP 785139 Crest Road, Albion Park, NSW.

The objectives of the Preliminary Documentation are to consolidate and present ecological information sufficient to enable interested stakeholders and the Minister to understand the consequences of the proposed action.

DEE stipulated that the Preliminary Documentation include the following:

- Description of the proposed action.
- Description of the existing environment and relevant MNES, with particular focus on the potential for significant impacts upon:
 - Illawarra and south coast lowland forest and woodland, listed as critically endangered. Hereon in referred to as Illawarra Lowlands Grassy Woodland.
 - White-flowered Wax Plant *Cynanchum elegans*, listed as endangered.
 - Illawarra Zieria *Zieria granulata*, listed as endangered.
 - Grey-headed Flying-fox *Pteropus poliocephalus*, listed as vulnerable.
 - Thick-lipped Spider-orchid *Caladenia tessellata*, listed as vulnerable.
 - Leafless Tongue-orchid *Cryptostylis hunteriana*, listed as vulnerable.
 - Illawarra Socketwood *Daphnandra johnsonii*, listed as endangered.
 - Yellow Gnat-orchid *Genoplesium baueri*, listed as endangered.

- Spiked Rice-flower *Pimelea spicata*, listed as endangered.
- Illawarra Greenhood *Pterostylis gibbosa*, listed as endangered.
- Spotted-tailed Quoll *Dasyurus maculatus* subsp. *maculatus* (SE mainland population), listed as endangered.
- Koala *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT), listed as vulnerable.
- New Holland Mouse *Pseudomys novaehollandiae*, listed as vulnerable.
- An assessment of the relevant impacts of the action.
- Proposed avoidance, mitigation and management measures.
- Proposed offset measures.
- Outcomes-based conditions.
- Economic and social matters.
- Environmental record of person(s) proposing to take the action.

This Preliminary Documentation has been prepared on the basis of:

- The Preliminary Documentation request by DEE described above.
- Correspondence from DEE.
- Information gained from a variety of relevant literature sources, notably previous studies undertaken in the study area (refer Section 1.1).
- A total of approximately 36 hours of field survey effort completed to record and assess the ecological values of the study area, including the identification of EPBC Act and *Biodiversity Conservation Act 2016* (BC Act) listed threatened ecological communities and potential habitat for other BC Act listed threatened flora and fauna.
- The knowledge of the authors regarding the flora, fauna (and associated habitat) and ecological communities of the general locality, specifically those of recognised conservation significance.

1.1 Previous studies

Initial diurnal flora and fauna surveys were carried out over the study area on 11 December 2012 as part of the Biobanking Assessment prepared by Biosis (2012). A subsequent site investigation for vegetation condition was undertaken on 5 June 2015, and an updated fauna habitat assessment on 23 June 2016, with a final report issued in 2017 (Biosis 2017a).

A summary of previous ecological and heritage studies undertaken within the study area and immediate surrounds is provided in Table 1. One heritage study pertaining to the referral boundary is summarised in Biosis (2016a).

Table 1 Previous ecological studies undertaken in the study area

Reference	Survey type	Location	Summary of results
EcoLogical (2011)	Flora and fauna assessment for land rezoning application.	Lot 101 DP 785139 Crest Road, Albion Park	<ul style="list-style-type: none"> Confirmed presence of Illawarra Lowlands Grassy Woodland and White-flowered Wax Plant <i>Cynanchum elegans</i>. Confirmed presence of Flame Robin <i>Petroica phoenica</i>, Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>, Little Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>, and Little Bent Wing Bat <i>Miniopterus australis</i> listed under the BC Act. Potential that Illawarra Zieria <i>Zieria granulata</i> could occur. Potential for Migratory Species - Black-faced Monarch <i>Monarcha melanopsis</i> and Satin Flycatcher <i>Myiagra cyanoleuca</i> listed EPBC Act. Grey-headed Flying-fox <i>Pteropus poliocephalus</i> observed over site.
Biosis (2012)	BioBanking Assessment	Lot 101 DP 785139 Crest Road, Albion Park.	<ul style="list-style-type: none"> Confirmed presence of Illawarra Lowlands Grassy Woodland and White-flowered Wax Plant <i>Cynanchum elegans</i>. Confirmed roosting habitat for Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> and Eastern False Pipistrelle listed under the BC Act. Confirm non-limiting foraging habitat for Grey-headed Flying-fox <i>Pteropus poliocephalus</i>. Confirmed presence of non-limiting foraging habitat for Eastern Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>, and Little Bent Wing Bat <i>Miniopterus australis</i> listed under BC Act. Potential that Varied Sittella <i>Daphoenositta chrysoptera</i> and Illawarra Zieria could occur.
Biosis (2017a)	Flora and fauna impact assessment.	Lot 3 DP 1214606, Albion Park (immediately west of the proposed action).	<ul style="list-style-type: none"> Confirmed presence of Illawarra Lowlands Grassy Woodland and Illawarra Zieria. Confirmed presence of Illawarra Lowlands Grassy Woodland to the north of Lot 101 DP 785139 Crest Road, Albion Park.

2 Description of the action

Proposed is the residential subdivision at Lot 101 DP 785139 Crest Road, Albion Park (referral boundary). The proposed development is for 71 residential lots, one environmental lot dwelling provision, associated public reserves, access roads, other public infrastructure and APZs (the proposed action).

The proposed development will require the installation of local roads and levelling off the ground surface to provide for appropriate contours. The development will require the installation of stormwater piping and other associated infrastructure, such as electricity and water supply. The development intends to retain native trees where situated outside of dwelling envelopes, boundary fence lines, road soil cuts and recreation areas. Site access during construction will be from via an extension of Crest Road (DA 119/2016) as well as via adjacent roads: Premier Drive and Raleigh Street.

The installation of the APZ will require selective thinning of trees, and suppression of shrubs and ground layer within the environmental lot. All remaining vegetation east of the APZ will be retained as native vegetation and form the residual of the study area. The development of the study area aims to conserve residual native vegetation within the eastern portion of the study area. The retained native vegetation will include residual vegetation and vegetation modified to be managed as an APZ. The retained residual and modified vegetation will also conserve endangered flora.

An indicative site layout of the development footprint is shown in Figure 2.

The key concepts and objectives of the development will be to:

- Permit low density residential development of 71 lots and one large environmental lot.
- Allow for establishment of an inner and outer APZ. This includes selective thinning of trees and suppression of shrubs and tall ground covers to maintain low ground fuel levels. The canopy will be retained within the benchmark for this plant community type in NSW (NSW PCT838/ BVT SR545).
- Incorporate and maximise the existing landscape and topographical characteristics of the site by retaining hollow-bearing trees where feasible and safe to do so.
- Retain residual native vegetation, provide ongoing planning controls within an E3 – Environmental Management LEP zone, and enhance biodiversity and sensitive habitats through the implementation of a Vegetation Management Plan (VMP) (Appendix 4, Biosis 2017c).
- Protect threatened flora through fencing where appropriate, targeted weed control and landholder monitoring.
- Provide nest boxes for specific fauna types in retained vegetation to compensate for lost habitat in the form of hollow-bearing trees.

2.1 Location of the action

The proposed action is located in the suburb of Albion Park, NSW approximately 22 kilometres south-west of the Wollongong central business district (CBD) in the Shellharbour Local Government Area (LGA) (Figure 1). The 'study area' encompasses 9.65 hectares of land within Lot 101 DP785139 Crest Road, Albion Park. The extent of land to be subdivided within the study area, the 'referral boundary', encompasses 7.56 hectares of which 2.71 hectares constitutes land zoned E3 Environmental Management and the remaining land zoned R2 Low Density Residential under the Shellharbour Local Environment Plan (LEP) 2013. The location of the referral boundary within the study area is illustrated in Figure 2.

2.2 Surrounding land use

The referral boundary is bordered by residential properties in the north, remnant vegetation to the west and east, and rural residential land to the south. The property immediately south of the study area is currently a construction site for a non-related development subdivision. Albion Park and surrounding suburbs are undergoing rapid growth and residential developments are common throughout the locality. These are typically interspersed with patches of remnant natural bushland and open spaces mostly within Council reserves.

2.3 Description of the action

The proposed action involves the subdivision of 7.56 hectares of land within Lot 101 DP785139, Albion Park to provide 71 low density residential lots (Figure 2). The centre point of Lot 101 DP785139 is located at - 34.581640, 150.766134.

The proposed action will result in the following impacts to the EPBC Act listed Critically Endangered Ecological Community (CEEC): *Illawarra and South Coast Lowland Forest and Woodland* (Illawarra Lowlands Grassy Woodland CEEC):

- Removal of 2.81 hectares of for the development of residential dwellings and associated infrastructure.
- Permanent modification of a further 1.09 hectares to establish and maintain asset protection zones (APZs) for adequate bushfire protection.

Therefore, impacts to a total of 3.9 hectares of Illawarra Lowlands Grassy Woodland CEEC form the basis of the referred action.

It is important to note that the original referral documentation submitted to The Department of Environment and Energy (DEE) stated that impacts to 4.15 hectares of Illawarra Lowlands Grassy Woodland CEEC required assessment by the Commonwealth on Preliminary Documentation as a controlled action (Biosis 2017b). The referral also stated that areas containing 'scattered trees' outside of the mapped moderate condition Illawarra Lowlands Grassy Woodland CEEC do not meet the condition thresholds for the EPBC Act listed CEEC as less than 30 % of the total perennial understorey cover is comprised of native species. In addition, on 30 November 2017 a variation to the proposed action to excise 0.25 hectares of Illawarra Lowlands Grassy Woodland from the referral boundary was approved by DEE, facilitating the extension of Crest Road. Therefore, the area containing 'scattered trees' and the 0.25 hectares excised from the referral boundary are not considered part of the referred action.

APZs will include an Inner Protection Area (IPA) of 30 metres and an Outer Protection Area (OPA) of 30 metres along the eastern boundary, and an IPA of 25 metres along the western boundary in accordance with the bushfire risk assessment report for the study area (Bushfire and Evacuation Solutions 2015). Within the APZs, native vegetation will be managed in order to achieve the performance requirements described in Planning for Bushfire Protection 2006 (RFS 2006). This will include the removal of some canopy trees and understorey shrubs as well as the management of ground cover to maintain APZ fuel requirements. In the OPA, canopy and shrub vegetation will be managed so it is not continuous and achieves relevant OPA fuel loads. Clumping of vegetation and retention of groundcover within the OPA will allow retention of some flora and fauna habitat. The extent of vegetation thinning to meet APZ requirements for each area are detailed in Biosis (2017a).

The direct disturbance footprint of the action and all construction related activities including internal road construction will be restricted to within the referral boundary. Access to created residential lots will be via Crest Road, Premier Drive and Raleigh Street.

Indirect disturbance to native vegetation adjoining the referral boundary is predicted to extend up to 20 metres from the edge of the referral boundary and will be mitigated through a suite of onsite construction and operational mitigation measures. Edge effects and associated impacts to threatened species and communities have been taken into account when assessing the potential residual impacts of the proposed action (refer Section 4 and 5).

2.4 Measures adopted to avoid and minimise impacts from the proposed action

2.4.1 Consideration of feasible alternatives

Consideration of alternative proposals for the subject site has been undertaken throughout the project to ensure that an appropriate balance is achieved between retention and enhancement of the significant biodiversity values of the subject site and surrounds.

In developing the site layout, a number of alternatives were considered including:

- Clearance of entire lot for residential subdivision.
- Positioning of development envelopes and roads to maximise retention of highest condition native vegetation and lot yield.
- GIS modelling of trees and hollow-bearing tree locations to assist in retaining important habitat trees within lots and positioning of development envelopes to assist retention.
- Offsetting vegetation removal using the NSW Biobanking Scheme.
- Rezoning and subdivision of the environmental lot in the eastern portion of the study area to E3 - Environmental Management under the Shellharbour LEP.

2.4.2 Avoidance and minimisation of impacts

The residential lot proposed layout was selected within the area supporting the lowest condition CEEC (most floristically depauperate and highest edge to core area ratios) areas and scattered trees with highly modified exotic groundcovers. Prior to the development proposal the subdivision footprint area was re-zoned to R2 – Low density residential. The rezoning of the study area and proposed development footprint aims to protect residual CEEC, APZ modified CEEC vegetation and threatened flora within land zoned E3 – Environmental Management and provide for ongoing management through implementation of a VMP.

The development will be undertaken within areas of R2 zoned land. Vegetation within the E3 – Environmental Management zoned land will not be cleared. APZ works only will be undertaken in part of this area, the remainder of which is to be retained and managed for conservation purposes; together constituting the 'Environmental Management Area' (EMA). An associated Vegetation Management Plan has been developed detailing restoration and on-going management actions (Biosis 2017c).

The EMA includes 1.1 hectares of Illawarra Lowlands Grassy Woodland and seven individuals of White-flowered Wax Plant *Cynanchum elegans* at two locations (Figure 3).

Whilst the development of the subdivision plan has sought to avoid and minimise impacts to identified biodiversity values within E3 – Environmental Management land, the only alternative to taking the proposed action in its currently proposed form, would be the 'do nothing' option. Given the referral boundary is located

adjacent to current residential development and within a residential land use zone, the 'do nothing' alternative was not considered feasible.

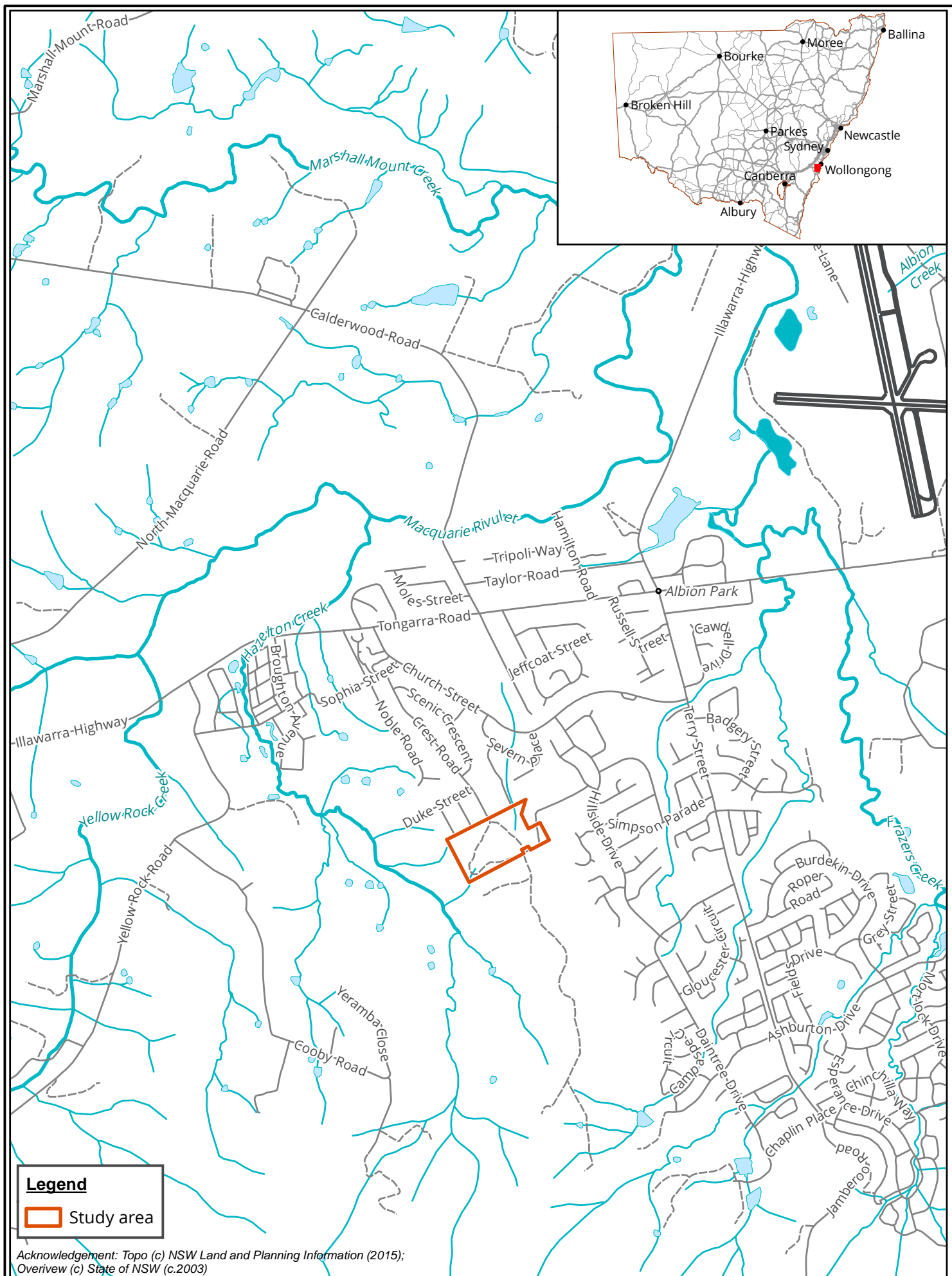
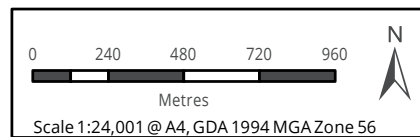


Figure 1 Location of the proposed action



Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 10 April 2019,
Checked by: MJM, Drawn by: LH, Last edited by: amurray
Location: P:\25300s\25345\Mapping\





Legend

- Study area
- Referral boundary
- Crest Road Extension (DA 119/2016)
- Subject site
- APZ
- Proposed subdivision
- Proposed lot boundary
- Zoning Boundaries
- E3 Environmental Management
- R2 Low Density Residential
- Development - APZ
- Development - Building envelope
- Development - Lots
- Development - Roads
- Environmental management
- Environmental management - Inner APZ
- Environmental management - Outer APZ

Figure 2 Proposed action area

0 10 20 30 40 50
Metres

Scale: 1:1,800 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 10 April 2019
Checked by: LH, Drawn by: NMG
Location: P:\25300s\25345\Mapping\25345 E3 DevFootprint CrestRdExtUpdate

3 Description of the existing environment and MNES

3.1 General description of the referral boundary and study area

The referral boundary includes the land within Lot 101 DP785139 Crest Road, Albion Park designated for development (including APZ areas), and covers 7.56 hectares. The broader study area, which encompasses the referral boundary, covers an area of 9.65 hectares and includes the remaining land within the property.

The study area is located approximately 25 kilometres south-west of Wollongong Central Business District (CBD). The study area is surrounded by mixed land uses, predominantly consisting of low-density residential blocks to the north and east, and land modified through clearing for agriculture to the south and west. Albion Park is currently experiencing rapid growth with development common in the area.

The referral boundary has been partially cleared and currently supports scattered remnant native vegetation. It is subject to ongoing disturbance through the use of the site for horse agistment. Grazing and trampling of the flatter, low relief sections of the referral boundary (western two thirds) by horses has resulted in a high degree of disturbance in these areas. These areas support mature trees over a low, grazed groundcover consisting of a mix of native and exotic species. The mid-storey in these areas is limited to scattered shrubs around the perimeter. The area includes both fenced and unfenced grazing areas, tack area, numerous small corrugated sheds, organic waste stockpiling areas and gravel trails. Paddocks and intensively used areas tend to be in poor condition and supporting mostly exotic perennial groundcover. The vegetation within the referral boundary varies from moderate to poor condition, for the most part lacking midstorey due to continuous grazing. The remainder of the study area to the east supports a heavy cover of Lantana where moderate slopes occur.

The gradient across the study area slopes slightly downhill to the west. Drainage occurs to the west for the most of the study area and also into a dry gully in the eastern portion. Stormwater flow is proposed to be diverted to west along a dry rock based gully to comply with the certifying authorities requirements for floodplain modelling.

The study area occurs on Albion Park and Bombo soils landscapes, where plateaus or medium gradient slopes occur (Hazelton 1992). Outcropping latite and loose medium sized boulders were noted on occasion in steeper sections of the slope.

Albion Park soil landscapes occur on the flat or gently sloped parts of the study area and support friable brownish black sandy clay loam overlying mottled greyish brown light clay where deeper weathering occurs (Hazelton 1992). Bombo soil landscapes occur on the slopes at and adjacent to, the eastern and western margins of the study area. Associated soils are reddish brown sandy clays, on crests and upper-slopes (Hazelton 1992).

Previous studies have confirmed that the following ecological features are supported by the study area (Biosis 2017a):

- Native vegetation including Illawarra Lowlands Grassy Woodland in poor/moderate condition.
- White-flowered Wax Plant (seven individuals).
- A total of 922 trees, 33 of which are hollow-bearing.

The study area forms part of vegetated corridor extending north and south of the study area, connecting to the Tongarra – Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al. 2011). Within this corridor, the study area forms part of a partially cleared area along the upper crest, with cleared land

extending further south. On a local scale, the study area acts as a dispersal corridor for more mobile species including avifauna and arboreal mammals. It provides connectivity to interspersed remnant vegetation found among the adjacent rural development.

The proposed action will not result in the fragmentation of this corridor, with native vegetation to the east and west remaining connected and being maintained.

The following section of this report provides further detailed description and discussion of the ecological values of the referral boundary and broader study area; drawing on the results of literature review, database searches and field surveys completed in 2012 (as described in Section 1.1) as well as the results of earlier surveys across the study area (EcoLogical 2011, Mills 2007).

3.2 Matters of National Significance

3.2.1 Illawarra and south coast lowland forest and woodland

The floristic composition and structure of the native grassland mapped as Illawarra Lowlands Grassy Woodland CEEC on Figure 3 is consistent with that described in the Approved Conservation Advice for *Illawarra and south coast lowland forest and woodland in the Sydney Basin Bioregion* pursuant to the Commonwealth EPBC Act [(Threatened Species Scientific Committee (TSSC) 2016)].

A total of 8.37 hectares of Illawarra Lowlands Grassy Woodland vegetation in varying conditions was mapped within the study area, occurring as contiguous vegetation and scattered trees within modified pasture. Of this, an area of 5.77 hectares of EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC was mapped within the study area (Figure 3).

The CEEC within the study area is consistent with the Plant Community Type (PCT): *838 - Forest Red Gum – Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* described under the NSW Vegetation Information System (VIS).

The extent of the CEEC within the study area is as follows:

- 2.81 hectares in the development footprint.
- 0.44 hectares in the inner APZ.
- 0.65 hectares in the outer APZ.
- 1.87 hectares to be retained within the EMA, outside of the referral boundary.

This vegetation was consistent with the ecological community listings for Category D moderate condition class as per the Approved Conservation Advice (including listing advice) for *Illawarra and south coast lowland forest and woodland ecological community Critically Endangered Ecological Community* under the EPBC Act as:

- The vegetation, existing as a single, connected patch was larger than 0.5 hectares.
- The condition of the groundcover was above 30% native content.
- Trees with Diameter at Breast Height (DBH) greater than 50 centimetres and containing hollows were present.
- The patch was contiguous with at least one hectare of native vegetation (with perennial vegetation cover where 50% or greater is comprised of native vegetation).

A summary of the vegetation plot/transect data, referenced against the condition criteria as outlined in the Approved Conservation Advice is provided in Appendix 3. This data reflects the condition of the vegetation at the time of survey for the ecological assessment in 2012 (Biosis, 2017a). Since the original assessment, the site has continued to be managed as a horse agistment facility, and the vegetation has been subject to continual disturbances associated with the use of the land, including but not limited to grazing.

The EPBC listed vegetation within the referral boundary was in moderate condition and for the most part supported moderately disturbed groundcovers and almost no midstorey from ongoing grazing.

The canopy of the community was dominated by Forest Red Gum *Eucalyptus tereticornis* over both the flatter plateau area and north east slopes, with Thin-leaved Stringybark *Eucalyptus eugenoides* also present. Both areas had a very sparse midstorey of regenerating canopy species with occasional Hickory Wattle *Acacia implexa*, Maiden's Wattle *Acacia maidenii*, Red Ash *Alphitonia excelsa*, Sticky Hop-bush *Dodonaea viscosa* ssp. *angustifolia* and Muttonwood *Myrsine variabilis*. The understorey on the higher plateau was absent as a result of intensive grazing resulting from horse agistment (Plate 1), whilst the understorey on the north east slopes

was entirely dominated by Lantana with occasional native shrubs on the higher slopes (Plate 2). The groundcover stratum on the higher plateau was in a moderate condition supporting a range of native grasses and herbs including Scurvy Weed *Commelina cyanea*, Slender Flat-sedge *Cyperus gracilis*, Slender Tick-trefoil *Desmodium varians*, Kidney Weed *Dichondra repens*, Weeping Grass *Microlaena stipoides* var. *stipoides* and *Oplismenus* *Oplismenus imbecillis*. Groundcover under the thickets of Lantana on the north-east slopes was virtually absent with sparse cover of native and exotic grasses, herbs and scramblers such as Asparagus Fern *Asparagus aethiopicus*, Indian Pennywort *Centella asiatica*, Scurvy Weed *Commelina cyanea*, Cape Ivy *Delairea odorata*, Panic Veldtgrass *Ehrharta erecta* and Wombat Berry *Eustrephus latifolius*.



Plate 1 Illawarra Lowlands Grassy Woodland, higher plateau area



Plate 2 Illawarra Lowlands Grassy Woodland, north east slopes

Areas mapped as 'scattered trees' within the study area were considered to be in low condition. While the vegetation satisfied key diagnostic characteristics such as appropriate regional context, foliage cover averaging at least 10% and Forest Red Gum canopy trees; the vegetation failed to meet the condition threshold for Category D Moderate condition class because it failed to satisfy the following biotic threshold:

- At least 30% of total perennial understorey cover is comprised of native species.

In addition to this, areas between scattered trees mapped as exotic grassland supported a total perennial understorey with native species cover less than 30% of the total. Therefore, these areas were not considered to represent a derived grassland form of Illawarra Lowlands Grassy Woodland CEEC.

The key threatening processes typical of this community and relevant to this project include (TSSC 2016):

- **Land clearance** – including historic clearing for agriculture and current clearing for development practises.
- **Invasion by novel biota; Lantana of particular note** – Clearing and habitat fragmentation have made this community susceptible to invasion by Lantana, which forms a dense shrubby mid-layer.
- **Land degradation by rabbits** – An increasing urban population in areas surrounding this community has encouraged the recruitment of rabbit colonies. Rabbits limit the regeneration capacity of the ecological community through grazing and ground disturbance.

Measures to avoid and mitigate the threatening processes are discussed in Section 5.

3.2.2 EPBC Act threatened flora and fauna

Lists of threatened species returned by updated database searches described in Section 4 are provided in Appendix 1, Table 9 (fauna) and Appendix 2, Table 12 (flora). An assessment of the likelihood of these species occurring in the referral boundary and broader study area, and an indication of which habitats or values are of relevance to the species is included.

White-flowered Wax Plant (Endangered, EPBC Act) has been recorded within the referral boundary during previous studies and in the most recent survey (Table 1).

Previous survey (EcoLogical 2011) recorded Grey-headed Flying-fox (Vulnerable, EPBC Act) over-flying the study area.

Additionally, based on an assessment of faunal habitats undertaken, the referral boundary has a low likelihood of providing foraging and dispersal habitat for the following MNES listed fauna:

- Swift Parrot *Lathamus discolor* (Critically Endangered, EPBC Act).
- Koala *Phascolarctos cinereus* (Vulnerable, EPBC Act).
- New Holland Mouse *Pseudomys novae-hollandiae* (Vulnerable, EPBC Act).
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, EPBC Act).
- Spotted-tailed Quoll *Dasyurus maculatus* (Endangered, EPBC Act).

Impacts to the above listed fauna species are not discussed further based on their low likelihood of occurring.

Illawarra Zieria (Endangered, EPBC Act) was not recorded within the study area, however has been recorded on land to the west of the study area. Therefore, was assessed as having a moderate likelihood of occurring based on the habitat present and the potential for this species to have propagules within a soil stored seed bank (Biosis 2017a). An assessment of the likelihood of occurrence for further EPBC listed flora known to occur within the locality is provided in Table 12. Further details regarding the rationale for species assessed as having a low likelihood of occurrence within the study area, and therefore are not discussed further, is provided in Table 9 and Table 13.

The results of recent targeted surveys and a discussion of the broader understanding of each species' presence within the referral boundary and broader study area are described further below.

White-flowered Wax Plant

Seven White-flowered Wax Plant individuals were recorded in two general locations in the study area. One location consists of five individuals and occurs within the APZ of the referral boundary, outside of the development footprint. These plants will be managed by fencing and specific controls within a 20 metre buffer. Where the buffer zone intersects with the APZ, this area will comprise the allowable 20% of unmanaged vegetation in the groundcover and midstorey strata as specified in the requirements for the Outer Protection Area (OPA). The remainder of the OPA will be managed to the following specification:

- Canopy to be reduced through removal of trees, if required, and maintained to maximum canopy coverage of 30%.
- Lower branches of retained trees to be removed to a height of 2 metres and should not form a direct canopy linkage.
- Hollow-bearing trees will be retained.
- Removal of all fine fuels annually and maintenance of a shrub cover of less than 20% of the area.

- Control of Priority Weeds and environmental weeds in accordance with best practice methods.

All vegetation control activities within the fenced-off area will be undertaken manually, and any trees that require removal will be sectioned and lowered in a way to avoid any damage to individual stems or the adjacent supporting vegetation.

The remaining five individual plants are located outside of the referral boundary and will be retained within the E3 – Environmental Management land and will be managed under the site-specific VMP (Figure 3). Weed control measures outlined in the VMP include:

- All primary weed control within a 20 metre buffer of White-flowered Wax Plant is to be restricted to manual cut and paint methodologies.
- No herbicide application by spot spray within 10 metre buffers of known locations will be allowed, due to White-flowered Wax Plant's capacity to sucker at extended distances from the parent plant.
- The known White-flowered Wax-plant locations will be identified and buffer areas marked out prior to starting primary weed control.
- Mechanical slashing cannot be used to control Lantana within 20 metres of any known location of White-flowered Wax Plant. This is because there is a high likelihood that unrecorded White-flowered Wax Plant could be growing within areas of Lantana, and has the potential to be established within more open areas.

Further recruitment of White-flowered Wax Plant individuals within the study area in response to ongoing vegetation management is possible. Contingencies to approaching this scenario are also provided in the VMP.

The main threat to the persistence of White-Flowered Wax Plant within the study area appears to be degradation of habitat due to weed invasion and grazing. Safeguards will be implemented to abate this key threat and are discussed further in Section 5.

Illawarra Zieria

No Illawarra Zieria plants have been recorded within the study area during surveys. There is a low likelihood that the environmental lot to be retained as managed residual vegetation contains a soil stored seed bank. Safeguards to avoid potential impacts to this species are included within the VMP. Monitoring activities will be undertaken within the environmental lot which include:

- Survey within three months of primary control following removal of Lantana.
- If the plant is recorded recruiting, procedures for weed management will apply as per White-flowered Wax Plant.
- If no plants are detected, annual targeted survey for the plant will cease after three years.

Grey-headed Flying-fox

Previous surveys recorded this species over-flying the study area (EcoLogical 2011). Potential habitat for the Grey-headed Flying-fox will be managed and protected within the local area in the form of the abovementioned Illawarra Lowlands Grassy Woodland CEEC environmental outcomes. The total minimum area of habitat that will contribute to the environmental outcomes for these species is 1.87 hectares.

The conservation areas will be improved through a range of ecological restoration works set out in a VMP. A minimum of 2.68 hectares (including APZ) will be subject to the VMP.

3.2.3 Migratory species

Database searches returned a total of 33 species listed as migratory under the EPBC Act (Table 10). No listed migratory species are considered likely to breed within the subject site (Biosis 2017a). Suitable habitat for the EPBC listed migratory species is limited to foraging and dispersal resources provided by eucalypts and exotic trees within the study area.



Legend

- Study area
- Referral boundary
- Zone
- Impact - APZ modification CEEC
- Impact - removal CEEC
- Threatened Flora
- + White-flowered Wax Plant (Biosis 2012)
- Hollow-bearing tree
- Vegetation community
- Illawarra Lowlands Grassy
- Woodlands EPBC Act (moderate condition class)
- Scattered trees

Figure 3 Ecological features within the study area

0 10 20 30 40 50
Metres
Scale: 1:1,800 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 10 April 2019
Checked by: LH, Drawn by: NMG
Location: P:\25300s\25345\mapping\25345_P4_VegComms

4 Impacts arising from proposed action

4.1 Potential direct and indirect impacts to MNES

This section details the MNES within the referral boundary and broader study area that could be impacted if development was undertaken as currently designed (Figure 3) and without the implementation of any controls or safeguards (i.e. no measures to minimise or mitigate impacts). It provides a comparison against which residual impacts (following implementation of measures to avoid minimise and mitigate impacts) can be compared.

Table 3 presents the potential impacts that may occur to MNES within the study area. For each potential direct and indirect impact to MNES, Table 3 identifies:

- Stage of the development during which the impact(s) has the potential to occur.
- The MNES which may be impacted.
- The rationale for considering the potential impact relevant to the proposed action, drawing on information provided in relevant conservation advices, recovery plans and threat abatement plans as well as other strategies, plans and published literature where appropriate.

For the most part, ecological values at highest risk of impact as a result of the proposed development including Illawarra Lowlands Grassy Woodland are relatively well studied in NSW and as such, potential urban development-related impacts may be predicted with a relatively high level of confidence.

In regards to other threatened species which may utilise the study area, available habitat is likely marginal and similar or better quality habitat is available nearby. In this context, the potential overall impacts of the proposed action to these species are also considered predictable and were deemed unlikely based on their low likelihoods of occurrence (Appendix 1 and Appendix 2). For this reason, these species were excluded from further impact consideration in this document.

The majority of indirect impacts can be avoided, minimised and mitigated and this is discussed further in Section 5.

Table 2 Potential direct and indirect impacts to MNES

Potential impact	Rationale	Development Stage		MNES potentially impacted			
		Construction stage	Operational stage	Illawarra Lowlands Grassy Woodland	White-flowered Wax Plant	Illawarra Zieria (habitat)	Grey-headed Flying-fox
Permanent removal of 2.81 ha of vegetation consistent with the CEEC Illawarra Lowlands Grassy Woodland.	The loss of Illawarra Lowlands Grassy Woodland from clearing relating to urban development is identified as a key threat and reason for listing this community as critically endangered under the BC Act and EPBC Act (TSSC 2016). The removal of 2.81 ha of CEEC will also reduce the area of potential Illawarra Zieria habitat and Grey-headed Flying-fox foraging and dispersal habitat.	X		X		X	X
Modification of 1.09 ha of Illawarra Lowlands Grassy Woodland vegetation and associated threatened flora and fauna habitat.	The installation and maintenance of the APZ will result in a reduction of the overstorey canopy cover to 15% cover across 0.44 ha to facilitate the inner protection zone, and a reduction of canopy overstorey cover to 30 % across 0.65 ha for the outer protection zone. This will involve the removal of <i>Eucalyptus</i> species including winter and spring - flowering mature Forest Red-gum trees; a foraging resource for the Grey-headed Flying-fox. Regular slashing of the groundcover will lead to permanent modification of the community structure. Loss of habitat due to clearing has been cited as a major threat to White-flowered Wax Plant (DEWHA 2008). Similarly, loss of foraging habitat is considered a primary threat to the Grey-headed Flying-fox (DEE 2017).	X	X	X	X	X	X
Removal of up to 33 hollow-bearing trees	Hollow-bearing trees provide potential foraging and dispersal habitat for one Commonwealth listed threatened species; Grey-headed Flying-fox. In addition, hollow-bearing trees provide potential foraging, dispersal and roosting resources for local native fauna including mammal and bird species listed as threatened under the NSW BC Act.	X					X
Weed encroachment into retained native vegetation during the construction stage of the development and from landscaped areas and private gardens during the operation stage of the proposed development.	Agricultural weeds and garden escapees are a key threat to Illawarra Lowlands Grassy Woodland CEEC as their establishment and spread affects the structure, composition and ecological function of the ecosystem with potential flow on impacts to flora and fauna species to which they provide important habitat (TSSC 2016). Invasion of Illawarra Lowlands Grassy Woodland vegetation by Lantana, in particular is identified as a major threat to the community as well as threatened flora supported by the community such as White-flowered Wax Plant and Illawarra Zieria. The mechanism attributed to the threatening process of weed invasion is competition for light, space, water and nutrients.	X	X	X	X	X	
Changes in hydrological regime experienced by retained native vegetation, including reduction in over-land and sub-surface flows due to capture and retention of storm water within the proposed development footprint and increase in storm water run-off from the proposed development.	Changes in hydrology have the potential to alter soil moisture condition and increase surface erosion within Illawarra Lowlands Grassy Woodland vegetation. This has the potential to impact the structure, composition and ecological function of the ecosystem. Alterations to hydrology is an indirect impact associated with a number of key threatening processes identified by the TSSC (2016), DEWHA (2008) and TSSC (2015) for Illawarra Lowlands Grassy Woodland, White-flowered Wax Plant and Illawarra Zieria respectively. These threatening processes include clearing for development and agriculture, grazing and timber removal.	X	X	X	X	X	
Damage to Illawarra Lowlands Grassy Woodland CEEC associated flora and fauna habitat within and beyond the referral boundary caused by overspray and/or run-off of herbicide used in weed management (during demolition and construction works) and management of landscaped areas and private gardens during operation of the proposed development.	Inappropriate use of herbicides is identified as a potential threat to Illawarra Lowlands Grassy Woodland, White-flowered Wax Plant and Illawarra Zieria as spray-drift can directly affect the composition of ecological communities and the survival of flora TSSC (2016), DEWHA (2008) and TSSC (2015).	X	X	X	X	X	

Potential impact	Rationale	Development Stage		MNES potentially impacted			
		Construction stage	Operational stage	Illawarra Lowlands Grassy Woodland	White-flowered Wax Plant	Illawarra Zieria (habitat)	Grey-headed Flying-fox
Reduction in the area of the vegetation corridor orientated north to south contiguous with the Tongarra-Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al. 2011).	The vegetation to be permanently removed as part of the proposed action will reduce the area of the corridor, but will not result in a discrete break in the corridor's length. Minor fragmentation of Illawarra Lowlands Grassy Woodland will result; contributing to a key threat identified for the CEEC (TSSC 2016).	X		X			X
Disturbances relating to increased human population density including trampling, rubbish dumping, and inappropriate recreational activities such as trail bike riding within the referral boundary and adjoining areas.	Trampling of retained native vegetation, including Illawarra Lowlands Grassy Woodland by livestock and people has been identified as a potential impact to the community (TSSC 2016), as well as to associated threatened flora including Illawarra Zieria (TSSC 2015) and White-flowered Wax Plant (DEHWA 2008).	X	X	X	X	X	
Increased predation of local native fauna as a result of increased abundance of domestic, stray, feral or introduced animal species, primarily cats and foxes.	TSSC (2016) noted the degradation of the structure and composition of Illawarra Lowlands Grassy Woodland by feral animals as a major threatening process. Also, increased grazing pressure by the feral European Rabbit <i>Oryctolagus cuniculus</i> associated with development is listed as a threat to the CEEC as well as to threatened flora. In Albion Park, degradation of habitat due to grazing and trampling from deer is also a threat to the CEEC and threatened flora.		X	X	X	X	

The proposed removal of Illawarra Lowlands Grassy Woodland is irreversible and may be expected to affect Illawarra Lowlands Grassy Woodland CEEC, White-flowered Wax Plant and local fauna species that utilise vegetative habitat at the site over the long-term. The removal of up to 33 hollow-bearing trees within the study area will result in the reduction in availability of marginal foraging habitat and roosting habitat for local fauna. However, prioritising the removal of non-hollow-bearing trees will minimise this impact.

Potential indirect and offsite impacts (i.e. trampling, weed encroachment, sedimentation and erosion, nutrient and hydrological changes, increased predation and herbicide run-off) may impact Illawarra Lowlands Grassy Woodland, White-flowered Wax Plant, Illawarra Zieria and Grey-headed Flying-fox habitat over the long term as a result of construction and operation of the proposed action. However these impacts can be effectively managed by a suite of measures (outlined further in Section 5) such that only minor short term impacts to protected matters are likely to occur.

4.2 Potential cumulative impacts to MNES

Cumulative impacts to MNES potentially arising from the proposed action are outlined below.

4.2.1 Potential cumulative impacts to Illawarra and South Coast Lowland Forest and Woodland

The proposed action will result in a reduction in the total extent of Illawarra Lowlands Grassy Woodland CEEC in the study area from 5.77 hectares to 2.96 hectares. The total extent of the CEEC remaining has been estimated at 4,200 hectares, representing a maximum of 24% of the original extent of the community (Tozer et al. 2010). The removal of 2.81 hectares of the CEEC represents 0.07% of the local extent of the community.

The local occurrence of the CEEC constitutes the habitat corridor extending from the south and east of the study area. The vegetation to be removed as part of the proposed action will reduce the area of the corridor, but will not result in a discrete break in the corridors length. The CEEC to be retained within the east of the study area will retain connectivity to the south. The proposed action will have a minimal impact to the vegetation to the west of the study area which adjoins native vegetation further to the north.

Without the implementation of adequate mitigation measures, there is the potential for the proposed action to exacerbate and/or accelerate the degradation of the remaining 2.96 hectares of the CEEC potentially leading to the extinction of this community from the study area. Such an outcome would result in an overall 0.14% decline in the total extent of Illawarra Lowlands Grassy Woodland CEEC.

4.2.2 Potential cumulative impacts to White-flowered Wax Plant

The proposed action will not directly impact White-flowered Wax Plant individuals from vegetation clearing. A 20 metre buffer exclusion zone will surround the two populations of this threatened species within the APZ of the referral boundary. Without adequate mitigation measures there is potential for the proposed development to degrade the habitat occupied by this species.

White-flowered Wax Plant occurs in a range of vegetation communities, therefore its current known extent is difficult to predict (DEWHA 2008). Habitat with the potential to support this species within the referral boundary includes 5.77 hectares of Illawarra Lowlands Grassy Woodland, of which 2.81 hectares is proposed for removal and a further 1.09 hectares to be permanently modified facilitating the APZ. Therefore the proposed action will remove 49% and permanently modify 20% of potential habitat currently present within the referral boundary, amounting to a total of 69% of potential White-flowered Wax Plant habitat impacted.

Mitigation and management actions relating to the CEEC and White-flowered Wax Plant are likely to increase the likelihood of White-flowered Wax Plant recruiting within the referral boundary. In this case, the VMP will require updating to address the onsite conservation of the additional threatened species if recruitment occurs.

4.2.3 Potential cumulative impacts to Illawarra Zieria

No Illawarra Zieria plants were recorded within the referral boundary. Given the low numbers of individuals recorded onsite there is a low likelihood that the environmental lot to be retained as managed residual vegetation contains a soil stored seed bank therefore potential for Illawarra Zieria to naturally recruit onsite. Similar to the White-flowered Wax Plant, potential Illawarra Zieria habitat in the form of 5.77 hectares of Illawarra Lowlands Grassy Woodland is supported by the study area, of which 2.81 hectares is proposed for removal and a further 1.09 hectares to be permanently modified facilitating the APZ. Therefore the proposed action will remove 549% and permanently modify 20% of potential habitat currently present within the referral boundary, amounting to a total of 69% of potential habitat impacted.

Mitigation and management actions relating to the CEEC and White-flowered Wax Plant are likely to increase the likelihood of Illawarra Zieria recruiting within the referral boundary. In this case, the VMP will require updating to address the onsite conservation of the additional threatened species if recruitment occurs.

4.2.4 Potential cumulative impacts to Grey-headed Flying-fox

The primary impact to Grey-headed Flying-fox arising from the proposed action relates to the loss of foraging resources associated with the removal of 2.81 hectares of native vegetation including Forest Red Gum trees. Given the current suburban setting of the study area, the availability of similar resources in the locality and high mobility of this species, cumulative impacts to this species arising from the proposed action are likely to be negligible.

5 Proposed avoidance, mitigation and management measures

5.1 MNES

The design of the proposed action has considered the Guidelines for threatened species assessment (DECC 2004) and importantly considered the Significant Impact Guidelines for MNES (CoA 2013), which both identify important factors that must be considered when assessing the potential impacts on threatened species, populations, or ecological communities, or their habitats; namely to avoid, minimise and finally to offset any residual impacts.

Qualified ecologists were consulted during the design phase of the project. As such, areas supporting high quality ecological values were avoided where feasible.

5.1.1 Avoidance

Various site planning options were considered in consultation with Biosis, MMJ Pty Ltd and Spinitu Pty Ltd throughout the design phase, taking into consideration specific ecological constraints. Initial consultation began at the Planning Proposal stage in 2011. This has informed avoidance and minimisation of direct and indirect impacts to biodiversity values; specifically EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC and White-flowered Wax Plant.

The following avoidance measures were taken into consideration during the design phase:

- Lot layout to be located in areas where the native vegetation and threatened species habitat is in the poorest condition.
- Lot layout to be located within the western portion of the lot to avoid fragmentation of existing vegetation.
- Minimise the amount of clearing or habitat loss.

Illawarra Lowlands Grassy Woodland

A number of development scenarios were considered with the intent of avoiding and minimising impact to Illawarra Lowlands Grassy Woodland CEEC, within the referral boundary. However, while impact on CEEC has not been completely avoided, impacts have been minimised as far as practicable to maintain the feasibility of residential development within the study area.

Overall, if the study area had been cleared the total impact of the proposed action would have been 5.77 hectares of Illawarra Lowlands Grassy Woodland CEEC. The redesign of the subdivision has been reduced to 2.81 hectares of CEEC to be removed, 1.09 hectares modified for APZs, leaving 1.87 hectares as residual CEEC not impacted by the proposed subdivision. These reductions in impact area were subsequently formalised through a planning proposal which rezoned the environmental lot to E3 – Environmental Management from RU1 – Primary Production.

The following recommendations to avoid impacts to the CEEC were also implemented:

- Utilising roads as a part of APZs, where possible, to avoid removal of native vegetation.
- Fencing of the boundary between the outer APZ and the remainder of the EMA to delineate management areas (see VMP).

- Protection and management of retained vegetation through the development and implementation of a VMP. The VMP will be implemented by a suitably qualified practitioner/Bush Regenerator as contracted by Spinitu. Following future subdivision and re-sale of the land, Spinitu will remain responsible for the implementation and management of the VMP within the EMA unless otherwise arranged with Council.
 - The VMP outlines plans for the removal of Lantana, and measures to improve the resilience of retained areas and revegetation of these areas if natural regeneration does not occur.
 - The VMP includes measures for the appropriate management of vegetation within APZs consistent with the recommendations of the bushfire assessment (Bushfire & Evacuation Solutions 2015) whilst achieving a positive conservation outcome.
- Management of fine fuels within the outer APZ should be limited to the raking or manual removal of fine fuels, with mowing limited to immediately prior to the fire season.
- The VMP instates an in perpetuity operational period and will be reviewed by Council on an annual basis.

White-flowered Wax Plant

One population of White-flowered Wax Plant, consisting of seven individuals in two locations will be retained within an environmental lot. The development footprint is located away from the local population, ensuring that no plants will be removed.

Additional measures to avoid impacts to White-flowered Wax Plant included:

- Rezoning of the eastern section of the site, supporting the White-flowered Wax Plant, to E3 Environmental Management.
- Ensuring appropriate management of known locations for the White-flowered Wax Plant within the VMP through the retention of a 20 metre buffer. Management of APZs within the buffer will be undertaken by a Bush Regenerator holding a Section 132 licence from the NSW OEH and subject to the specifications within the VMP.

Fauna habitat

A reduction in Grey-headed Flying-fox foraging habitat will result from the removal of 2.81 hectares of Illawarra Lowlands Grassy Woodland CEEC vegetation. Measures to avoid impacts to Grey-headed Flying-fox habitat are equivalent to the measures described above for the CEEC.

Hollow-bearing trees within the E3 – Environmental Management area will be retained. Where the removal of hollow-bearing trees cannot be avoided, compensatory hollow/nest boxes will be provided at a 1:1 ratio per hollow, in areas of vegetation to be retained. The nest boxes will be designed to support native species which would otherwise utilise the hollows to be removed (summary of hollows is provided in Appendix 2, Biosis 2017a).

5.1.2 Mitigation and management

The mitigation and management measures that will be undertaken as part of the proposed action represent cost-effective means of minimising and mitigating impacts within the referral boundary and on adjoining areas. Measures focus on the minimisation of impacts to MNES in land adjoining the referral boundary.

Mitigation and management measures are detailed in Table 4 and will be funded directly by the proponent. The proponent will be responsible for costs associated with purchasing and retiring biodiversity credits necessary to adequately offset impacts to Illawarra Lowlands Grassy Woodland CEEC as determined by

application of the *EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012) and the endorsed *NSW Biodiversity Assessment Method* (BAM) (OEH 2017).

Measures to offset significant residual impacts arising from the proposed action are described in Section 7.

Table 3 Avoidance, mitigation and management measures

Potential impact	MNES				Avoidance and mitigation measures
	Illawarra Lowlands Grassy Woodland CEEC	White-flowered Wax Plant	Illawarra Zieria	Grey-headed Flying-fox	
Permanent removal of 2.81 ha of Illawarra Lowlands Grassy Woodland CEEC and associated habitat for Grey-headed Flying-fox, White-flowered Wax Plant and Illawarra Zieria.	X	X	X	X	Construction stage: <ul style="list-style-type: none"> Lowest quality areas of Illawarra Lowlands Woodland CEEC and areas along the edges of the vegetation patch will be removed. This will minimize the extent of habitat fragmentation resulting from the project. The development plan has been sited to avoid areas supporting White-flowered Wax Plant individuals. Implementation of a site Construction Environmental Management Plan (CEMP). The extent of the vegetation clearing works area within the referral boundary will be delineated using site fencing and will not extend into any areas of adjacent native vegetation. Site access will be via gated entrances at existing bitumen roads. Operational stage: <ul style="list-style-type: none"> Implementation of the VMP associated with the EMA (Biosis 2017c) will ensure adequate conservation measures are undertaken to protect retained vegetation and associated threatened species habitat.
Modification of 1.09 ha of Illawarra Lowlands Grassy Woodland CEEC vegetation and associated threatened flora and fauna habitat to facilitate the APZ.	X	X	X	X	Construction stage: <ul style="list-style-type: none"> Implementation of a site CEMP. Retention of hollow-bearing trees within the EMA. APZ specifications for maintaining the OPA and IPA within the EMA will be followed closely. White-flowered Wax Plant individuals will be retained and habitat conserved within the EMA. The APZ boundaries, including the outer APZ and inner APZ, will be clearly delineated on site using fencing and/or flagging tape. Site access will be via gated entrances at existing bitumen roads. Operational stage: <ul style="list-style-type: none"> Where the removal of hollow-bearing trees cannot be avoided, compensatory hollow/nest boxes should be provided at a 1:1 ratio in areas of vegetation to be retained. Implementation of the VMP associated with the EMA will ensure adequate conservation measures are undertaken to protect retained vegetation and associated threatened species habitat (Biosis 2017c).
Removal of up to 33 hollow-bearing trees	X			X	Construction stage: <ul style="list-style-type: none"> Retained trees will be protected using appropriate exclusion zoning in accordance with <i>Australian Standards – Protection of trees on development sites</i> (Standards Australia 2009). Implementation of a site CEMP. Retain as many hollow-bearing trees as possible within the APZ, including stags. Non hollow-bearing trees will be removed prior to consideration of hollow-bearing tree removal. Hollow limbs removed from the development site will be translocated into the EMA, outside of the APZs, for habitat supplementation. A qualified ecologist will be on site during hollow-bearing tree removal to salvage and relocate fauna species that may be occupying hollows. Operational stage: <ul style="list-style-type: none"> Where the removal of hollow-bearing trees is unavoidable, compensatory hollow/nest boxes will be provided at a 1:1 ratio in areas of vegetation to be retained. These nest boxes will be designed to support the native species which would otherwise utilise the hollows to be removed. Erected nest boxes will be monitored bi-annually by a suitably qualified Ecologist, to be contracted by the property owner, for a period of three years and results reported to Council.

Potential impact	MNES				Avoidance and mitigation measures
	Illawarra Lowlands Grassy Woodland CEEC	White-flowered Wax Plant	Illawarra Zieria	Grey-headed Flying-fox	
Weed encroachment into retained native vegetation during the construction stage of the development and from landscaped areas and private gardens during the operation stage of the proposed development.	X	X	X		<p>Construction stage:</p> <ul style="list-style-type: none"> Production and implementation of a Soil and Water Management Plan (SWMP), identifying site features and constraints. The SWMP will specify the type and location of erosion and sediment control measures required. Implementation of a site CEMP, which includes: <ul style="list-style-type: none"> Weed hygiene protocols for all vehicles and equipment entering and exiting the site. Sediment and erosion controls. Contaminated lands and unexpected finds protocols. On-site inductions for all construction personnel and visitors to communicate key aspects of the WMP and importance of adherence to the WMP. <p>Operational stage:</p> <ul style="list-style-type: none"> Implementation of the VMP associated with the EMA will ensure adequate conservation measures are undertaken to protect retained vegetation and associated threatened species habitat. Weed management measures captured within the VMP include: <ul style="list-style-type: none"> Identification of priority weeds and weed areas. Description of methods, frequency and duration of weed control actions. Roles and responsibilities of site personnel for ongoing weed management. Schedule of weed management actions and monitoring. Corrective actions if weed infestations are identified. Routine monitoring to identify any new weed areas within the construction site and at the perimeter of the site. Educate residents regarding the biodiversity value of the surrounding area and encourage the use of native gardens and non-invasive exotic species.
Changes in hydrological regime experienced by retained native vegetation.	X	X	X		<p>Construction stage:</p> <ul style="list-style-type: none"> Implementation of a site SWMP. Implementation of a site CEMP. A 30m buffer around Illawarra Lowlands Grassy Woodland CEEC was incorporated into the development design. This will provide a buffer zone between retained CEEC vegetation and indirect hydrological impacts from construction activities. The proposed roads and drainage system have been well-designed, considering potential impacts to surrounding biodiversity. Sediment fencing will be placed on site during construction activities to reduce the potential for downstream impacts into the retained areas via soil erosion. <p>Operational stage:</p> <ul style="list-style-type: none"> The majority of runoff from residential hard surfaces and stormwater flows will be re-directed through stormwater infrastructure to a rock lined ephemeral gully to the west. This will reduce any increased flows into areas of the CEEC and avoid localised changes in hydrology that will result in a wetter environment.
Alteration of the nutrient status of native vegetation and associated flora and fauna habitat within and beyond the referral boundary.	X	X	X		<p>Construction stage:</p> <ul style="list-style-type: none"> Negligible risks of increased nutrient load in the soil as a result of herbicide application will occur during the construction stage of the project. Precautions described above to avoid and mitigate adverse hydrological impacts will also provide a safeguard for undesirable nutrient runoff within the referral boundary and surrounding areas. <p>Operational stage:</p> <ul style="list-style-type: none"> The implementation of the VMP within the EMA will ensure that the application of herbicides will be limited to spot application or via manual control. Weed control will be undertaken by suitably qualified personnel in accordance with the methods detailed in the VMP.

Potential impact	MNES				Avoidance and mitigation measures
	Illawarra Lowlands Grassy Woodland CEEC	White-flowered Wax Plant	Illawarra Zieria	Grey-headed Flying-fox	
Reduction in connectivity between the vegetation corridors contiguous with regional biodiversity corridors.	X			X	The proposed development has been designed to minimise the extent of habitat fragmentation resulting from clearing vegetation for the project. The residual Illawarra Lowlands Grassy Woodland CEEC and APZ modified areas to be retained within the east of the study area (EMA) will retain connectivity to the south.
Trampling and inadvertent damage to vegetation within the referral boundary and surrounding areas relating to increased human population density.	X	X	X		Construction stage: <ul style="list-style-type: none"> Submit and implement a Construction Traffic Management Plan (CTMP) detailing vehicle routes, number of truck, hours of operation etc. Implementation of a site CEMP, which details: <ul style="list-style-type: none"> Retained native vegetation and threatened species protection measures including installing site perimeter fencing prior to construction. Access to the site will be restricted to designated access points; via an extension of Crest Road (DA 119/2016) as well as via adjacent roads: Premier Drive and Raleigh Street. Operational stage: <ul style="list-style-type: none"> All vehicle and pedestrian access to and from the residential development will be via formal bitumen roads. Strategic fencing will be installed in accordance with the VMP, deterring informal walking and bike trails within retained vegetation. Signage and education material will be provided to residents and visitors to communicate the conservation significance of retained native vegetation and threatened species habitat within and adjacent to the development.
Increased predation of native fauna by domestic, stray, feral or introduced animal species, primarily cats and foxes.	X	X	X		Construction stage: <ul style="list-style-type: none"> Waste enclosures will be used for all rubbish on site and rubbish will be removed when required or full. Operational stage: <ul style="list-style-type: none"> Signage and education material to be provided to residents and visitors will include information regarding pets and interactions with local wildlife.

5.1.3 Effectiveness of mitigation and management measures

Mitigation and management measures for the proposed action have been designed to avoid and reduce the risk of potential impacts to MNES within the referral boundary and immediately adjacent to the referral boundary.

Overall, the proposed mitigation and management measures are expected to be effective in reducing the direct and indirect impact to MNES. Table 5 below describes the predicted effectiveness of each proposed measure as well as proposed monitoring and adaptive management.

Table 4 Expected or predicted effectiveness of measures to mitigate and manage potential impacts to MNES

Proposed mitigation measures	Predicted effectiveness	Monitoring and adaptive management	Timing and duration of implementation	Responsibility for management
Implementation of a CEMP covering construction works.	<p>The implementation of a comprehensive and integrated CEMP prior to construction is expected to be highly effective in managing potential construction impacts related to the introduction and spread of weeds, generation of dust, erosion and sedimentation and the inadvertent disturbance to vegetation within and outside the referral boundary. Measures implemented as part of the CEMP will ensure impacts to Illawarra Lowlands Grassy Woodland, White-flowered Wax Plant, Illawarra Zieria and Grey-headed Flying-fox within the referral boundary are minimised. They will further minimise the potential for indirect impacts to these values and to values present in adjoining land.</p> <p>Measures to be incorporated within the CEMP are listed below and are considered standard and routine for construction stages of a residential development such as the proposed action.</p> <ul style="list-style-type: none"> • Sediment and erosion controls. • Management of fuels and chemicals. • Dust control measures. • Retained native vegetation, threatened species and fauna protection measures. 	The CEMP will outline regular monitoring to ensure mitigation measures are in place and functioning effectively. The CEMP will identify performance indicators against which the effectiveness of the plan can be assessed.	The CEMP is to be finalised prior to commencement of construction works and to remain in place until completion of all construction works.	Spinitu Pty Ltd or an appointed contractor.
Implementation of a SWMP	<p>The production and implementation of a site-specific SWMP in conjunction with the CEMP, identifying site features and constraints will reduce the risk of impacts to the surrounding environment and retained vegetation from erosion, sediment run-off and the spread of weeds.</p> <p>Measures including silt fencing, appropriate citing of stockpiles, etc. will substantially reduce the potential for sedimentation or erosion to occur beyond the referral boundary.</p> <p>The onsite and offsite control of sedimentation and erosion and the containment of stormwater run-off within the site boundary is a standard component of construction environmental management practice and is therefore likely to be implemented effectively by the construction contractor.</p>	The SWMP will outline adaptive management strategies in the event that unanticipated impacts as a result of erosion and/or run-off occur. These will include but not limited to; a vegetation rehabilitation strategy, and usage of temporary sediment ponds where required.	The CEMP is to be finalised prior to commencement of construction works and to remain in place until completion of all construction works.	Spinitu Pty Ltd or an appointed contractor.
Implementation of a VMP	The VMP is predicted to substantially reduce the risk of introduction and spread of weeds within the referral boundary and adjoining land. The implementation of the VMP is expected to be effective in ensuring the EMA is maintained in a healthy condition and thereby provides maximum value as a buffer to Illawarra Lowlands Grassy Woodland CEEC and threatened species habitats of land adjoining the referral boundary to the east and west, specifically. The VMP will further be effective in identifying and new weed introductions, particularly those with potential to threaten Illawarra Lowlands Grassy Woodland CEEC.	The VMP will outline regular monitoring to ensure retained native vegetation is maintained and weeds are effectively managed. The VMP will identify performance indicators for landscaped buffers and weeds against which the effectiveness of the plan can be assessed.	As specified in the VMP (Biosis 2017c); primary weed control, revegetation and the removal of sheds, fences and waste site, will be completed prior to subdivision completion, and that scheduled maintenance detailed within the VMP will be required by the owner for a period of five years.	A suitable qualified Bush Regenerator.
Installation of compensatory hollow/nest in areas of vegetation to be retained	<p>The nest boxes to be erected will be dependent on the number and sizes of hollows removed from the site; nest box types will target species that are most likely to be impacted from a loss of hollows for habitat. A replacement ratio of 1:1 will be implemented as specified by Council.</p> <p>The effectiveness of nest boxes varies widely, thus is difficult to predict. Nest box monitoring will guide adaptive management actions if required.</p>	Bi-annual monitoring of nest boxes by a qualified ecologist for at least the first three years following installation.	Submission of a nest box replacement strategy or similar to Council will need to occur prior to the issue of the Construction Certificate. Nest boxes are to be installed at least one month prior to removal of hollow-bearing	Suitably qualified Project Ecologist/ Arborist.

Proposed mitigation measures	Predicted effectiveness	Monitoring and adaptive management	Timing and duration of implementation	Responsibility for management
			trees.	
Pre-clearance survey and hollow-bearing tree removal supervision by an ecologist	An on-site ecologist will ensure correct protocols are followed during vegetation clearing works. Any native fauna displaced by the removal of hollows will be dealt with in the best way practical; relocation to adjacent habitat at a suitable time of day, or WIRES will be contacted to care for injured animals. This standard pre-clearance and clearing procedure is expected to effectively avoid and minimize adverse impacts to fauna.	A letter report summarising the findings and outcomes will be provided to Council following clearing supervision.	Non hollow-bearing trees are to be removed 48 hours prior to the felling of hollow-bearing trees.	Suitably qualified Ecologist
Site perimeter fencing for duration of construction activities.	The erection of site fencing around the perimeter of the referral boundary will create a physical barrier between construction activities, personnel and machinery and retained vegetation and associated threatened species habitat. This measure will substantially reduce the potential for inadvertent physical damage to surrounding vegetation during construction works.	The proper functioning of site fencing will be regularly checked as part of the CEMP monitoring program.	Installed prior to commencement of construction activities. Site fencing will remain in place until completion of construction.	Spinitu Pty Ltd or an appointed contractor.
Waste enclosures will be used for all rubbish on site and rubbish will be removed when required or full.	The use of waste enclosures for rubbish will be moderately effective in reducing the risk of increased native and feral predator use of the site during demolition and construction activities.	The CEMP will include routine checks to ensure waste enclosures are operating correctly and are emptied when required.	Prior to commencement and for the duration of all demolition, ancillary works and construction activities.	Spinitu Pty Ltd or an appointed contractor.
Installation of signage and education material to communicate conservation significance of lands adjoining referral boundary.	Educational signage and other material will provide a moderately effective means of minimising damage caused by trampling, creation of tracks, rubbish dumping, use by domestic pets, etc.to adjoining Illawarra Lowlands Grassy Woodland CEEC and associated flora and fauna habitat in land adjoining the referral boundary.	The VMP will outline regular checks of the condition of installed educational signage.	Installation during construction activities and maintenance for duration of action.	Spinitu Pty Ltd of an appointed contractor.

6 Residual impacts and significance of impacts

6.1 Matters of National Environmental Significance

The proposed action will undertake a range of avoidance and mitigation measures which will reduce the direct and indirect impacts to MNES within the referral boundary and substantially reduce the risk of indirect direct and indirect impacts to ecological values identified in land adjoining the referral boundary.

Mitigation measures proposed during the construction and operational stages of the residential development are considered likely to be moderately to highly effective in mitigating impacts to Illawarra Lowlands Grassy Woodland CEEC, White-flowered Wax Plant, Illawarra Zieria and Grey-headed Flying-fox in retained land surrounding the referral boundary. As such, direct and indirect impacts beyond the referral boundary are expected to be effectively managed, such that residual impacts to MNES will be confined within the referral boundary. The proposed action will have the following residual direct and indirect impacts on MNES:

- Permanent removal of 3.9 hectares of native vegetation, including 2.81 hectares of moderate condition Illawarra Lowlands Grassy Woodland CEEC.
- Modification of 1.09 hectares of moderate condition Illawarra Lowlands Grassy Woodland CEEC and White-Flowered Wax Plant habitat. All seven individuals of White-flowered Wax Plant recorded will be retained and protected.
- Permanent removal of 2.81 hectares of Grey-headed Flying-fox dispersal and foraging habitat.
- Permanent removal of 2.81 hectares of potential Illawarra Zieria habitat.
- Removal of up to 318 trees including eight hollow-bearing trees (containing 12 hollows) which may provide foraging and dispersal resources for Grey-headed Flying-fox.
- Reduction in connectivity associated with the Tongarra – Stockyard Mountain to Dunmore Hills regional biodiversity corridor.

Based on the approved conservation advice for the CEEC (TSSC 2016), the permanent removal of 2.81 hectares of Illawarra Lowlands Grassy Woodland is likely to be a significant residual impact under the EPBC Act (Commonwealth of Australia 2013) as it will adversely affect habitat which is critical to the survival of the CEEC. Areas critical to the survival of the CEEC are areas that meet the condition thresholds for the community as defined in the conservation advice (TSSC 2016).

Provided that adequate measures are implemented to mitigate potential impacts of the proposed action to areas beyond the referral boundary, significant impacts to the retained Illawarra Lowlands Grassy Woodland CEEC and threatened species for which it provides habitat beyond the referral boundary are considered unlikely. The removal of 2.81 hectares and modification of 1.09 hectares of Grey-headed Flying-fox, Illawarra Zieria and White-flowered Wax Plant habitat is unlikely to be a significant residual impact under the EPBC Act. No White-flowered Wax Plant individuals will be removed and the improvement of areas of retained Illawarra Lowlands Grassy Woodland through management in accordance with the VMP will benefit White-flowered Wax Plant individuals and increase the potential for Illawarra Zieria to establish. The Grey-headed Flying-fox is a highly mobile species, therefore the reduction in available habitat as a result of the proposed action is unlikely to significantly impact limiting habitat for this species.

Under the *EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012), offsets to compensate for residual significant impacts to Illawarra Lowlands Grassy Woodland CEEC will be required.

7 Proposed offset measures

7.1 Overview of offset requirements

Significant residual impacts to listed MNES arising from the proposed action include the removal of 2.81 hectares and permanent modification of 1.09 hectares of Illawarra Lowlands Grassy Woodland CEEC.

The significant residual impacts to 3.9 hectares of Illawarra Lowlands Grassy Woodland CEEC will be offset through the purchase and retirement of suitable biodiversity credits (ecosystem credits) generated under the NSW Biodiversity Banking and Offsets Scheme (BioBanking).

The following sections describe the calculation of MNES offset requirements using the EPBC Act Offsets Assessment Guide, details of the offset site and consideration of how the offset will meet the principles of the *EPBC Act Environmental Offsets policy* (Commonwealth of Australia 2012).

7.2 Commonwealth offset requirements

BioBanking has been endorsed by the Commonwealth as an appropriate means to compensate for residual impacts to threatened species and communities and the purchase of suitable biodiversity credits will ensure the requirements of the *EPBC Act Environmental Offsets Policy* are met. The calculation of biodiversity credits considered impacts to biodiversity values within the proposed action area as well as measures to avoid, minimise and mitigate those impacts.

Table 6 provides a summary of the credit offset requirement in accordance with the NSW BBAM (OEH 2014) and the equivalent biodiversity credits required to offset 3.9 hectares of Illawarra Lowlands Grassy Woodland CEEC, including impacts from APZs amounting to 1.09 hectares, under the EPBC Act. The number of credits is based on the BBAM and refers to the vegetation management zones in the *Lot 101 DP 785139, Crest Rd, Albion Park – BioBanking Assessment – Draft report* (Biosis 2012, Appendix 5).

This offset strategy has been based on securing direct (like-for-like) offsetting requirements outlined under the *EPBC Act Environmental Offsets Policy*. In summary, a total of 3.9 hectares of the Illawarra Lowlands Grassy Woodland CEEC are proposed to be impacted, requiring 51 ecosystem credits to be offset under Commonwealth legislative requirements (Table 6).

Table 5 EPBC Act listed Illawarra Lowlands Grassy Woodland offset calculations and requirements for the proposed action

Vegetation type	BBAM offset requirement (NSW BioBanking, Biosis 2012)	EPBC offset requirement for the proposed action (1:1 ratio for BBAM to EPBC offsets)
PCT 838 (SR545) - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (EPBC Act condition)	MZ2: 42 credits (3.46ha) MZ3: 2 credits (0.5ha) MZ4: 1 credit (0.09ha) MZ5: 6 credits (1.72ha)	MZ2: 42 credits MZ3: 2 credits MZ4: 1 credit MZ5: 6 credits
TOTAL	51	51

Spinitu Pty Ltd require 51 ecosystem credits to offset, for which the BioBank site can supply 100% of the offset requirement in the form of PCT 838 - *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* credits (equivalent to the EPBC Act listed Illawarra Lowland Grassy Woodland CEEC), under the NSW BioBanking scheme.

7.2.1 The proposed offset site

Spinitu Pty Ltd, in consultation with Biosis, has identified a suitable offset site containing Illawarra Lowlands Grassy Woodland vegetation (SR545) for which 87 credits are available for purchase and retirement on the BioBanking Public Register. The BioBank site is located within the Wollongong LGA, approximately 25 kilometres north of the proposed action area.

The proponent is currently negotiating the purchase of biodiversity credits from the owner of a BioBank site in Figtree, NSW. The proposed offset site supports the following ecological values relevant to the EPBC Act offset requirement for the proposed action area:

- A total of 9.3 hectares of EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC.
- White-flowered Wax Plant individuals (632 species credits).
- Grey-headed Flying-fox foraging and dispersal habitat.
- Illawarra Zieria habitat.

Biosis initially undertook the assessments for establishment of a BioBanking Agreement at the Figtree property and can confirm that the *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* vegetation meets the EPBC Act listing criteria for Illawarra Lowlands Grassy Woodland CEEC (Biosis 2016b). Further details are provided below.

As negotiations relating to the purchase of credits are still underway, requested details of the proposed offset site will be provided upon request to DEE as commercial in confidence.

7.3 Consistency with EPBC Act Environmental Offsets Policy

The following sections demonstrate how the purchasing and retirement of biodiversity credits at the above listed BioBank site will meet the offsetting requirements for impacts to EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC, as required under the *EPBC Act Offsets Policy* (Commonwealth of Australia 2012).

Improve or maintain principles

The NSW BioBanking scheme's centrepiece is the 'improve or maintain biodiversity values' test, as set out in the BBAM (OEH 2014). As stated on OEH's website, the methodology provides a rules-based approach to determine whether a development can proceed. If the development can proceed, the loss of biodiversity values on the development site from removing native vegetation, habitat of threatened species and threatened species themselves can be offset through the gain in biodiversity values from undertaking management actions on the offset area.

The proposed offset will maintain and improve the viability of Illawarra Lowlands Grassy Woodland CEEC through the purchase of 51 ecosystem credits which will fund the direct in perpetuity conservation and management of EPBC listed Illawarra Lowlands Grassy Woodland CEEC within the offset site.

The quality of Illawarra Lowlands Grassy Woodland CEEC at the offset site prior to the imposition of management actions meets or exceeds the quality at the referral boundary and will be modestly improved over a 20 year timeframe through implementation of management actions.

Given the levels of disturbance present and patch size of some areas of Illawarra Lowlands Grassy Woodland CEEC within the proposed action area, the current disturbance regimes operating both within and surrounding the site, the current R2 zoning of the site, the allocation of funding to protect, secure and manage an off-site patch of the CEEC is going to improve the overall viability of the protected MNES when compared to what is likely to have occurred under the status quo if neither the action of the offset had taken place.

Direct offset

The *EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012) states that a minimum of 90 % of offsets must be built around direct offsets, and other compensatory measures may satisfy up to the maximum of 10 % of the total offset requirement.

The proponent has identified that they will be able to satisfy 100 % direct offsets by retiring 51 *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* biodiversity credits that meet the offset requirements for Illawarra Lowlands Grassy Woodland CEEC.

A key component of the suitability of direct offsets is the condition that the quality of the protected matter at an offset site must at a minimum meet the quality of the protected matter at the proposed action area (Commonwealth of Australia 2012). This can be demonstrated through interpretation of the BBAM site values scores for the proposed action and area and offset sites.

Site attribute data collected in the BBAM is scored out of 100 and include values for native plant species richness, over and mid-storey cover, native ground cover, exotic plant cover, number of trees with hollows, overstorey regeneration present, and length of fallen logs.

As outlined in *Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment. Report* (Biosis 2012) the site attribute scores for each vegetation zone supporting EPBC Act Illawarra Lowlands Grassy Woodland CEEC (Table 6 above) are as follows:

- MZ2 – 35.42 (3.46 hectares).
- MZ3 – 35.42 (0.5 hectares).
- MZ4 – 43.75 (0.09 hectares).
- MZ 5 – 73.75 (1.72 hectares).

Site attribute scores prior to management for zones at the offset site supporting Illawarra Lowlands Grassy Woodland CEEC (as determined in accordance with the BBAM) at the Figtree site are as follows (Biosis 2016b):

- MZ3 – 72.4 (7.93 hectares).
- MZ4 – 72.4 (1.05 hectares).
- MZ5 – 10.94 (0.32 hectares).

Therefore, the majority of the Illawarra Lowlands Grassy Woodland CEEC vegetation present at the offset site has been calculated to be in a higher condition state and supporting a larger patch size than that proposed for removal from within the action area.

Table 7 below outlines how the Illawarra Lowlands Grassy Woodland present at the proposed offset site conforms to the EPBC Act listing criteria for the community (Biosis 2016b).

Table 6 Summary of the Illawarra Lowlands Grassy Woodland and EPBC Act listing criteria at the proposed offset site (Biosis 2016b)

Management zone	Patch Size > 0.5ha	Of the perennial understorey vegetative content present, is 30 % made up of native species	The patch is contiguous with another patch of native vegetation > 1ha; OR The patch has at least one large locally indigenous tree >50cm DBH; OR at least one hollow-bearing tree	The Listed (EPBC Act) Ecological Community is Present
MZ3 (quadrat 2)	YES Total patch size is 8.98 ha	YES BioBanking Plot Data Native Ground Cover Grasses FPC – 50% Native Ground Cover Shrubs FPC – 8% Native Ground Cover Other FPC – 24% Exotics FPC – 8%	YES The patch size is contiguous with a patch of native vegetation > 1ha.	YES
MZ4 (quadrat 1)	YES Total patch size is 8.98 ha	YES BioBanking Plot Data Native Ground Cover Grasses FPC – 58% Native Ground Cover Shrubs FPC – 2% Native Ground Cover Other FPC – 16% Exotics FPC – 16%	YES The patch size is contiguous with a patch of native vegetation > 1ha.	YES
MZ5 (quadrat 18)	YES Total patch size is 8.98 ha	NO BioBanking Plot Data Native Ground Cover Grasses FPC – 40% Native Ground Cover Shrubs FPC – 0% Native Ground Cover Other FPC – 4% Exotics FPC – 56%	YES The patch size is contiguous with a patch of native vegetation > 1ha.	YES

The proponent is currently negotiating the purchase of credits from the relevant landowner. Offsets for impacts to EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC arising from the proposed action will be 100 % provided for by 51 *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* ecosystem credits, therefore ensuring that the "relevant protected matter" is protected.

Statutory protection at offset site

Application of the EPBC Act Environmental Offsets Assessment Guide indicates that offsetting of 6.5 hectares of Illawarra Lowlands Grassy Woodland CEEC will provide offsets of an appropriate magnitude to compensate for the significant residual impacts to Illawarra Lowlands Grassy Woodland CEEC within the referral boundary.

Ecosystem credits equivalent to the area of Illawarra Lowlands Grassy Woodland CEEC required to be offset according to the EPBC Act Offsets Assessment Guide will be purchased so as to ensure the offset is proportion to the level of statutory protection that applies to the MNES.

Size and scale comparison

As detailed above, the following offsets are required for direct impacts to 3.9 hectares of EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC within the proposed action area:

- 6.5 hectares of EPBC Act listed Illawarra Lowlands Grassy Woodland at the proposed offset site in Figtree, in the Wollongong LGA.

This offset to impact ratio is in accordance with the outputs of the EPBC Act Offsets Assessment Guide and will result in the purchase of a greater number of biodiversity credits than is required for the proposed action based on application of the BioBanking Credit Calculator. The proposed offset will therefore be of an appropriate magnitude to compensate for the significant residual impacts to Illawarra Lowlands Grassy Woodland CEEC.

Risks of offset site not succeeding

The BioBank Agreement at the proposed offset site (or BioBank site) was assessed under the former *Threatened Species Conservation Act 1995* and the *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* (BioBanking Regulation). This legislation identified that an offset site cannot be established on land where past, present or proposed uses of the site or surrounding sites are inconsistent with biodiversity conservation or will prevent management actions from being carried out or biodiversity gains from being achieved. This reduces the risk of the offset site not succeeding from the outset. All credits required to offset EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC will be purchased through the BioBanking Credit Register and will therefore be subject to an assessment of suitability prior to the issuing of a BioBanking Agreement by OEH.

Management measures at the proposed offset site are developed based on a suite of mandatory measures identified by OEH. In order to improve the quality of vegetation within the offset areas, in perpetuity, mandatory management actions are required and include weed control, ecological burns and pest animal control. Prior to approving an offset site (by issuing a BioBanking Agreement), management measures proposed to be undertaken are reviewed by OEH in consultation with the landowner of the offset site. This review ensures management measures are relevant, achievable and cost-effective. Under the NSW BioBanking Scheme, management measures described in the BioBanking Agreement for each offset area are funded in perpetuity through annual management payments to landowners of the offset site from the BioBanking Trust Fund.

Every year after each offset area is established, the land owner must submit an annual report that details how the conditions set out in the BioBanking Agreement have been achieved. The annual reporting template, provided in the BioBanking Agreement, must be submitted to OEH within 30 days of the anniversary date. As credits required to offset EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC will be purchased through the BioBanking Credit Register, the landowner will be responsible for implementing the requirements of the BioBanking Agreement issued by OEH, including annual reporting.

The risk of offset sites not succeeding is considered to be very low (<5 %).

Additional management of offset site

To ensure that offset sites deliver a conservation gain for the impacted MNES, clause 11 of the BioBanking Regulation identifies the following circumstances in which land is ineligible to become a BioBank site:

- Land already used as a biodiversity offset under a property vegetation plan approved under the recently repealed *Native Vegetation Act 2003*. Current legislation governing native vegetation management in NSW include the *Local Land Services Act 2013* and the BC Act.
- Land which is subject to ongoing biodiversity conservation measures as a condition of a development consent or approval granted under Part 3A, 4 or 5 of the *Environmental Planning and Assessment Act 1979*.
- Land where biodiversity conservation measures are being, or are required to be, carried out under an offset arrangement which was made to comply with requirements imposed by or under any Act.

The proponent will therefore be securing credits at an offset site that is subject to adhering to the requirements of the *Biodiversity Conservation Act 2016* (BC Act) and the BioBanking Regulation and will ensure a gain in protection for EPBC Act listed Illawarra Lowlands Grassy Woodland CEEC.

Efficient, effective, timely, transparent, scientifically robust and reasonable offsets

As detailed in Section 7.2 above, offsets have been calculated using the NSW Biodiversity Banking and Offsets Scheme by application of the NSW BBAM (OEH 2014). The application of the BBAM (OEH 2014) to Commonwealth referred projects in NSW was endorsed by the Australian Government in February 2014. Therefore the offset is considered efficient, effective, scientifically robust and reasonable in conserving Illawarra Lowlands Grassy Woodland CEEC.

Governance arrangement

Under the NSW BioBanking Scheme, each biobank site is managed according to a set of agreed management actions and management plans described in the BioBanking agreement. The landowner is obliged by law to implement all actions described in the BioBanking agreement.

The landowner must submit an annual report each year detailing how conditions set out in the BioBanking agreement have been met. The annual report includes:

- A record of the management actions undertaken on the biobank site, including minor alterations that are part of adaptive management.
- A record of events that have had an impact on the site's ecological values.
- Problems experienced and the recommendations proposed or the actions taken to address them.
- Results of photo-point monitoring identified in the BioBanking agreement.
- Details of any other requirements set out in the BioBanking agreement.

The annual report must be submitted to OEH within 30 days of the BioBanking Agreement anniversary date. This provides an opportunity for OEH to review the management actions and amend accordingly in consultation with OEH, ultimately ensuring that conservation works at the offset site are being carried out and are enforced.

7.4 Environmental offset contingency

As described in detail in the preceding sections, Spinitu Pty Ltd has identified a highly suitable offset which will see Illawarra Lowlands Grassy Woodland CEEC conserved and managed in perpetuity and in accordance with the *EPBC Act Environmental Offsets Policy*. The offset will be delivered through the purchase of ecosystem and species credits generated through the NSW BioBanking Scheme.

If, for some unforeseen reason, the offset as described above cannot be delivered in full by Spinitu Pty Ltd, an alternative offset and/or additional offsets will be identified in consultation with DEE in order to fully compensate for residual significant impacts of the proposed action on Illawarra Lowlands Grassy Woodland CEEC.

8 Outcomes-based conditions

The appropriate environmental outcome for the current proposal is No Net-Loss of EPBC Act Illawarra Lowlands Grassy Woodland CEEC. This objective will be achieved through the purchase and retirement of an appropriate type and number of ecosystem credits under the Australian Government-endorsed NSW Biodiversity Banking and Offsets Scheme. The purchase and retirement of ecosystem credits will provide like-for-like and direct offsets and deliver a No Net Loss outcome for EPBC Act Illawarra Lowlands Grassy Woodland CEEC thereby meeting the objectives of the *EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012).

The proposed development exhibits several of the characteristics described in Commonwealth of Australia (2015) as necessary for a proposal to be considered suitable, for outcomes-based conditions. However, our preferred approach would be to apply a condition that seeks to ensure the proponent has met the requirements of the BioBanking Statement issued under the NSW Biodiversity Banking and Offset Scheme stating that the proponent must retire the appropriate type and number of biodiversity credits such that the 'improve or maintain' test for EPBC Act Illawarra Lowlands Grassy Woodland CEEC has been met under the endorsed offsetting scheme.

9 Economic and social matters

9.1 Cost/benefit analysis

The proposed action delivers residential development opportunities to the Illawarra and represents an economic and proper use of the land zoned as R2 Low Density Residential within the proposed action area. The proposal will create approximately 71 residential housing lots and will contribute to the increased amount of development in Albion Park and surrounds. The proposal will facilitate housing for a rapidly increasing population in the Illawarra.

The proposed development will not generate unreasonable demand upon utility services or infrastructure as these will be augmented as required via appropriate conditions of consent. Existing road infrastructure will be able to accommodate the proposed development and vehicle access.

Impacts to biodiversity have, where practicable, been avoided and mitigated to ensure the viability of surrounding local remnants. The proposed development will result in some loss of native vegetation and native species habitats however, application of the NSW Biodiversity Banking and Offsets Scheme will ensure the development improves or maintains biodiversity values of the locality. The proponent has identified a source of credits from within with same IBRA subregion (Sydney Basin) and adjacent LGA (Wollongong). Establishing offsets at this site will ensure that the benefits of the NSW Biodiversity Banking and Offsets Scheme stay within the locality.

9.2 Consideration of different scales

The proposed development is consistent with the objectives of the R2 Low Density Residential zone as defined in the Shellharbour LEP 2013 which is to (i) provide for the housing needs of the community within a low density residential environment, (ii) enable other land uses that provide facilities or services to meet the day to day needs of residents.

Moreover, the proposed retention and conservation of the E3 Environmental Management zone is consistent with the objectives of this zone as outlined in the Shellharbour LEP 2013; (i) to protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values, (ii) to provide for a limited range of development that does not have an adverse effect on those values, (iii) to retain and enhance the visual and scenic qualities of the Illawarra Escarpment.

9.3 Specific dollar value of the proposed action

The development will contribute to the economy of the area through the provision of construction jobs as the construction of the dwellings progresses. The estimated construction value of the project is \$40 million.

10 Environmental record of person(s) proposing to take the action

It is the assertion of Spinitu Pty Ltd that they have not been the subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

Spinitu is a Proprietary Limited company, they are not a corporation and do not have an environmental policy and planning framework.

11 Conclusion

This report provides the final Preliminary Documentation required by DEE to assess the project as a controlled action.

The document has sought to adequately address the items raised by DEE including:

1. Description of the proposed action.
2. A description of the existing environment and relevant MNES.
3. An assessment of the relevant impacts of the action.
4. Proposed avoidance, mitigation and management measures.
5. Proposed offset measures.
6. Economic and social matters.
7. Environmental record of person(s) proposing to take the action.

References

- Atlas of Living Australia (ALA) 2017. Atlas of Living Australia [Online]. Accessed 17 January 2017. Available: <http://www.ala.org.au/about-the-atlas/>.
- Biosis 2012. Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment. Report for Martin Morris and Jones. Authors: A. Aguiar, N. Garvey, Biosis Pty Ltd, Wollongong. Project no 15634.
- Biosis 2016a. Crest Road, Albion Park: Aboriginal Cultural Heritage Due Diligence Assessment. Prepared for Spiritu Pty Ltd. Authors: Castle N, Cole J. Biosis Pty Ltd, Wollongong. Project no. 18853.
- Biosis 2016b. Redgum Ridge Western Precinct BioBank Site: Biodiversity Assessment Report. Report for Edenvell Pty Ltd. Authors: N Garvey & M Misdale, Biosis Pty Ltd, Wollongong. Project no. 20289.
- Biosis 2017a. Flora and Fauna Assessment for Crest Road, Albion Park. Report for MMJ Real Estate and Spiritu Pty Ltd. Authors: Garvey N, Biosis Pty Ltd, Wollongong. Project no 18852.
- Biosis 2017b. Referral of proposed action – Lot 101 DP 785139 Crest Road, Albion Park. Report for DEE on behalf of MMJ Wollongong. Author: Misdale M. Biosis Pty Ltd, Wollongong. Project no. 25345.
- Biosis 2017c. Lot 101 DP 785139 Crest Road, Albion Park: Vegetation Management Plan. Report for Martin Morris and Jones. Author: M Misdale, Biosis Pty Ltd, Wollongong. Project no. 18852.
- Bushfire and Evacuation Solutions 2015. Bushfire Hazard Risk Assessment & Compliance Report – Lot 101 DP 785139 Crest Road, Albion Park, NSW.
- Commonwealth of Australia 2012 *Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Australian Government, October 2012.
- Commonwealth of Australia 2013. *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies. Significant impact guidelines 1.2*. Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra.
- Commonwealth of Australia 2015. Outcomes-based conditions policy - draft. Department of the Environment, Canberra, ACT.
- DECC 2004. *Threatened species assessment guidelines- the assessment of significance*. Available online at: <https://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf>
- DEE 2017. Draft Recovery Plan for the Grey-Headed Flying-fox *Pteropus poliocephalus*. Commonwealth of Australia.
- Department of Environment, Climate Change and Water NSW. 2009. Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.
- DEWHA 2008. Approved Conservation Advice for *Cynanchum elegans* (White-flowered Wax Plant). Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/12533-conservation-advice.pdf>.
- Eco Logical 2011. Flora and Fauna Assessment. Lot 101 DP 785139 Crest Road, Albion Park. Eco Logical Australia, Sydney.
- Mills, K. 2007. Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study. City of Shellharbour. Kevin Mills and Associates. Jamberoo.

- NPWS 2002. Threatened Species Information. *Cynanchum elegans*. NSW National Parks and Wildlife Service, Hurstville.
- OEH 2014. BioBanking Assessment Methodology 2014. Office of Environment and Heritage, Sydney.
- OEH 2017. *Biodiversity Assessment Method*. NSW Government, Sydney.
- Standards Australia 2009. *Protection of Trees on Development Sites – AS 4970-2009*. Standards Australia, GPO Box 476, Sydney, NSW 2001. ISBN 0 7337 9229 4.
- Tozer M, Turner K, Keith D, Tindall D, Pennay C, Simpson C, MacKenzie B, & Beukers P 2010. 'Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands', *Cunninghamia*, 11,; 359–406.
- TSSC 2015. Conservation Advice *Zieria granulata* Illawarra *Zieria*. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/17147-conservation-advice-01102015.pdf>.
- TSSC 2016. Approved Conservation Advice (incorporating listing advice) for the Illawarra and south coast lowland forest and woodland ecological community. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/144-conservation-advice.pdf>.

Appendices

Appendix 1: Fauna recorded from the study area (Biosis 2012)

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 five kilometres of the study area.

Notes to table:

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

Table 7: Vertebrate fauna recorded from the study area (Biosis 2012)

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		<i>Alisterus scapularis</i>	Australian King-parrot		#
		<i>Cracticus tibicen</i>	Australian Magpie	#	
		<i>Corvus coronoides</i>	Australian Raven	#	#
		<i>Ceyx azureus</i>	Azure Kingfisher	#	
		<i>Elanus axillaris</i>	Black-shouldered Kite		#
		<i>Acanthiza pusilla</i>	Brown Thornbill	#	
		<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	#	#
		<i>Sturnus tristis</i>	Common Myna *	#	#
		<i>Ocyphaps lophotes</i>	Crested Pigeon	#	#
		<i>Platycercus elegans</i>	Crimson Rosella		#
		<i>Eudynamys orientalis</i>	Eastern Koel	#	
		<i>Platycercus eximius</i>	Eastern Rosella		#
		<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	#	
		<i>Psophodes olivaceus</i>	Eastern Whipbird	#	
	V	<i>Petroica phoenicea</i>	Flame Robin		#
		<i>Eolophus roseicapillus</i>	Galah	#	#
		<i>Cracticus torquatus</i>	Grey Butcherbird	#	#
		<i>Rhipidura albiscapa</i>	Grey Fantail	#	#
		<i>Dacelo novaeguineae</i>	Laughing Kookaburra	#	#

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		<i>Grallina cyanoleuca</i>	Magpie-lark	#	#
		<i>Vanellus miles</i>	Masked Lapwing		#
		<i>Philemon corniculatus</i>	Noisy Friarbird		#
		<i>Manorina melanocephala</i>	Noisy Miner	#	#
		<i>Strepera graculina</i>	Pied Currawong		#
		<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		#
		<i>Anthochaera carunculata</i>	Red Wattlebird		#
		<i>Todiramphus sanctus</i>	Sacred Kingfisher		#
		<i>Zosterops lateralis</i>	Silvereye	#	
		<i>Pardalotus punctatus</i>	Spotted Pardalote		#
		<i>Streptopelia chinensis</i>	Spotted Turtle-Dove *	#	#
		<i>Pardalotus striatus</i>	Striated Pardalote		#
		<i>Acanthiza lineata</i>	Striated Thornbill	#	#
		<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	#	#
		<i>Malurus cyaneus</i>	Superb Fairy-wren	#	
		<i>Rhipidura leucophrys</i>	Willie Wagtail		#
		<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	#	
		<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	#	#
		<i>Felis catus</i>	Cat *		#
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat		#
		<i>Trichosurus vulpecula</i>	Common Brushtail Possum		#
	V	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		#
	V	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		#
		<i>Macropus giganteus</i>	Eastern Grey Kangaroo		#
		<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat		#
		<i>Vulpes vulpes</i>	Fox *		#
		<i>Mormopterus</i> sp. 2	Freetail Bat		#
VU	V	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox		#
		<i>Equus caballus</i>	Horse *	#	#
		<i>Vespadelus darlingtoni</i>	Large Forest Bat		#
		<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		#

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
	V	<i>Miniopterus australis</i>	Little Bentwing-bat		#
		<i>Vespadelus vulturnus</i>	Little Forest Bat		#
		<i>Oryctolagus cuniculus</i>	Rabbit *	#	#
		<i>Wallabia bicolor</i>	Swamp Wallaby	#	
		<i>Tadarida australis</i>	White-striped Freetail-bat		#
		<i>Litoria dentata</i>	Bleating Tree Frog		#
		<i>Crinia signifera</i>	Common Eastern Froglet		#
		<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	#	
		<i>Amphibolurus muricatus</i>	Jacky Lizard		#

A2.1 Threatened 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 NSW BioNet Wildlife Atlas, BirdLife Australia data search and the Protected Matters Search Tool (DoE; accessed on 15/07/2015).

Notes to table:

#	species predicted to occur by the DoE 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
2015	recorded during current survey

Likelihood of occurrence	Potential criteria
High	<ul style="list-style-type: none"> Species recorded in study area during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). Study area is within species natural distributional range (if known). Species has been recorded within <five or ten kilometres> or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial species within five kilometres of the study area 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	<ul style="list-style-type: none"> No records within five kilometres of the study area 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	<ul style="list-style-type: none"> Habitat not present in study area Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 8: Threatened fauna species recorded, or predicted to occur, within five kilometres of the study area (Biosis 2017b)

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Birds							
<i>Botaurus poiciloptilus</i>	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 <i>Typha</i> spp. and <i>Eleocharis</i> 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.
<i>Rostratula australis</i>	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 permanent, although they have been recorded in brackish waters.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Ninox connivens</i>	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, Woodland, swamp Woodland 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.
<i>Ixobrychus flavicollis</i>	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, Woodland, 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 constructed of reeds and sticks in branches overhanging the water.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Ephippiorhynchus asiaticus</i>	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.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	EN	E1	#	Negligible	Suitable habitat not present.	Found in coastal Woodland, dense scrub and heathlands, particularly where it borders taller Woodland.
<i>Sternula nereis nereis</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Petroica phoenicea</i>	Flame Robin		V	2011	Recorded	This species was recorded by ELA (2011) along the northern boundary of the site. Unlikely to be resident.	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 Woodland, whilst in winter prefers open Woodland and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.
<i>Stictonetta naevosa</i>	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.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V	##	Low	Ecological (2011a) predicted that this species may forage within the study area on occasion. Hollows unsuitable for roosting or breeding.	The Gang-gang Cockatoo occurs from Victoria to central, south and eastern NSW (Hunter region, Central Tablelands and south-west slopes). It favours old growth nesting and roosting, inhabiting mountain forests and mature wet sclerophyll forests in spring and summer, moving to lower altitudes and drier, more open eucalypt forests and Woodland (e.g. box-gum and box-ironbark assemblages) in autumn and winter. It occasionally occurs in sub-alpine Snow Gum Eucalyptus pauciflora woodland and temperate rainforests.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Calyptrorhynchus lathami</i>	Glossy Black-Cockatoo		V, E2	1999	Low	Although individuals may overfly the study area on occasion significant habitat features, including breeding habitat and foraging resources, not present	Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> 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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Neophema chrysogaster</i>	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 <i>Sarcocornia quinqueflora</i> Beaded Glasswort and <i>Sclerostegia arbuscula</i> 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.
<i>Erythroriorchis radiatus</i>	Red Goshawk	VU	E4A	#	Negligible	Suitable habitat not present.	Occur in forest and woodland habitat near permanent water. In NSW prefer <i>Melaleuca</i> swamp forest and open eucalypt woodland. Require greater than 20 m tall trees for nesting.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Anthochaera phrygia</i>	Regent Honeyeater	EN	E4A	#	Low	Whilst the species may forage within the study area on occasion it is considered vagrant in this area.	A semi-nomadic species occurring in temperate eucalypt Woodland 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: <i>E. microcarpa</i> , <i>E. punctata</i> , <i>E. polyanthemos</i> , <i>E. mollucana</i> , <i>Corymbia robusta</i> , <i>E. crebra</i> , <i>E. caleyi</i> , <i>C. maculata</i> , <i>E. mckieana</i> , <i>E. macrorhyncha</i> , <i>E. laevopinea</i> and <i>Angophora floribunda</i> . Nectar and fruit from the mistletoes <i>A. miquelii</i> , <i>A. pendula</i> , <i>A. cambagei</i> 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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Lathamus discolor</i>	Swift Parrot	EN	E1	#	Low	Whilst the species may forage within the study area on occasion it is considered vagrant in this area.	The Swift Parrot occurs in Woodland 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 <i>E. robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V	2009	Low	Study area largely lacks rough-barked eucalypt species which provide foraging habitat. Disturbance further makes the study area unsuitable.	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and Woodland, 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 Woodland, 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							
<i>Hoplocephalus bungaroides</i>	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.
Amphibians							

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Mixophyes iteratus</i>	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.
<i>Heleioporus australiacus</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Litoria aurea</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Litoria littlejohni</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Mixophyes balbus</i>	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							
<i>Petrogale penicillata</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		V	2015	Recorded	This species was recorded by Ecological (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.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		V	2015	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. Hollow bearing trees which may provide roosting habitat for the species also occur within the study area.	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 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.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat		V	2015	Moderate	Species is likely to forage within the study area. Species may also roost within tree hollows within the study area.	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat		V	2015	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 forage within the study area on occasion. Hollow bearing trees which may provide roosting habitat for the species also occur within the study area.	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.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	#	Recorded	This species was recorded by Ecological (2011a) 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, Woodland, melaleuca swamps and banksia Woodland. 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.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Phascolarctos cinereus</i> (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 <i>E. robusta</i> , <i>E. tereticornis</i> , <i>E. punctata</i> , <i>E. haemostoma</i> and <i>E. signata</i> . 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.
<i>Chalinolobus dwyeri</i>	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 Woodland, but also found in rainforest fringes and subalpine Woodland. 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.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Miniopterus australis</i>	Little Bentwing-bat		V	2011	Recorded	This species was recorded by Ecological (2011a) within the study area.	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 canopy of densely vegetated habitats.
<i>Potorous tridactylus tridactylus</i>	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, but 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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	VU		#	Negligible	Has not been recorded within 5 kilometres of the study area. Suitable habitat is 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 Woodland 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.
<i>Pseudomys fumeus</i>	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	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Isoodon obesulus obesulus</i>	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.
<i>Dasyurus maculatus</i>	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 corridor 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 Woodland, 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.

* - habitat descriptions have been adapted by qualified ecologists from the DoE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Migratory species (EPBC Act listed)

Includes records from the following sources:

- DEE database (accessed on 26/03/2018)
- BirdLife Australia data search

Table 9 Migratory fauna species recorded or predicted to occur within 5 kilometres of the study area

Scientific Name	Common Name	Most recent record
<i>Actitis hypoleucos</i>	Common Sandpiper	#
<i>Anthochaera phrygia</i>	Regent Honeyeater	#
<i>Apus pacificus</i>	Fork-tailed Swift	#
<i>Ardea ibis</i>	Cattle Egret	2015/#
<i>Ardea modesta</i>	Eastern Great Egret	2014/#
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	2007
<i>Calidris canutus</i>	Red Knot	#
<i>Calidris ferruginea</i>	Curlew Sandpiper	
<i>Calidris melanotos</i>	Pectoral Sandpiper	2007
<i>Calidris ruficollis</i>	Red-necked Stint	2014
<i>Cuculus optatus</i>	Oriental Cuckoo	#
<i>Chalcophaps indica</i>	Emerald Dove	2000
<i>Danaus plexippus</i>	Monarch Butterfly	2009
<i>Gallinago hardwickii</i>	Latham's Snipe	2011/#
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	2014/#
<i>Hirundapus caudacutus</i>	White-throated Needletail	2010/#
<i>Hydroprogne caspia</i>	Caspian Tern	2012
<i>Lamna nasus</i>	Porbeagle, mackerel shark	#

Scientific Name	Common Name	Most recent record
<i>Limosa lapponica</i>	Bar-tailed Godwit	2011
<i>Merops ornatus</i>	Rainbow Bee-eater	#
<i>Monarcha melanopsis</i>	Black-faced Monarch	2013/#
<i>Motacilla flava</i>	Yellow Wagtail	#
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	#
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	#
<i>Numenius madagascariensis</i>	Eastern Curlew	2002
<i>Pandion haliaetus</i>	Osprey	2014/#
<i>Plegadis falcinellus</i>	Glossy Ibis	1985
<i>Pluvialis fulva</i>	Pacific Golden Plover	1999
<i>Rhipidura rufifrons</i>	Rufous Fantail	2012/#
<i>Rostratula australis</i>	Australian Painted Snipe	2011/#
<i>Symposiachrus trivirgatus</i>	Spectacled Monarch	#
<i>Tringa nebularia</i>	Common Greenshank	2011
<i>Tringa stagnatilis</i>	Marsh Sandpiper	1987

* - habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile for listed migratory species, references within the above table are provided within the report reference list

Appendix 2: BBAM Quadrat / Transect Data

BBAM quadrat / transect data collected by Biosis is 2012 which informed the report: *Lot 101 DP 785139 Crest Road, Albion Park: Flora and Fauna Assessment* completed in 2017 (Biosis, 2017a) is provided in Table 11 below.

Table 10: 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 3: Flora plot data including a comparison against EPBC listing diagnostic criteria

BBAM flora plot data collected by Biosis is 2012 as part of the report: *Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment* (Biosis, 2012) is provided in Table 12 below.

A 1 Flora species recorded from the study area

Notes to tables:

EPBC Act: CR - Critically Endangered EN - Endangered VU - Vulnerable	TSC Act: 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)
General status: # - Native species outside natural range * - Exotic (not native to Australia)	
Modified Braun Blanquet Cover Abundance	
1 <5% - 3 or less individuals	
2 <5% - more than 3 sparsely scattered	
3 <5% - common throughout plot	
4 5% - 25%	
5 25% - 50%	
6 50% - 75%	
7 75% - 100%	

Table 11: Flora species recorded from the study area (Biosis 2012)

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Fabaceae - Mimosoideae	<i>Acacia binervata</i>	Two-veined Hickory					1	
	Fabaceae - Mimosoideae	<i>Acacia fimbriata</i>	Fringed Wattle						
	Fabaceae - Mimosoideae	<i>Acacia implexa</i>	Hickory Wattle						
	Fabaceae - Mimosoideae	<i>Acacia maidenii</i>	Maiden's Wattle	1					
	Fabaceae - Mimosoideae	<i>Acacia mearnsii</i>	Black Wattle						
	Fabaceae - Mimosoideae	<i>Acacia parramattensis</i>	Sydney Green Wattle						
*	Fabaceae - Mimosoideae	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle						
	Fabaceae - Mimosoideae	<i>Acacia saliciformis</i>							
*	Polygonaceae	<i>Acetosella vulgaris</i>	Sorrel						
	Myrtaceae	<i>Acmena smithii</i>	Lilly Pilly						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Sapindaceae	<i>Alectryon subcinereus</i>	Native Quince						
	Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash			1			
	Loranthaceae	<i>Amyema pendulum</i> ssp.							
*	Primulaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	2					
	Commelinaceae	<i>Aneilema acuminatum</i>							
	Aphanopetalaceae	<i>Aphanopetalum resinosum</i>	Gum Vine				1		
*	Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	1					
*	Asparagaceae	<i>Asparagus aethiopicus</i>	Asparagus Fern	1	1				
*	Asparagaceae	<i>Asparagus asparagoides</i>	Bridal Creeper		1				
	Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass						
*	Asteraceae	<i>Bidens pilosa</i>	Cobblers Pegs						
	Poaceae	<i>Bothriochloa macra</i>	Red Grass						
	Sterculiaceae	<i>Brachychiton populneus</i>	Kurrajong						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush		1			1	
*	Poaceae	<i>Briza subaristata</i>							
*	Poaceae	<i>Bromus catharticus</i>	Praire Grass	3				3	2
	Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush						
	Cyperaceae	<i>Carex inversa</i>							
	Cyperaceae	<i>Carex longebrachiata</i>							
	Vitaceae	<i>Cayratia clematidea</i>	Native Grape		1				
	Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	1					
*	Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	1				2	
	Chenopodiaceae	<i>Chenopodium pumilio</i>	Small Crumbweed						
*	Poaceae	<i>Chloris gayana</i>	Rhodes Grass				2		
*	Anthericaceae	<i>Chlorophytum comosum</i>	Spider Plant						
	Vitaceae	<i>Cissus hypoglauca</i>	Water Vine		2				
	Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum	1	1				
	Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed	2	2	2	2	3	
*	Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	3					
*	Crassulaceae	<i>Crassula multicava</i>							
	Cyatheaceae	<i>Cyathea australis</i>	Black Tree-fern						
	Rubiaceae	<i>Cyclophyllum longipetalum</i>	Coast Canthium						
EN, E1	Apocynaceae	<i>Cynanchum elegans</i>							
	Poaceae	<i>Cynodon dactylon</i>	Couch						3
	Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	4				4	4
	Cyperaceae	<i>Cyperus imbecillis</i>							
*	Cyperaceae	<i>Cyperus</i> sp.		1					
*	Asteraceae	<i>Delairea odorata</i>	Cape Ivy		3	3	2		
	Fabaceae - Faboideae	<i>Desmodium varians</i>	Slender Tick-trefoil	2				2	

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Phormiaceae	<i>Dianella revoluta</i> ssp. <i>revoluta</i>	Blueberry Lily						
	Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass						
	Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	3	2			2	
*	Poaceae	<i>Digitaria sanguinalis</i>	Summer Grass	2					
	Sapindaceae	<i>Dodonaea viscosa</i> ssp. <i>angustifolia</i>	Sticky Hop-bush		1		1		
*	Poaceae	<i>Echinochloa crus-galli</i>	Barnyard Grass						
	Poaceae	<i>Echinopogon caespitosus</i> var <i>caespitosus</i>	Tufted Hedgehog-grass						
	Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass						
*	Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	1	2	2	2		
	Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	2				1	
	Chenopodiaceae	<i>Einadia trigonos</i> ssp <i>trigonos</i>	Fishweed	3				3	
	Celastraceae	<i>Elaeodendron australe</i>							

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Poaceae	<i>Entolasia marginata</i>	Bordered Panic						
	Poaceae	<i>Entolasia stricta</i>	Wiry Panic						
	Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass						
	Myrtaceae	<i>Eucalyptus amplifolia</i> <i>ssp amplifolia</i>	Cabbage Gum						
	Myrtaceae	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark	1			2	1	
	Myrtaceae	<i>Eucalyptus</i> <i>quadrangulata</i>	White-topped Box						
	Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	1	1	3	3	4	1
	Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed						
	Asteraceae	<i>Euchiton sphaericus</i>							
*	Euphorbiaceae	<i>Euphorbia peplus</i>	Petty Spurge						
	Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry		2		2		
	Santalaceae	<i>Exocarpos</i> <i>cupressiformis</i>	Cherry Ballart						
	Moraceae	<i>Ficus macrophylla</i>	Moreton Bay Fig						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Fumariaceae	<i>Fumaria bastardii</i>	Bastards Fumitory						
	Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge		1				
*	Asteraceae	<i>Gamochaeta americana</i>	Cudweed	2					3
*	Asteraceae	<i>Gamochaeta</i> sp.							
	Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	1	2	2	2		
	Geraniaceae	<i>Geranium homeanum</i>	Native Geranium						
	Geraniaceae	<i>Geranium solanderi</i> ssp <i>solanderi</i>	Native Geranium						
	Poaceae	<i>Glyceria</i> sp.							
	Fabaceae - Faboideae	<i>Glycine clandestina</i>			2			2	
	Fabaceae - Faboideae	<i>Glycine microphylla</i>	Small-leaf glycine						
	Fabaceae - Faboideae	<i>Glycine tabacina</i>		2					2
*	Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Fabaceae - Faboideae	<i>Hardenbergia violacea</i>	Purple Coral Pea						
	Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower						
	Malvaceae	<i>Hibiscus heterophyllus</i> <i>ssp heterophyllus</i>	Native Rosella						
	Clusiaceae	<i>Hypericum japonicum</i>							
*	Asteraceae	<i>Hypochaeris radicata</i>	Catsear					2	
*	Asteraceae	<i>Hypochaeris</i> sp.	White Flatweed						
	Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Golden Weather- grass						
*	Balsaminaceae	<i>Impatiens walleriana</i>							
	Fabaceae - Faboideae	<i>Indigofera australis</i>	Australian Indigo						
	Poaceae	<i>Joycea pallida</i>	Silvertop Wallaby Grass						
	Juncaceae	<i>Juncus usitatus</i>	Common Rush						
	Fabaceae - Faboideae	<i>Kennedia rubicunda</i>	Dusky Coral Pea						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Verbenaceae	<i>Lantana camara</i>	Lantana		7	7	7		
	Menispermaceae	<i>Legnephora moorei</i>	Round-leaf Vine						
*	Brassicaceae	<i>Lepidium</i> sp.		2				2	
	Ericaceae - Styphelioideae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath						
*	Oleaceae	<i>Ligustrum lucidum</i>	Large Leaved Privet						
	Arecaceae	<i>Livistona australis</i>	Cabbage Fan-palm						
*	Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass						
	Moraceae	<i>Maclura cochinchinensis</i>	Cockspur Thorn		1		1		
	Apocynaceae	<i>Marsdenia rostrata</i>	Milk Vine				1		
*	Fabaceae - Faboideae	<i>Medicago lupulina</i>	Black Medic	1					
	Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree						
	Meliaceae	<i>Melia azedarach</i>	White Cedar						
	Violaceae	<i>Melicytus dentatus</i>	Tree Violet						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Poaceae	<i>Microlaena stipoides</i> var <i>stipoides</i>	Weeping Grass	3				6	4
*	Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	3				3	3
	Myrsinaceae	<i>Myrsine variabilis</i>		1	2				
	Oleaceae	<i>Notelaea ovata</i>							
	Oleaceae	<i>Notelaea venosa</i>	Veined Mock-olive						
	Asteraceae	<i>Olearia viscidula</i>	Wallaby Weed						
	Poaceae	<i>Oplismenus aemulus</i>	Oplismenus	2					
	Poaceae	<i>Oplismenus imbecillis</i>	Oplismenus		3				
*	Oxalidaceae	<i>Oxalis corniculata</i>		2				2	2
	Oxalidaceae	<i>Oxalis exilis</i>							
	Oxalidaceae	<i>Oxalis perennans</i>							
	Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine		2		2		
*	Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort						
	Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod				1		

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Poaceae	<i>Paspalum dilatatum</i>	Paspalum						3
*	Passifloraceae	<i>Passiflora subpeltata</i>	White Passionflower		1		2		
*	Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass						3
*	Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed						
*	Pinaceae	<i>Pinus radiata</i>	Radiata Pine						
	Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn		1		1		
	Pittosporaceae	<i>Pittosporum revolutum</i>	Wild Yellow Jasmine						
	Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum						
*	Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	2				3	
	Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower						
	Poaceae	<i>Poa affinis</i>	Poa						2
	Poaceae	<i>Poa labillardierei</i>	Tussock Grass						
	Euphorbiaceae	<i>Poranthera microphylla</i>							
	Portulacaceae	<i>Portulaca oleracea</i>	Pigweed						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
	Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot						
	Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower	3	2		2		2
	Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry						
	Santalaceae	<i>Santalum obtusifolium</i>	Blunt Sandalwood						
*	Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	3				3	2
*	Fabaceae - Caesalpinioideae	<i>Senna pendula</i> var <i>glabrata</i>				1			
*	Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass						
*	Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	4				4	3
	Asteraceae	<i>Sigesbeckia orientalis</i> <i>ssp orientalis</i>							
*	Solanaceae	<i>Solanum linnaeanum</i>							
*	Solanaceae	<i>Solanum mauritianum</i>		1		1			
*	Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade						

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	2					
*	Poaceae	<i>Sporobolus africanus</i>	Parramatta Grass						
	Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass						
*	Caryophyllaceae	<i>Stellaria media</i>	Common Chickweed						
*	Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass						
	Moraceae	<i>Streblus brunonianus</i>	Whalebone Tree						
*	Asteraceae	<i>Tagetes minuta</i>	Stinking Roger						
*	Asteraceae	<i>Taraxacum officinale</i>	Dandelion					2	
*	Bignoniaceae	<i>Tecoma capensis</i>	Cape Honeysuckle						
	Poaceae	<i>Themeda australis</i>	Kangaroo Grass						
*	Commelinaceae	<i>Tradescantia fluminensis</i>	Wandering Jew						
*	Fabaceae - Faboideae	<i>Trifolium repens</i>	White Clover						
	Apocynaceae	<i>Tylophora barbata</i>	Bearded Tylophora		2		2		

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	2					
	Asteraceae	<i>Vernonia cinerea</i> ssp <i>cinerea</i>							
	Scrophulariaceae	<i>Veronica calycina</i>	Hairy Speedwell						
	Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell	1				1	
*	Poaceae	<i>Vulpia muralis</i>							
	Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell						
	Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell						
*	Asteraceae	<i>Xanthium occidentale</i>	Noogoora Burr						
	Asteraceae	<i>Xerochrysum bracteatum</i>	Golden Everlasting						
	Fabaceae - Faboideae	<i>Zornia dyctiocarpa</i>	Zornia						
Occurrence of <i>E.longifolia</i> or <i>E.tereticornis</i>				Y	Y	Y	Y	Y	Y
% native understorey (understorey vegetation cover includes vascular plant species of both the ground layer and the shrub layer (where present))				48	32	12	6	68	42

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
Condition (Biosis 2012)				Moderate / Good	Moderate / Good / Lantana	Moderate / Good / Lantana	Moderate / Good / Lantana	Moderate / Good	Low
Satisfies EPBC Act listed CEEC criteria*				Y - Moderate (D) condition	Y - Moderate (D) condition	Y - Moderate (D) condition	Y - Moderate (D) condition	Y - Moderate (D) condition	N

*The condition of each patch / vegetation zone, and assessment against the EPBC listing condition thresholds, was determined based on an assessment of the overall condition of the entire patch / vegetation zone during the field investigation by Biosis in 2012 (Biosis 2012).

The following table includes a list of the threatened flora species and ecological communities that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas and the Protected Matters Search Tool (DoE; accessed on 15/07/2015).

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
High	<ul style="list-style-type: none"> Species/ecological communities recorded in study area during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). Study area is within species natural distributional range (if known). Species has been recorded within five kilometres or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial biota within five kilometres of the study area 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	<ul style="list-style-type: none"> No records within five kilometres of the study area 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	<ul style="list-style-type: none"> Habitat not present in study area Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 12: Threatened flora species recorded / predicted to occur within five kilometres of the study area (Biosis 2017b)

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Boronia deanei</i>	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.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	VU	E1	#	Low	This species has not been recorded within 5 kilometres of the study area. Marginal habitat present (low quality & extent).	<i>Caladenia tessellata</i> 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	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Chorizema parviflorum</i>	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 <i>Eucalyptus tereticornis</i> and/or Woollybutt <i>E. longifolia</i> . At Austinmer, the species is recorded from a coastal headland.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	VU	V	#	Low	This species has not been recorded within 5 kilometres of the study area. 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 <i>E.sclerophylla</i> , <i>E. sieberi</i> , <i>Corymbia gummifera</i> and <i>Allocasuarina littoralis</i> ; appears to prefer open areas in the understorey of this community and is often found in association with the <i>Cryptostylus subulata</i> . 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	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Cynanchum elegans</i>	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. <i>Cynanchum elegans</i> usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; <i>Leptospermum laevigatum</i> , <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> ; <i>E. tereticornis</i> open forest and woodland; <i>E. maculata</i> open forest and woodland; and <i>Melaleuca armillaris</i> 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.
<i>Daphnandra johnsonii</i>	Illawarra Socketwood	EN		2001/#	Low	This species has been recorded within 5 kilometres of the study area. However, site surveys did not identify its presence or the presence of suitable habitat in the form of rocky	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	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
						hillsides in gullies/lowlands.	
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E	#	Low	This species has not been recorded within 5 kilometres of the study area. Habitat in the form of moss gardens on sandstone is not present within the study area.	This terrestrial orchid species grows in open sclerophyll forest or moss gardens on sandstone. Typically the habitat is a drier heathy forest. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites.
<i>Irenepharsus trypherus</i>	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 <i>Backhousia myrtifolia</i> thicket, and rainforest.

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	VU	V	#	Negligible	Habitat not present on site.	<p>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.</p> <p>Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.</p> <p>Flowering occurs over just 3-4 weeks in September and October.</p>

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	#	Low	This species has not been recorded within 5 kilometres of the study area. Marginal habitat present (low quality & extent).	<p>Once widespread on the Cumberland Plain, <i>Pimelea spicata</i> occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment.</p> <p>In the Illawarra region, <i>P. spicata</i> is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include <i>E. tereticornis</i>, <i>E. eugenoides</i>, <i>Themeda australis</i>, and <i>Lomandra longifolia</i>. In coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey.</p> <p><i>Pimelea spicata</i> flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for <i>P. spicata</i> vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.</p>

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	EN	E1	2007/#	Low	This species was recorded within 5 kilometres of the study area approximately 10 years ago. The level of ground disturbance and extent of current grazing practises on site limit the potential for this species to persist and recruit.	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 <i>Eucalyptus tereticornis</i> , <i>E. longifolia</i> and <i>Melaleuca decora</i> . Near Nowra, the species grows in an open forest of <i>Corymbia maculata</i> , <i>E.tereticornis</i> and <i>E. paniculata</i> . 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.
<i>Solanum celatum</i>			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	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Thesium australe</i>	Austral Toadflax	VU	V	#	Low	Has not been recorded within 5 kilometres of the study area. 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. <i>Thesium australe</i> 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 <i>Themeda australis</i> , but also found on other grass species at inland sites. Occurs on clay soils in grassy Woodland or coastal headlands.
<i>Zieria granulata</i>	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 <i>Melaleuca armillaris</i> scrub, <i>E. tereticornis</i> woodland and rainforest margins, although the species has been recorded from a number of other vegetation types

* - habitat descriptions have been adapted by qualified ecologists from the DoE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Appendix 4: VMP (Biosis 2017c)

Lot 101 DP 785139 Crest Road, Albion Park: Vegetation Management Plan

FINAL REPORT Version 3

Prepared for MMJ Real Estate on behalf of Spinitu Pty Ltd

13 April 2017

Biosis offices

AUSTRALIAN CAPITAL TERRITORY

Canberra

Floor 1, Unit 3, 38 Essington Street
Mitchell ACT 2911

Phone: (02) 6102 1200
Email: canberra@biosis.com.au

NEW SOUTH WALES

Newcastle

39 Platt Street
Waratah NSW 2298

Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney

Unit 14 17-27 Power Avenue
Alexandria NSW 2015

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

8 Tate Street
Wollongong NSW 2500

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

QUEENSLAND

Brisbane

Suite 4 First Floor, 72 Wickham Street
Fortitude Valley QLD 4006

Phone: (07) 3831 7400
Email: brisbane@biosis.com.au

VICTORIA

Ballarat

506 Macarthur Street
Ballarat VIC 3350

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne (Head Office)

38 Bertie Street
Port Melbourne VIC 3207

Phone: (03) 8686 4800
Fax: (03) 9646 9242
Email: melbourne@biosis.com.au

Wangaratta

16 Templeton Street
Wangaratta VIC 3677

Phone: (03) 5721 9453
Email: wangaratta@biosis.com.au

Document information

Report to: Spinitu Pty Ltd

Prepared by: Mathew Misdale

Biosis project no.: 18852

File name: 18852.Crest.Road.Albion.Park.VMP.FIN03.20170413

Citation: Biosis 2015. Lot 101 DP 785139 Crest Road, Albion Park: Vegetation Management Plan. Report for Martin Morris and Jones. Author: M Misdale, Biosis Pty Ltd, Wollongong. Project no. 18852

Document control

Version	Internal reviewer	Date issued
Draft version 01	Stefan Rose	30/11/15
Final version 01	Nathan Garvey	11/02/2016
Final version 02	Mathew Misdale	19/07/2016
Final version 03	Mathew Misdale	13/04/2017

Acknowledgements

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

- Spinitu Pty Ltd: Peter Robertson
- MMJ Real Estate: Luke Rollinson
- LandTeam: Dijana Harrison and Alex Gollan

Biosis staff involved in this project were:

- Lauren Harley and Ashleigh Pritchard (mapping)
- Stefan Rose for (quality assurance)

© Biosis Pty Ltd

This document is and shall remain the property of Biosis Pty Ltd. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

1.	Introduction	1
1.1	Project background	1
1.2	Scope of Vegetation Management Plan.....	1
1.3	Environmental Management Area	2
1.4	Proposed Works.....	2
2.	Methods	5
2.1	Flora and fauna assessment of the Environmental Management Area	5
2.2	Additional site investigation	5
2.3	Limitations.....	5
2.4	Legislation and policy	5
	2.4.1 State and federal legislation	5
	2.4.2 Regional biodiversity plans	5
2.5	Mapping.....	6
3.	Site Description	7
3.1	General.....	7
3.2	Landscape connectivity.....	7
3.3	Flora.....	7
	3.3.1 Native Vegetation of the Environmental Management Area	7
	3.3.2 Significant flora species and fauna habitat.....	8
	3.3.3 Hollow-bearing trees.....	8
	3.3.4 Noxious and Environmental Weeds	8
4.	Vegetation Management Plan	11
4.1	Vegetation management zones	11
	4.1.1 Management zone 1 - Inner APZ.....	11
	4.1.2 Management zone 2 - Outer APZ.....	11
	4.1.3 Management zone 3 - Retained native vegetation.....	12
4.2	Specific management directions or actions required	13
	4.2.1 Tree Protection	13
	4.2.2 Weed control	13
	4.2.3 Sheds, fences and general waste	17
	4.2.4 Revegetation.....	17
	4.2.5 Hollow offset - nest box installation.....	19
4.3	Monitoring.....	1
	4.3.1 Threatened Flora	1
	4.3.2 MZ1 - Inner APZ and MZ2 - Outer APZ.....	1
	4.3.3 MZ3 – Retained vegetation	2

4.3.4 Nest box monitoring	2
4.3.5 Revegetation.....	2
4.3.6 Erosion control.....	2
5. VMP program and works	4
References.....	5
Appendices.....	6
Appendix 1: Flora Species Inventory.....	7
Appendix 2: Revegetation List.....	16
Appendix 3: Hollow-bearing tree inventory	19

List of Figures

Figure 1 Location of the Environmental Management Area, Crest Road, Albion Park NSW.....	3
Figure 2 Environmental Management Area overview.....	4
Figure 3 Management zones of the Crest Road Environmental Management Area, Albion Park NSW (including vegetation management zones and ecological features).....	10

List of Tables

Table 1 Noxious and environmental weeds present and their control method.....	14
Table 2 Nest-box installation specifications	1
Table 3: Vegetation Management Plan by Zone and Task	1
Table 4: Flora species recorded from the Environmental Management Area and apprio	7
Table 5: Revegetation list and specifications for Environmental Management Area	16
Table 6 Hollow bearing trees recorded within the environmental management area.....	20

Glossary

APZ	Asset Protection Zone (Bushfire)
DBH	Diameter at Breast Height
DoE	Department of the Environment
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
HBT	Hollow Bearing Tree
KTP	Key Threatening Process
LEP	Local Environment Plan
NSW	New South Wales
NV Act	<i>Native Vegetation Act 2003</i>
NW Act	<i>Noxious Weed Act 1993</i>
OEH	NSW Office of Environment and Heritage
TSC Act	<i>Threatened Species Conservation Act 1995</i>
Council	Shellharbour City Council

1. Introduction

1.1 Project background

Biosis Pty Ltd has been engaged by MMJ Real Estate (MMJ) on behalf of Spinitu Pty Ltd, to prepare a Vegetation Management Plan (VMP) for Lot 101 DP 785139 Crest Road, Albion Park (Figure 1). As a part of the residential subdivision of land an area zoned 'E3 Environmental Management', under the Shellharbour City Council LEP (2013) will be retained as an 'Environmental Management Area' and managed for conservation purposes. This VMP addresses requirements for restoration and on-going management of the Environmental Management Area.

Under Section 20.2 of Shellharbour City Council DCP - Remnant vegetation and wetlands, the Environmental Management Area requires a VMP to include the following:

- Methods of weed removal and control – all exotic vegetation should be removed.
- Revegetation – include plant species, location, methods for planting, site preparation and site stabilisation.
- Site and vegetation maintenance requirements including the establishment phase and longer term requirements.
- Aquatic and semi-aquatic plant species including location and planting density.
- Staging and sequence details for revegetation and maintenance tasks.
- A monitoring and performance evaluation program and to include replacement species.

Additional to these requirements Council has requested nest boxes be installed within the Environmental Management Area at an offset of 1:1 for loss from the development site. The management requirements for nest boxes are detailed within this plan.

1.2 Scope of Vegetation Management Plan

The VMP addresses the management of vegetation, as per the requirements set out within the Shellharbour DCP for Environmental Land, for the Environmental Management Area shown in Figure 2. The objectives of the VMP are to:

- Provide a management plan to address the ecological values of the property and identify specific management actions for any flora or fauna habitat within retained Environmental Management Area.
- Identify vegetation management zones, as well as significant native flora species, fauna habitat and weed species present within the VMP's maps.
- Define native trees to be retained and provide measures to ensure the protection of retained trees, if required, during the construction phase of the project.
- Detail management objectives, actions and performance measures for each management zone.
- Provide nest box replacement details and management requirements.
- Provide a program of works with specific timeframes detailing actions required within each management zone and performance evaluation criteria.

- Provide specifications for the revegetation of areas where retained vegetation is in poor condition.
- Provide on-going weed management actions for five years to guide maintenance of primary restoration works and ensure the ecological values of native vegetation within the Environmental Management Area are maintained.
- Provide a brief monitoring program based on the objectives, actions and performance measures for each management zone.

1.3 Environmental Management Area

The Environmental Management Area site is located at Albion Park in the Shellharbour LGA (Figure 1) and encompasses a parcel of land approximately 2.71 hectares in area at Crest Rd, Albion Park. The Environmental Management Area is underlain by both the Bombo Soils Landscape and Albion Park Soils Landscape. The former is found in steeper areas of the Environmental Management Area, with the Albion Park Soils landscape occurring as the terrain flattens on the hill crest down to the southern and western boundaries of the site (Hazleton & Tille 1990). Erosion hazard for steeper slopes on Bombo soils landscapes is considered moderate to high for concentrated and non-concentrated flows is moderate to high (Hazleton & Tille 1990). The north-eastern section of the Environmental Management Area is located on steep slopes, sloping down towards the gully.

The Environmental Management Area falls within the:

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

1.4 Proposed Works

An Environmental Management Area will be created to the east of the proposed residential subdivision within the parcel of land, Lot 101 DP 785139 Crest Road, Albion Park. A building envelope is proposed to be created within the lot to which the Environmental Management Area (E3 zoning) will apply, and will be located along the eastern side of the proposed extension of Crest Road (Figure 2). The Environmental Management Area will include the establishment of both an Inner and Outer Bushfire Asset Protection Zone, in areas adjacent to the proposed housing subdivision, and within woodland areas to be retained (Figure 1).



Legend

- Study area
- Environmental management area
- Proposed subdivision**
 - Road
 - Proposed lot boundary
 - APZ
 - Development - APZ
 - Development - Building envelope
 - Development - Lots
 - Development - Roads

Figure 1: Location of the Environmental Management Area, Crest Road, Albion Park NSW

0 10 20 30 40 50
Metres

Scale: 1:1,800 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 18852
Date: 19 July 2016
Checked by: LH, Drawn by: NMG
Location: \\10.3.0.4\Matters\18800s\18852\Mapping\18852_VMP_F1_StudyArea



Legend

- StudyArea
- Environmental management - Retained Vegetation
- Environmental management - Inner APZ
- Environmental management - Outer APZ

Vegetation community

- Illawarra Lowlands Grassy Woodland - Disturbed
- Illawarra Lowlands Grassy Woodland - Weedy
- Scattered trees

Figure 2: Environmental Management Area overview

0 8.5 17 25.5 34 42.5
Metres

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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 18852
Date: 30 November 2015,
Checked by: LH, Drawn by: NMG
Location: P:\18800s\18852\Mapping\18852_VMP_F2_EMA

2. Methods

2.1 Flora and fauna assessment of the Environmental Management Area

Flora and fauna assessments that have previously been undertaken for the Environmental Management Area and include:

- *Flora and Fauna Assessment. Lot 1011 DP 785139 Crest Road, Albion Park* (ELA 2011).
- *Lot 101 DP 785139, Crest Rd, Albion Park: BioBanking Assessment* (Biosis 2012).

This information has been reviewed and updated within *Lot 101 DP 785139 Crest Road, Albion Park: Flora and Fauna Assessment* (Biosis 2015). Site assessment for significant flora and fauna within the Environmental Management Area is based on a review of all these documents.

A brief review of ecological features within the Environmental Management Area is included in Section 3.

2.2 Additional site investigation

The field survey was undertaken on 5 June 2015. The Environmental Management Area was traversed to assess the vegetation condition and compile an inventory of environmental and noxious weeds species. Notes were also recorded on general condition of the native vegetation observed. Photos were taken and the locations of significant weed infestations were recorded on a hand held GPS.

2.3 Limitations

Site investigations 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 and seasonal conditions. During site investigations conducted on 5 June 2015, it was observed that parts of the Environmental Management Area were being continuously grazed, which may not result in a full range of weed species with potential to require treatment following removal of grazing pressures. Similarly, in areas where a monoculture of woody weeds is present, the removal of these species may trigger the germination of stored seed banks of both weeds and native species.

2.4 Legislation and policy

2.4.1 State and federal legislation

The following key biodiversity legislation has been considered in the assessment of the values of the Environmental Management Area and management actions developed:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Noxious Weed Act 1993* (NW Act).

2.4.2 Regional biodiversity plans

The following regional biodiversity plans have been considered in the assessment of the values of the Environmental Management Area and management actions developed:

- *Illawarra Biodiversity Strategy. Volume 2 Background Information* (WCC et al 2011)
- *South East Catchment Action Plan 2013 – 2023* (South East LLS)

2.5 Mapping

Land Team Australia Pty Ltd provided a site concept plan showing proposed zonings, indicative lot and Asset Protection Zone (APZ) layout and roads. The Environmental Management Area 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 has been produced using a GIS including spatial data collected in the field and site information transposed from non-spatially referenced plans.

3. Site Description

3.1 General

Site inspection of the Environmental Management Area on 5 June 2015, recorded native vegetation in low to moderate condition variously affected by: historic land clearing; grazing by agisted horses; informal vehicle tracks; weed invasion; storage of general waste materials; erection of informal sheds; soil / waste stockpiling and herbivory by rabbits.

Native vegetation was recorded in the following general conditions within the study as:

- Lacking any significant vegetation in areas containing vehicle tracks, fenced paddock areas, and areas surrounding sheds.
- Open forest containing low, grazed groundcovers with a moderate proportion of native species.
- Closed and open forested canopies in steeper areas with a dense midstorey of woody weeds.

Vegetation has been previously mapped and ground-truthed as detailed within Section 2.1, and is briefly presented within Section 3.2. A more detailed description of vegetation at the site is included within Biosis (2015).

3.2 Landscape connectivity

The Environmental Management Area is at the northern extent of a continuous corridor of vegetation that winds its way south. At its most southern point the vegetation corridor is joined to the Tongarra - Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al 2011). The surrounding landscape has been modified as a result of agriculture (south) and residential development (north and east) adjacent to the Environmental Management Area.

On a local scale, the Environmental Management Area is within a dispersal corridor for more mobile species including avifauna and arboreal mammals.

3.3 Flora

3.3.1 Native Vegetation of the Environmental Management Area

Forest Red Gum - Thin-leaved Stringybark grassy woodland is supported within the Environmental Management Area, and is consistent with the final determination for Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion, which is listed as an Endangered Ecological Community pursuant to the *NSW Threatened Species Conservation Act 1995* (TSC Act).

The community supports a canopy of Forest Red Gum *Eucalyptus tereticornis* over both the flatter areas and north east slopes with Thin-leaved Stringybark *Eucalyptus eugenioides* also present. A very sparse midstorey of regenerating canopy species with occasional Hickory Wattle *Acacia implexa*, Maiden's Wattle *Acacia maidenii*, Red Ash *Alphitonia excelsa*, Sticky Hop-bush *Dodonaea viscosa ssp. angustifolia* and Muttonwood *Myrsine variabilis* occurs in these areas.

Shrub species are mostly absent from the understorey in the western portion, as a result of intensive grazing, whilst the understorey on the north east slopes is entirely dominated by Lantana *Lantana camara* with occasional native shrubs on the higher slopes.

The grazed groundcover supports a moderate diversity of native grasses and herbs including Scurvy Weed *Commelina cyanea*, Slender Flat-sedge *Cyperus gracilis*, Slender Tick-trefoil *Desmodium varians*, Kidney Weed *Dichondra repens*, Weeping Grass *Microlaena stipoides* var. *stipoides* and Basket Grass *Oplismenus imbecillis*. Groundcover species under Lantana thickets on the north east slopes are virtually absent. A sparse cover of native and exotic grasses, herbs and scramblers are present such as Asparagus Fern *Asparagus aethiopicus*, Indian Pennywort *Centella asiatica*, Scurvy Weed *Commelina cyanea*, Cape Ivy *Delairea odorata*, Panic Veldtgrass *Ehrharta erecta* and Wombat Berry *Eustrephus latifolius*.

3.3.2 Significant flora species and fauna habitat

The Environmental Management Area contains one endangered flora species, White Wax Flower *Cynanchum elegans*, which is listed as Endangered under both the *Environmental Protection & Biodiversity Conservation Act* 1999 (EPBC Act) and TSC Act. White-flower Wax Plant is present at two locations as shown in Figure 3.

Illawarra Zieria *Zieria granulata* is also listed as Endangered under both the EPBC Act and TSC Act. While not recorded within the Environmental Management Area, there is potential for this species to regenerate from stored soil seed banks following control of dense Lantana (DEC 2005a).

Hollow bearing trees (HBT's), mapped within Figure 3, are present within the Environmental Management Area. While hollows are generally small (between 5 cm and 20 cm), they provide roosting habitat for two threatened microbats Greater Broad-nosed Bat *Scoteanax rueppellii* and Eastern False Pipistrelle *Falsistrellus tasmaniensis*, which are listed under the NSW TSC Act and recorded by Eco Logical (2011) within the Crest Road development study area.

3.3.3 Hollow-bearing trees

Hollow-bearing trees recorded within the Environmental Management Area detailed in Appendix 3, Table 6. A total of 12 hollow-bearing trees were recorded and are shown on Figure 3. One tree was assessed as being unsuitable to provide habitat. The remaining 11 trees contained hollows suitable for fauna including:

- 8 hollows for roosting microbats.
- 4 hollows for breeding small parrot species.
- 5 hollows for breeding medium parrots or small possums.

Species expected to use these hollows have been included in Table 2.

3.3.4 Noxious and Environmental Weeds

Five declared noxious weeds listed under Noxious Weed (Control Order) 2014 for the Shellharbour LGA were recorded within the Environmental Management Area.

Two Class 4 noxious weeds were recorded that require 'the growth of the plant to be suppressed in a manner that continuously inhibits the ability of the plant to spread':

- Lantana
- Blackberry *Rubus fruticosus* aggregate species.

Three additional Class 4 weeds were recorded, including Blackberry require that 'the plant must not be knowingly distributed':

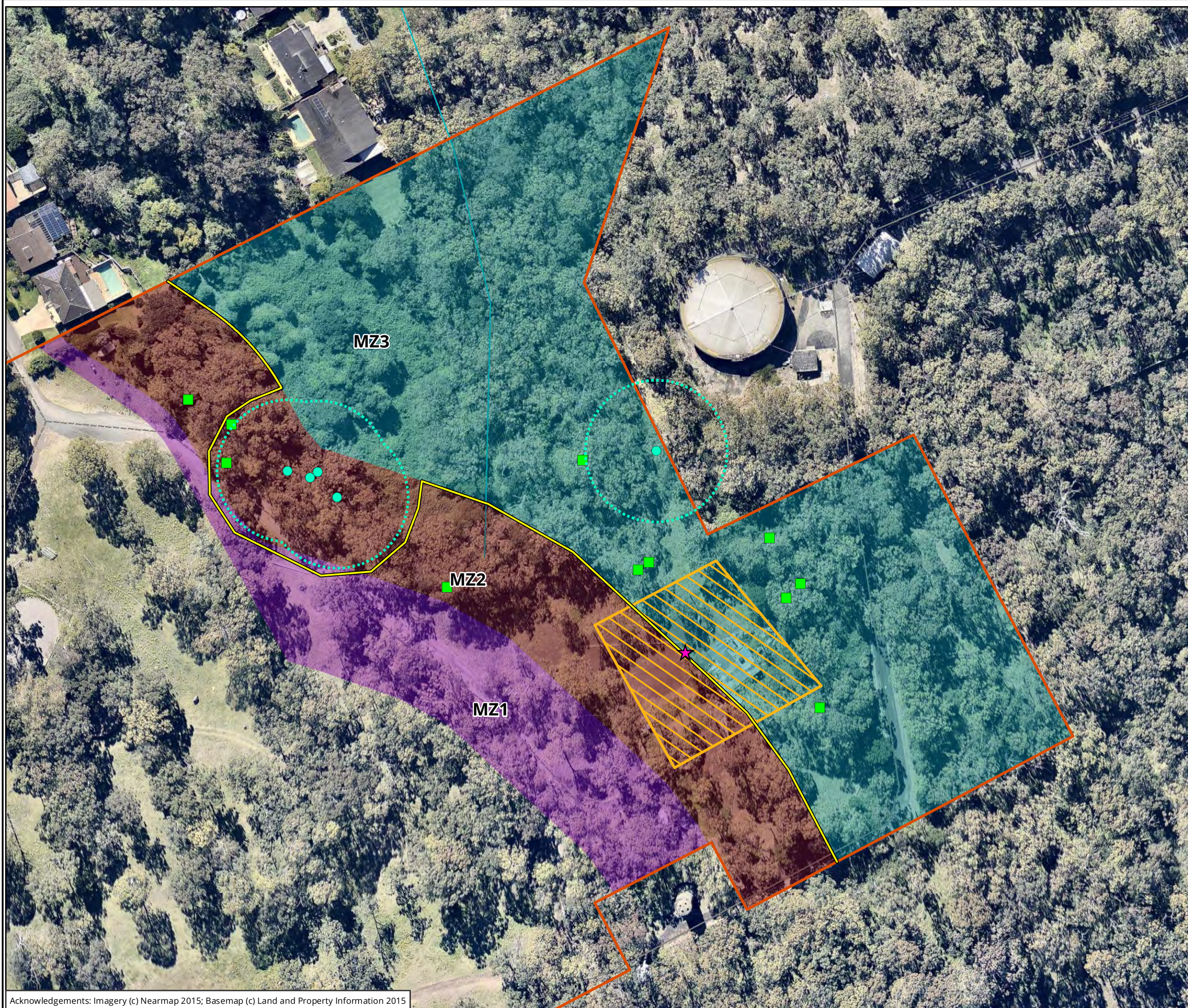
- Bridal Creeper *Asparagus asparagoides*
- Ground Asparagus *Asparagus aethiopicus*
- Fireweed *Senecio madagascariensis*

The Regional Weed Strategy (Southern Rivers CMA et al 2011) provides strategic guidance for weed control priorities within the Illawarra. This document provides priorities for the control of wide spread environmental weeds for locally occurring endangered ecological communities.

Priority weeds that have been identified as a threat to Illawarra lowlands grassy woodland and recorded within the Environmental Management Area include:

- Cape Ivy *Delairea odorata*
- Large Leaved Privet *Ligustrum lucidum*
- Moth Vine *Araujia sericifera*
- Madeira Vine *Anredera cordifolia*
- Rhodes Grass *Chloris gayana*
- Trad *Tradescantia fluminensis*

Methods for control of noxious and environmental weeds are included in the Section 4.2.2.



Legend

- Study area
- Cynanchum elegans*
- Cynanchum elegans* 20m buffer
- Hollow-bearing tree
- Targeted weed removal (Madeira Vine waste pile)
- EMA fenceline
- Low condition - Revegetation area
- Environmental management - Retained Vegetation
- Environmental management - Inner APZ
- Environmental management - Outer APZ

Figure 3: Management zones of the Crest Road Environmental Management Area, Albion Park NSW (including vegetation management zones and ecological features)

0 8 16 24 32 40
Metres

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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 18852
Date: 13 April 2017,
Checked by: LH, Drawn by: NMG
Location: P:\18800s\18852\Mapping\
18852_VMP_F3_ManagementZones_20170413

4. Vegetation Management Plan

4.1 Vegetation management zones

The property has been divided into three management zones (MZ) according to the differing management objectives across the property (Figure 3).

Vegetation management within the Environmental Management Area will include management of APZ's for bushfire protection and ecological outcomes.

The APZ's will require vegetation thinning and management of shrubs and ground fuel levels specific to the Inner (MZ1) and Outer (MZ2) APZ zonings, as detailed within Section 4.1.1 and Section 4.1.2. MZ3 is detailed within Section 4.1.3 and managed solely for ecological outcomes.

Revegetation will be required within the Environmental Management Area, where shown in Figure 3. These areas in MZ2 and MZ3 have been subject to intensive agistment impacts and demonstrate a low capacity to regenerate without further intervention. Revegetation specifications that are appropriate for MZ2 for APZ's and MZ3 are provided below in Section 4.2.

Table 3 provides the management zones, objectives for each zone with regard to vegetation management and actions required to achieve the objectives for each zone. Performance measures are also given against the management actions and can be used for monitoring the outcomes of the VMP.

Weed control methods are outlined in Table 1.

4.1.1 Management zone 1 - Inner APZ

Management zone 1 (MZ1 – Inner APZ) is located closest to the proposed Crest Road subdivision. It is located on gently sloping land that is currently grazed. The vegetation is characterised by a tall open native canopy, with sparse midstorey and supporting moderately diverse, closely grazed native and exotic groundcover. Grazing has preserved a moderate diversity of native groundcovers, and also resulted in suppression of most weeds, except those unpalatable to the animals present. This zone will be managed as the "Inner APZ".

This area will be managed to the following specification:

- Canopy to be reduced via tree removal, if required, and maintained to maximum canopy coverage of 15%.
- Lower branches of retained trees to be removed to a height of 2m and should not form a direct canopy linkage.
- Hollow bearing trees will be retained.
- Removal of all fine fuels annually and maintenance of a low and green groundcover.
- Control of noxious and environmental weeds as detailed within Table 1.

Trees removed from MZ1 will be re-used in MZ3 to provide fauna habitat.

Specific management actions and monitoring are detailed within Section 4.2 and Section 4.3, respectively.

4.1.2 Management zone 2 - Outer APZ

Management Zone 2 (MZ2 – Outer APZ) is located east of MZ1 and includes:

- Areas of tall open canopy lacking significant midstorey as described for MZ1.

- Paddock areas that have been subject to intensive grazing.
- Informal structures.
- Other intensive agistment impacts and materials.

This area requires the removal of informal structures, agistment materials, general waste, and stockpiled organic wastes / soils. This zone will be managed as the "Outer APZ".

This area will be managed to the following specification:

- Canopy to be reduced through removal of trees, if required, and maintained to maximum canopy coverage of 30%.
- Lower branches of retained trees to be removed to a height of 2m and should not form a direct canopy linkage.
- Hollow bearing trees will be retained.
- Removal of all fine fuels annually and maintenance of a shrub cover of less than 20 per cent of the area.
- Control of noxious and environmental weeds as detailed within Table 1.

HBTs are to be retained as a priority within MZ2. Trees that are removed from MZ2 will be re-used in MZ3 to supplement fauna habitat. Trees requiring removal from steep slopes will be undertaken by arborists and stumps retained to retain slope stability. Areas where Lantana has been removed and groundcover is not present on steep slopes will require erosion protection using 'jute mesh' pegged at 1.5 metre spacing. These areas should be monitored for natural seedling regeneration after three months. If limited regeneration is occurring, revegetation as per Section 4.2.4 is to be undertaken.

Revegetation is required for the low condition area in MZ2 shown in Figure 3. Specifications are detailed within Section 4.2.3 with other management actions and monitoring detailed within Section 4.2.

4.1.3 Management zone 3 - Retained native vegetation

Management Zone 3 (MZ3 – Retained Native Vegetation) is located east of MZ2. Similar to MZ2, it contains mostly dense Lantana within the understorey of the steeper slopes and gully. MZ3 also contains areas in low condition that have resulted from intensive horse agistment, as described for MZ2. The endangered White-flowered Wax Plant is present in two locations (seven plants) and management of these locations will require adherence to specific control methods detailed in Section 4.2.2.

The key approaches for ecological restoration and management of MZ3, were developed using DEC (2005b), and generally follow the restoration approaches below:

- Retain – Retain remnant indigenous vegetation. Conserving existing native vegetation should be the highest priority.
- Regenerate – where bushland remains but is degraded, regeneration should be the primary objective.
- Revegetate – where there is no regeneration potential, revegetation is then an option.

Applying this approach, the focus should be weed control to assist natural regeneration of native plants within MZ3. Undertaking revegetation is required to improve vegetation condition where there is little potential for short term natural regeneration. The low condition area is shown in Figure 3.

MZ3 will also require fencing from the areas managed as APZ's, with fencing modified as per Figure 3, to protect endangered plants from APZ maintenance works. Further specific management for weed control requirements are detailed below within Section 4.2.

4.2 Specific management directions or actions required

4.2.1 Tree Protection

Hollow bearing trees are to be retained within APZ areas and the Environmental Management area as they provide roosting habitat to threatened microbats (Section 3.3.2).

HBTs and other retained trees are also to be protected from root or trunk damage by limiting access within the drip line of heavy plant during the removal of waste materials and informal structures that are left over from the agistment of horses.

The requirements for the tree protection zones are:

- The boundaries of the tree protection zones should correspond with the canopy spread for each tree.
- Temporary fencing is to be installed around retained trees within MZ3, where structures and waste are to be removed to protect trees from indirect impacts during the construction phase of the project. Fencing should be installed prior to construction works and be maintained throughout the construction phase of the project.
- No equipment, materials or fill are to be stored within tree protection zones.
- No fuel, paints or other chemicals are to be stored within tree protection zones.
- No excavation is to occur within tree protection zones.

4.2.2 Weed control

Table 1 details the weeds present within the property and the general methods for control. The control methods detailed below have been selected from methods detailed in *Noxious and Environmental Weed Control Handbook* (DPI 2011) as the most appropriate treatment for the scale of infestations within the property.

Primary weed control within MZ3 is to be undertaken by a suitable qualified bush regeneration contractor with previous experience undertaking woody weed control within areas containing White-flowered Wax Plant.

Mechanical methods will be restricted to slashing implements using tritter / slashing attachments or similar, as removal of weed cover may increase the risk of erosion (Section 1.3). Cut Lantana canes and other woody weed materials are also to be retained as mulch within MZ3 to reduce the potential for erosion on steep slopes. If areas are lacking in retained mulch cover, installation of 'jute mesh' must be undertaken and pegged at 1.5 m spacing.

White-flowered Wax Plant locations

Areas containing White-flowered Wax-plant that occur within the MZ3 and OPZ will require additional safeguards to protect the plants during weed control and annual fuel reduction tasks. The additional controls include:

- Initial clearing within the fenced-off area be undertaken by a qualified bush regenerator sufficiently experienced at working with the species.
- **All primary weed control within a 20 metre buffer of White-flowered Wax Plant** is to be restricted to manual cut and paint methodologies.

- **No herbicide application by spot spray** within ten metre buffers of known locations will be allowed, due to White-flowered Wax Plant's capacity to sucker at extended distances from the parent plant.
- The known White-flowered Wax-plant locations will be identified and buffer areas marked out prior to starting primary weed control.
- **Mechanical slashing cannot be used to control Lantana within 20 metres of any known location of White-flowered Wax Plant.** This is because there is a high likelihood that unrecorded White-flowered Wax Plant could be growing within areas of Lantana, and has the potential to be established within more open areas.
- Guidance of the mechanical plant operator is to be provided by a suitably qualified ecologist or bush regenerator, skilled in the identification of White-flowered Wax Plant, during trittering. If additional plants are identified during weed control activities, then these areas will be recorded, and control undertaken as per the specification detailed above.

The management of vegetation within the M3 portion of the OPZ will also require the following additional controls:

- Buffer fencing 20 m from White-flowered Wax-plant locations to protect the plant damage during OPZ management.
- All trees or shrubs supporting White-flowered Wax-plant individuals are to be retained within the OPZ as a component of the 20% unmanaged vegetation cover allowable within midstorey and groundcover strata of an OPA.
- All vegetation control activities within the fenced-off area will be undertaken manually, and any trees that require removal will be sectioned and lowered in a way to avoid any damage to individual stems or the adjacent supporting vegetation.

Table 1 Noxious and environmental weeds present and their control method

Scientific name	Common name	Control method
Woody Weeds		
<i>Lantana camara</i> **	Lantana	Tritter or slashing control outside of White-flowered Wax Plant buffers, with guidance by a qualified ecologist or bush regenerator with experience identifying this species. Cut and paint method within 5m White flowered Wax Plant buffers – Cut woody weeds at the base as close as possible to the ground and paint the freshly cut stem with concentrated Glyphosate based herbicide. This is best done using a poison applicator bottle.
<i>Chenopodium album</i>	Fat Hen	
<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	
<i>Ligustrum lucidum</i> **	Large-leaved Privet	
<i>Senna pendula var glabrata</i>		
<i>Sida rhombifolia</i>	Paddy's Lucerne	
<i>Tagetes minuta</i>	Stinking Roger	
<i>Xanthium occidentale</i>	Noogoora Burr	Spot spray using appropriate herbicide by suitably qualified contractor outside of 5m White flowered Wax Plant buffers.
Perennials/ Scrambling Weeds		
<i>Asparagus aethiopicus</i> **	Asparagus Fern	Individual plants/ small numbers:
<i>Asparagus asparagoides</i> **	Bridal Creeper	Manual removal - Any fruits present on plants

Scientific name	Common name	Control method
		<p>need to be removed prior to manual removal or spraying. For manual removal, the woody rhizome of each plant must be removed. This can be done using a knife for small plants or a mattock for large specimens.</p> <p>Rhizomes and fruit must be removed and disposed of appropriately. Water tubers are not propagules and do not require removal.</p> <p>Spot spray - Larger infestations can be sprayed by a suitable qualified contractor with a diluted Metsulfuron-methyl based herbicide.</p>
<i>Chlorophytum comosum</i>	Spider Plant	Manual removal - Remove rhizome and dispose of appropriately.
<i>Crassula multicava</i>		<p>Manual removal - Remove plant and dispose of appropriately.</p> <p>Spot Spray - Qualified contractor can spraying using appropriate herbicide such as Starane.</p> <p>Further maintenance weeding is likely to be required.</p>
<i>Tradescantia fluminensis</i> **	Trad	<p>Manual removal - Use a rake for larger infestations. Hand weed smaller infestations and for secondary required following raking. Must remove all part of the plant. Secondary weeding and further maintenance weeding is required to eradicate the infestation.</p> <p>Spot Spray - Qualified contractor can spraying using appropriate herbicide such as Starane.</p> <p>Further maintenance weeding is likely to be required.</p>
Annual and Grass Weeds		
<i>Chloris gayana</i> **	Rhodes Grass	<p>Small areas or numbers:</p> <p>Manual removal - Any seed heads present on plants need to be removed, taken offsite and disposed of appropriately. Plants can be manually removed by hand or cutting roots below crown.</p> <p>Large areas or numbers:</p> <p>Spot spray - Plants can also be sprayed with diluted Glyphosate based herbicide.</p>
<i>Echinochloa crus-galli</i>	Barnyard Grass	
<i>Ehrharta erecta</i>	Panic Veldt Grass	
<i>Paspalum dilatatum</i>	Paspalum	
<i>Setaria parviflora</i>	Pigeon Grass	
<i>Sporobolus africanus</i>	Parramatta Grass	
<i>Vulpia muralis</i>		
<i>Bidens pilosa</i>	Cobblers Pegs	
<i>Conyza sp</i>	Fleabane	
<i>Senecio madagascariensis</i> **	Fire weed	

Scientific name	Common name	Control method
Vines		
<i>Anredera coordiifolia</i> **	Madeira Vine	<p>Remove plants parts, as far as practicable, with identified soil stockpile, do not spread across Environmental Management Area. Dispose of this material to a registered waste disposal facility.</p> <p>Follow-up control: Manual removal of tubers with small mattock or trowel. Spot spray – Qualified contractors can spray with diluted Glyphosate or Starane based herbicide.</p> <p>Repeated follow up treatment will be required to eradicate infestation.</p>
<i>Delairea odorata</i> **	Cape Ivy	<p>Remove manually, roll and hang to dry and desiccate.</p> <p>During autumn and winter flowering times, remove plant and dispose of at a registered waste disposal facility.</p> <p>Spot spray – Qualified contractors can spray with diluted Glyphosate or Starane based herbicide.</p>
<i>Araujia sericifera</i> **	Moth Vine	<p>Mature vines: Stem scrape method – Scrape bark from stem from approximately 30 cm along stem to ground level. Apply concentrated Glyphosate based herbicide to the freshly scraped stem. Retain foliage on plant to draw herbicide up through the plant. Follow up treatment will be required to eradicate infestation.</p> <p>Hand weed seedlings and small plants.</p>

** Denotes noxious; or regional priority weed within Illawarra Lowlands Grassy Woodland.

Note: Herbicides should only be used in accordance with the specifications provided on the label and in the Materials Safety Data Sheet (MSDS) for each product.

Further information regarding the control methods detailed in Table 3 is available DPI (2011) http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0017/123317/Noxious-and-environmental-weed-control-handbook.pdf.

This VMP refers to primary, secondary and maintenance weeding within the performance measures (Table 3) and the program of works. An explanation of these terms is given below;

- Primary weeding – the initial weed treatment. This will include the trittering / mechanical slashing, cutting and painting or manual removal of woody weeds and vines and spot spraying or manual removal of perennial and annual weeds.

- Secondary Weeding – following primary weed removal there will be a rapid flush of weed growth resulting from the increased light availability as well as soil disturbance that will trigger the germination of weed seed within the soil. It is important that this secondary weeding is done within 6 weeks following primary weeding and maintained until the weed growth has reduced and the stabilised to prevent the further spread of weeds. Secondary weeding will involve a combination of hand weeding, particularly around plantings and native species, and spot spraying where outside protective buffers.
- Maintenance weeding - There is likely to be a large amount of weed seed stored in the soil as well as weed seed that will enter the property that will require continual weeding following the more intensive secondary weeding. This will include as combination of spot spraying and hand weeding.

4.2.3 Sheds, fences and general waste

MZ2 and MZ3 have highly modified areas which include sheds, fences and general waste. General waste includes old machinery, steel drums, organic materials from animal agistment and / or stored soil piles.

One area contains Madeira Vine over a pile of organic waste or stock piled soil (Figure 3). This area is recommended to be removed prior to weed control or revegetation occurring. Any waste soil should be removed to an appropriate waste disposal facility.

4.2.4 Revegetation

Revegetation is required within the area indicated for MZ2 and MZ3 (Figure 3).

The requirement for revegetation is to restore native groundcover and to a lesser extent native canopy vegetation where fencing of agisted animals has reduced the capacity for natural regeneration to recover within a practical time line.

Recommendation for revegetation within these areas must be consistent with the management outcomes for both zones. Separate recommendations for MZ2 for the outer APZ and MZ3 managed as retained vegetation are detailed below.

A recommended species planting list and planting densities for both zones is included in Appendix 2.

MZ2 – Outer APZ

As the vegetation community within the outer APZ is an EEC, the recommended species have mostly been selected from the final determination (NSWSC 2000). Modifications to this list have been made to be consistent with NSW RFS 'Standards for Asset Protection Zones' which require plants that are less flammable and have the following features (Appendix 2):

- High moisture content
- High levels of salt
- Low volatile oil content of leaves
- Smooth barks without 'ribbons' hanging from branches or trunks
- Dense crown and elevated branches.

MZ2 also requires specific management of shrub layers and canopy cover (4.1.2) therefore planting densities have been provided to provide consistency with APZ requirements.

Planting densities required throughout the Outer APZ revegetation area are:

- Three trees per 100 metres squared.

- 20 shrubs well spaced per 100 metres squared.
- Three grasses and/or groundcovers per metres squared.

Based on an estimated area for revegetation, within MZ2, the area requiring revegetation is approximately 900 square metres. Based on this area and the planting densities required above, MZ2 will require:

- 9 trees
- 180 Shrubs
- 2700 grasses and groundcovers.

Mulching of revegetation within the outer APZ is not to use chipped wood or other organic materials with the capacity to add to ground fuel loads. **Coir mulch mats** are only to be used to retain moisture and assist suppressing weeds during plant establishment.

MZ3 – Retained vegetation

As the vegetation community within the MZ3 is also an EEC, the recommended species has mostly been selected from the final determination (NSWSC 2000) with additions of common species that may also occur.

As the VMP is for woodland it is critical that groundcover vegetation is the focus of plantings (DEC 2005b), and important that the grassland component is not filled with shrubs.

Planting densities required throughout the revegetation area, these are:

- One tree per 25 metres squared
- Five shrubs per 25 metres squared
- Three grasses and/or groundcovers per metres squared.

Based on an estimated area for revegetation, within MZ2, the area requiring revegetation is approximately 1100 square metres. Based on this area and the planting densities required above, MZ2 will require:

- 33 trees
- 220 Shrubs
- 3300 grasses and groundcovers.

Planting preparation

Planting preparation should be conducted as detailed below:

- Conduct primary weed control works. Primary weed control works should be completed within MZ2 and MZ3 consecutively prior to planting.
- Conduct secondary weeding. Secondary weed control will be conducted at least once, six weeks after primary control and prior to mulching.
- Mulch the revegetation area using wood or leaf mulch to a depth of at least 10 centimetres.

Planting

Planting should be conducted as detailed below:

- Use forestry tube stock or Hiko cells of local provenance from the recommended species list given in Appendix 2 as per appropriate to MZ requirements.
- Plant according to the densities and specifications recommended above.

- Installation should be accompanied by plant protection to avoid damage by rabbits.
- Mulching to retain moisture and suppress weeds should be undertaken as appropriate for zone management outcomes.

Maintenance

Revegetation areas will need regular maintenance including maintenance weeding, watering and replacement of any dead plants:

- Maintenance weeding required will include hand weeding around plantings or other native vegetation present and spot spraying as required.
- The minimum amount of watering required for the initial establishment of plantings recommended is twice per week in the first and second weeks following planting then once per week for the following two to four weeks. This watering regime may need to be varied dependent on the season and the amount of rain received.
- The revegetation area should be assessed after the first and second years following planting. Dead plants should be replaced as required.

4.2.5 Hollow offset - nest box installation

Subdivision of Lot 101 DP 785139 Crest Road, Albion Park will result in 9 hollow bearing trees, including a total of 14 individual hollows being removed. Council requires installation of appropriate nest-boxes to offset at 1:1 within the Environmental Management Area to compensate for the loss. Nest boxes are to be installed following primary weed control, to allow for access, and at least 1 month prior to tree removal for the subdivision.

Nest-boxes will supplement habitat for threatened and non-threatened hollow dependent fauna, including microbats, small and medium sized parrots and small possums. Nest boxes installed will be species specific (Table 2) and will be designed to exclude invasive species. Specifications and numbers of nest-boxes to be installed are detailed within Table 2.

Installation is to be undertaken by a suitably qualified ecologist and details reported to Council following installation will include:

- Box number
- Target species
- Orientation/Aspect of box
- Height of nest box
- Tree Species box installed on
- Canopy Cover
- Location of closest branch
- Photo of each nest box (close-up and full tree).

Table 2 Nest-box installation specifications

Box Type	Target Species	Brief Description	Entrance Diameter/Internal Diameter	Material	Orientation/Aspect of box	Height of box	Number to be installed for offsets
Open bottom microbat box	Microbats species incl. Eastern False Pipistrelle and Greater Broad-nose Bat.	Unique design of vertical slits where microbat species can squeeze into and roost	200mm x 245mm	Hardwood or thick marine ply (17mm).	Avoid direct sunlight during the day, preferably with some canopy cover over the top	3-5m	9
Vertical nest box	Smaller birds incl. Rosella, Red-rumped Parrot, Rainbow Lorikeet.	Small opening vertical nest box.	60mm/120mm	Hardwood or thick marine ply (17mm).	Avoid direct sunlight during the day, preferably with some canopy cover over the top	5m	1
Vertical nest box	Medium sized fauna Incl. Ring Tailed Possum, Galah, Corella and King Parrot.	Medium opening vertical nest box.	150mm/200mm	Hardwood or thick marine ply (17mm).	Avoid direct sunlight during the day, preferably with some canopy cover over the top	4-8m	4

4.3 Monitoring

Under Section 20.2 of the Shellharbour City Council DCP - Remnant vegetation and wetlands, a monitoring and performance evaluation program is required within a VMP. Monitoring must include details of activities undertaken to achieve the management actions in Section 5 and should be supplied to the relevant Council officer on an annual basis for review.

Required reporting to Council

Council will require notification of completion of the following events for inspection:

- Completion of removal of sheds, fences.
- Tagging and establishment of 20 m buffer surrounding White-flowered Wax-plant and fencing of management areas.
- Completion of APZ works by a s 132 qualified bush regenerator within White-flowered Wax-plant protection buffers.
- Completion of primary weed control and installation of erosion control, including 'jute mesh' and pinning specifications used.
- Completion of revegetation.
- Completion of nest box installation.

Notifications will be supplied by short letter report via soft copy/ email.

On-going monitoring shall be detailed within an annual report in soft copy/email and supplied to Council in December each year and provide details on:

- Threatened flora.
- APZ management.
- Nest box monitoring.
- Revegetation.
- Erosion control.

4.3.1 Threatened Flora

Annual monitoring will include one photo point and stem counts for each clonal plant/ location where White-flowered Wax-plant is located. Monitoring points will be marked by a permanent wooden stake or star picket.

Annual monitoring will include survey following removal of Lantana for Illawarra Zieria and White-flowered Waxc Plant within 3 months of primary control. If the either plant is recorded recruiting, procedures for weed management will apply as per White-flowered Wax-plant. If no plants are detected, annual targeted survey for these plants will not be continued after 3 years.

4.3.2 MZ1 - Inner APZ and MZ2 - Outer APZ

Monitoring requires annual photo-point monitoring, one within MZ1 and one within MZ2 to monitor understorey and midstorey APZ maintenance is being undertaken, as well as weed control activities. Records of progress should be undertaken once per year in late November to show appropriate management of APZs immediately prior to bushfire season.

4.3.3 MZ3 – Retained vegetation

MZ3 should have photo records taken at least twice per year, in late November and April (after herbaceous weed growth is at its most rapid, to ensure management of weeds is adequate. The performance measures given in Table 3 can be used to ensure the program is progressing successfully.

The frequency of tasks given in the Program of Works (Table 3) should be altered where the specified timing or frequency of tasks (particularly regarding weed control) are not sufficient to meet the performance criteria given.

Photo-points are required within MZ3 for monitoring:

- All known White-flowered Wax Plant locations.
- One representative area where dense Lantana control has been undertaken and erosion control installed.
- One representative area where revegetation has been undertaken.

Details of activities and hours undertaken to achieve the management actions should be supplied to the relevant Council officer on an annual basis.

4.3.4 Nest box monitoring

Nest boxes will be monitored biannually, once between in November and December and again in June. Non-invasive methods should be used such as a scope camera to minimise disturbance of breeding fauna.

Details recorded during monitoring will include but not be limited to:

- Monitoring Date
- Property location
- Nest box number
- Target species or target species group
- Species inhabiting (including fauna presence and/or evidence of scats, fur, scratches, etc)
- Breeding success where appropriate
- Condition of box and attachment
- Box maintenance details, including replacement
- Management actions to remove or exclude invasive species (European Honeybee, Common Myna, Common Starling and House Sparrow).

4.3.5 Revegetation

Annual reporting for revegetation activities will include details of:

- Species and numbers planted initially.
- Percentage survival rate.
- Species installed to supplement losses.
- Annual photo-point record.

4.3.6 Erosion control

Annual reporting for erosion control success will include details of:

- Area of erosion control undertaken using 'jute mesh'.
- Seedling regeneration after 3 months.
- Inspections and activities undertaken to maintain erosion control mesh.
- Percentage establishment of native cover.
- Revegetation activities if required.

5. VMP program and works

The management area has been divided into three zones (Figure 3). These management zones have been established on the basis of specific management zone requirements. Each management zone is assigned specific works and management measures and these are accompanied by a general timing in Table 3.

The program assumes that primary weed control, revegetation and the removal of sheds, fences and waste site, will be completed prior to subdivision completion, and that scheduled maintenance detailed within the VMP will be required by the owner for a period of five years, or as otherwise determined by Council.

Table 3: Vegetation Management Plan by Zone and Task

Zone	Task	Actions Required	Details	Timing of Actions	Evaluation Criteria
MZ1 – Inner Asset Protection Zone	1. Establish monitoring points.	1. Establish one photopoint and monitor annually.	1. Install a star picket to maintain a static location and undertake photopoint monitoring in a north, south, east and west orientation.	1. Monitor photo points annually (spring) and report management details annually.	1. Supplied within VMP monitoring report annually to Council and the PCA.
	2. Primary and secondary weed control.	2a. Undertake primary weed control.	2a & b. Undertake primary and secondary control of Lantana, Blackberry, Vine weeds, Paddy's Lucerne, and Senna pendula var glabrata.	2a. Undertake primary weed control as soon as possible.	2 a-b. Details supplied to council and the PCA annually in VMP monitoring report.
		2b. Undertake secondary control.		2b. Undertake secondary weed control within 6 weeks of initial treatment.	
	3. Undertake APZ establishment.	3a. Mark trees to be removed, retaining HBT's to establish 15% cover.	3a. Undertake removal of marked canopy trees and branches up to 2 metres from ground level. Re-use removed trees and branches for habitat features within MZ3.	3a. Undertake APZ establishment prior to construction of dwellings. Placement of tree materials into MZ3, during tree removal and branch pruning.	3 a-c. Details supplied to council and the PCA annually in VMP monitoring report.
		3b. Slash groundcovers and prune all branches up to 2m in height on retain trees.	3b. Undertaken regular slashing of MZ1 and branch pruning.	3b. Slashing undertaken at a minimum of a quarterly basis, branch pruning undertaken annually.	
		3c. Other annual APZ management activities.	3c. Rake fine fuels (leaves and sticks) and remove from MZ1 annually prior to fire season.	3c. Fine fuel removal annually, completed before the end of November.	
	4. Maintenance weed control.	4. Maintenance weed control.	4. Maintenance weed control.	4. Maintenance weed control to be undertaken at three times annually, for the life of the VMP and as on-going maintenance: Spring (Oct-Nov), Summer (Feb-Mar), Autumn (May).	4 a. Noxious weeds to be maintained as per Section 3.3.3 and environmental weeds to be maintained below 10% cover..
	5. Threatened species and next box monitoring	5a. Monitor for persistence and recruitment of <i>Cynanchum elegans</i> and <i>Zieria granulata</i>	5a. Undertake photo point recording and stem count for known locations, visual inspection and record new locations of <i>Cynanchum elegans</i> and <i>Zieria granulata</i> .	5a. Undertake threatened flora monitoring annually.	5 a - b. Details to be supplied to council and the PCA annually in VMP monitoring report.
		5b. Monitor for next box use using scope camera or other non-invasive methods in Section 4.3.	5b. Undertake visual inspection and record presence of fauna.	5b. Undertake next box monitoring between November/December and June.	
	6. Fence boundary of zone	6. Establish boundary fencing along the western boundary of MZ1	6. Establish three string post and rail fence along western boundary of MZ1.	6. Establish fenceline as soon as possible.	6. Visual inspection of completion by Council on completion.
MZ2 – Outer Asset Protection Zone	1a. Establish monitoring points.	1a. Establish one photopoint and monitor annually.	1a. Install a star picket to maintain a static location and undertake photopoint monitoring in a north, south, east and west orientation.	1a. Monitor photo points annually and report management details annually.	1a. Supplied within VMP monitoring report annually to Council and the PCA.
	1b. Establish <i>Cynanchum elegans</i> locations.	1b. Locate and markout <i>Cynanchum elegans</i> stems and establish a 20 m buffer within APZ.	1b. Mark <i>Cynanchum</i> stems with high visibility tape and isolate/ clearly mark shrubs or trees used by the endangered vine to be retained. and establish 20 metre buffer to avoid damage during APZ installment.	1b. Prior to installing APZ or undertaking weed control.	1b. Number of stems and photopoint locations including within initial VMP monitoring report annually to Council and the PCA.

Zone	Task	Actions Required	Details	Timing of Actions	Evaluation Criteria
	2. Primary and secondary weed control.	2a. Undertake primary weed control.	2a & b. Undertake primary and secondary control of Lantana, Blackberry, Vine weeds, Paddy's Lucerne, and Senna pendula var glabrata.	2a. Undertake primary weed control as soon as possible.	2 a-b. Details supplied to council and the PCA annually in VMP monitoring report.
		2b. Undertake secondary control.		2b. Undertake secondary weed control within 6 weeks of initial treatment.	
	3. Undertake APZ establishment.	3a. Mark trees to be removed, retaining HBT's to establish 30% cover.	3a. Undertake removal of marked canopy trees and branches up to 2 metres from ground level. Re-use removed trees and branches for habitat features within MZ3.	3a. Undertake APZ establishment prior to construction of dwellings. Placement of tree materials into MZ3, during tree removal and branch pruning.	3 a-d. Details supplied to council and the PCA annually in VMP monitoring report.
		3b. Prune all branches up to 2m in height on retain trees.	3b. Undertaken regular slashing of MZ1 and branch pruning.	3b. Slashing undertaken at a minimum of a quarterly basis, branch pruning undertaken annually.	
		3c. Mark out and locate <i>Cynanchum elegans</i> stems prior to reducing shrub cover, with detailed fine fuel management within 20 m Cynanchum elegans habitat buffer.	3c. APZ reduction of shrubs and fine fuels undertaken by qualified bush regeneration contractor, as per Specification in Section 4.2.2.	3c. Undertake control of weeds and fuels within the Cynanchum buffer on a biannual to annual basis.	
		3d. Annual APZ management activities.	3d. Rake fine fuels (leaves and sticks) and remove from MZ2 annually prior to fire season.	3d. Fine fuel removal annually, completed before the end of November.	
	4. Clear site of agistment materials.	4. Remove sheds, fences, general waste, and stockpiled organic material and soils stockpiles from MZ2.	4. Remove shed materials, fence pickets, fencing wire, general waste, any non- natural wood products, remove stockpiles of soil and manure with Madeira Vine to a registered waste disposal facility.	4. Undertake removal as soon as possible.	4. Visual inspection on completion by Council on completion.
	5. Install and maintain erosion protection in steep areas where lantana has been removed and mulch cover is not present.	5a Install 'jute mesh' in steep areas lacking mulch cover.	5a. Installation of 'jute mesh' in steeper areas lacking mulch cover.	5a. Installation of erosion control, immediately following APZ establishment and Lantana control, if required.	5a. Visual inspection on completion by Council on completion.
		5b. Monitor for natural regeneration trigger to undertake revegetation.	5b. Visually inspect the seedling regeneration and make recommendations for revegetation requirements.	5b. Monitor seedling regeneration three months from Lantana removal. Revegetation to be undertaken at a time determined by Council.	5b. Visual inspection by Council with proponent or their representative after 3 months.
		5c. Monitor 'jute mesh' for lifting or undermining' to undertake revegetation.	5c. Visually inspect the 'jute mesh' on a quarterly basis and re-peg if required.	5c. Monitor until establishment of greater than 50 % native groundcover has occurred.	5c. Annual visual inspection by Council until completion of 3 year or establishment of groundcover greater than 50%.
	6. Revegetation of low condition area	6a. Control weeds prior to planting.	6a. Control all weeds prior to planting to provide optimal establishment.	6a. Control weeds 6 weeks prior to planting.	6a-c. Annual visual inspection by Council until completion of 3 year, 80% success rate for survival.
		6b. Undertake planting of trees, shrubs and groundcovers	6b. Revegetation as per the specifications in Section 4.1.2.	6b. Planting 6 weeks after weed control.	
		6c. Undertake revegetation aftercare (watering and weeding)	6c. Revegetation aftercare, watering and weeding.	6c. Revegetation aftercare as per Section 4.2.4.	
	7. Maintenance weed control.	7. Maintenance weed control.	7. Maintenance weed control.	7. Maintenance weed control to be undertaken at three times annually, for the life of the VMP and as on-going maintenance: Spring (Oct-Nov), Summer (Feb-Mar), Autumn (May).	7 a. Noxious weeds to be maintained as per Section 3.3.3 and environmental weeds to be maintained below 10% cover.

Zone	Task	Actions Required	Details	Timing of Actions	Evaluation Criteria
	8. Threatened species and next box monitoring	8a. Monitor for persistence and recruitment of <i>Cynnachum elegans</i> and <i>Zieria granulata</i>	8a. Undertake photo point recording and stem count for known locations managed for asset protection, visual inspection and record new locations of <i>Cynnachum elegans</i> and <i>Zieria granulata</i> .	8a. Undertake threatened flora monitoring annually.	8a-b. Details to be supplied to council annually in VMP monitoring report.
		8b. Monitor for next box use using scope camera or other non-invasive methods in Section 4.3.	8b. Undertake visual inspection and record presence of fauna using next boxes.	8b. Undertake next box monitoring in November/December and June.	
	9. Fence boundary of zone including <i>Cynnachum elegans</i> APZ management area	9. Establish boundary fencing along the eastern boundary of MZ2	9. Establish three string post and rail fence along eastern boundary of MZ2.	9. Establish fenceline as soon as possible.	9. Visual inspection of completion by Council on completion.
MZ3 – Retained Native Vegetation	1.Establish monitoring points as per Section 4.3 for MZ3.	1. Establish photopoints and monitor annually.	1. Install star pickets to maintain a static location, undertake photopoint monitoring in a north, south, east and west orientation for dense lantana area and a single shot representative of revegetation area.	1. Monitor photopoints annually and report management details annually.	1. Supplied within VMP monitoring report annually to Council and the PCA.
	1b. Establish <i>Cynnachum elegans</i> locations.	1b. Locate and markout <i>Cynnachum elegans</i> stems.	1b. Mark <i>Cynnachum</i> stems with high visibility tape and isolate/ clearly mark shrubs or trees used by the endangered vine to be retained and avoid damage during APZ installment.	1b. Prior to installing APZ or undertaking weed control.	1b. Number of stems and photopoint locations including within initial VMP monitoring report annually to Council and the PCA.
	2. Primary and secondary weed control.	2a. Undertake primary weed control using slashing or manual control methods dependent on slope and accessibility (excluding White Flowered Wax Plant buffers).	2a. Undertake primary weed control as soon as possible.	2a.Undertake primary weed control as soon as possible.	2 a-b. Details supplied to council and the PCA annually in VMP monitoring report.
		2b. Undertake secondary weed control.	2a & b. Undertake primary and secondary control of Lantana, Blackberry, Vine weeds, Paddy's Lucerne, and Senna pendula var glabrata.	2b. Undertake secondary weed control within 6 weeks of initial treatment.	
	3. Install and maintain erosion protection in steep areas where lantana has been removed and mulch cover is not present.	3a. Install 'jute mesh' in steep areas lacking mulch cover.	3a Installation of 'jute mesh' in steeper areas lacking mulch cover.	3a. Installation of erosion control, immediately following APZ establishment and Lantana control, if required.	3a. Visual inspection on completion by Council on completion.
		3b. Monitor for natural regeneration trigger to undertake revegetation.	3b. Visually inspect the seedling regeneration and make recommendations for revegetation requirements.	5b. Monitor seedling regeneration three months from Lantana removal. Revegetation to be undertaken at a time determined by Council.	3b. Visual inspection by Council with proponent or their representative after 3 months.
		3c. Monitor 'jute mesh' for lifting or undermining' to undertake revegetation.	3c. Visually inspect the 'jute mesh' on a quarterly basis and re-peg if required.	3c. Monitor until establishment of greater than 50 % native groundcover has occurred.	3c. Annual visual inspection by Council until completion of 3 year or establishment of groundcover greater than 50%.
	4. Habitat embellishment of MZ3	4. Transfer cut logs, stumps and finer materials to MZ3 for placement as habitat and additional	4. Arrange tree materials cross slope and re-use finer upper branches as brush matting to assist in the establishment of canopy species.	4. Undertaken following installation of jute mesh.	4. Visual inspection on completion by Council on completion.

Zone	Task	Actions Required	Details	Timing of Actions	Evaluation Criteria
		brush matting.			
	5. Revegetation of low condition area	5a. Control weeds prior to planting.	5a. Control all weeds prior to planting to provide optimal establishment.	5a. Control weeds 6 weeks prior to planting.	5a-c. Annual visual inspection by Council until completion of 3 year VMP, 80% success rate for survival.
		5b. Undertake planting of trees, shrubs and groundcovers	5b. Revegetation as per the specifications in Section 4.1.2.	5b. Planting 6 weeks after weed control.	
		5c. Undertake revegetation aftercare (watering and weeding)	5c. Revegetation aftercare, watering and weeding.	5c. Revegetation aftercare as per Section 4.2.4.	
	6. Maintenance weed control.	6. Maintenance weed control.	6. Maintenance weed control.	6. Maintenance weed control to be undertaken at three times annually, for the life of the VMP and as on-going maintenance: Spring (Oct-Nov), Summer (Feb-Mar), Autumn (May).	6 a. Noxious weeds to be maintained as per Section 3.3.3 and environmental weeds to be maintained below 10% cover
	7. Threatened species and next box monitoring	7a. Monitor for persistence and recruitment of <i>Cynanchum elegans</i> and <i>Zieria granulata</i>	7a. Undertake photo point recording and stem count for known locations managed for asset protection, visual inspection and record new locations of <i>Cynanchum elegans</i> and <i>Zieria granulata</i> .	7a. Undertake threatened flora monitoring annually.	7a-b. Details to be supplied to council annually in VMP monitoring report.
		7b. Monitor for next box use using scope camera or other non-invasive methods in Section 4.3.	7b. Undertake visual inspection and record presence of fauna using next boxes.	7b. Undertake next box monitoring in November/December and June.	

*Note – Weed control timing is a guide only, timing of weed control events may vary depending on seasonal variation in rainfall and climatic regimes. Some weeds require seasonal targeting to remove seed or propagule sources as per Table 1

References

Biosis 2012. *Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment*. Authors: Morrissey B & Garvey N. Biosis Pty Ltd, Wollongong. Project No. 15634.

Biosis 2014. Flora and Fauna Assessment for Crest Road, Albion Park. Report for Martin Morris and Jones. Authors: Aguiar A & Garvey N. Biosis Pty Ltd, Wollongong. Project no 18852.

DEC 2005a. *Zieria granulata (Illawarra Zieria) Recovery Plan*. NSW Department of Environment and Conservation, Hurstville NSW.

DEC 2005b. *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland*. Department of Environment and Conservation (NSW), Sydney.

ELA 2011. Flora and Fauna Assessment: Lot 101 DP 785139 Crest Road, Albion Park. EcoLogical Australia. Sydney.

Hazelton P A. & Tille P J. 1990. *Soils Landscapes of the Wollongong – Port Hacking 1:100 000 Sheet*, Soil Conservation Service of NSW, Sydney.

NSWSC 2000. Illawarra lowlands grassy woodland in the Sydney Basin Bioregion - endangered ecological community listing – final determination. NSW Scientific Committee (<http://www.environment.nsw.gov.au/determinations/IllawarraLowlandsGrassyWoodlandSydneyBasinEndComListing.htm> accessed: 23 July 2015)

SCC 2013. *Shellharbour Development Control Plan*. Shellharbour City Council.

Southern Rivers CMA & Southern Councils Group 2011. Southern Rivers Regional Weed Management Strategy 2011- 2015. Southern Rivers CMA and Southern Councils Group.

WCC et al. 2011. *Illawarra Biodiversity Strategy. Volume 2 Background Information*. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

Appendices

Appendix 1: Flora Species Inventory

A1.1 Flora species recorded from the Environmental Management Area

Notes to tables:

EPBC Act: CR - Critically Endangered EN - Endangered VU - Vulnerable	TSC Act: 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: # - Native species outside natural range * - Exotic (not native to Australia) ** - Noxious weed species declared under the <i>Noxious Weeds Act 1993</i>	Noxious weed status: 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)

Table 4: Flora species recorded from the Environmental Management Area and apprio

Status	Family	Genus species	Common Name
	Fabaceae - Mimosoideae	<i>Acacia binervata</i>	Two-veined Hickory
	Fabaceae - Mimosoideae	<i>Acacia fimbriata</i>	Fringed Wattle
	Fabaceae - Mimosoideae	<i>Acacia implexa</i>	Hickory Wattle
	Fabaceae - Mimosoideae	<i>Acacia maidenii</i>	Maiden's Wattle
	Fabaceae - Mimosoideae	<i>Acacia mearnsii</i>	Black Wattle
	Fabaceae - Mimosoideae	<i>Acacia parramattensis</i>	Sydney Green Wattle

Status	Family	Genus species	Common Name
*	Fabaceae - Mimosoideae	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle
	Fabaceae - Mimosoideae	<i>Acacia saliciformis</i>	
*	Polygonaceae	<i>Acetosella vulgaris</i>	Sorrel
	Myrtaceae	<i>Acmena smithii</i>	Lilly Pilly
	Sapindaceae	<i>Alectryon subcinereus</i>	Native Quince
	Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
	Loranthaceae	<i>Amyema pendulum ssp</i>	
*	Primulaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel
	Commelinaceae	<i>Aneilema acuminatum</i>	
	Aphanopetalaceae	<i>Aphanopetalum resinosum</i>	Gum Vine
*	Apocynaceae	<i>Araujia sericifera</i>	Moth Vine
*	Asparagaceae	<i>Asparagus aethiopicus</i>	Asparagus Fern
**RR	Asparagaceae	<i>Asparagus asparagoides</i>	Bridal Creeper
	Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass
*	Asteraceae	<i>Bidens pilosa</i>	Cobblers Pegs
	Poaceae	<i>Bothriochloa macra</i>	Red Grass
	Sterculiaceae	<i>Brachychiton populneus</i>	Kurrajong
	Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
*	Poaceae	<i>Briza subaristata</i>	
*	Poaceae	<i>Bromus catharticus</i>	Prairie Grass
	Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush
	Cyperaceae	<i>Carex inversa</i>	
	Cyperaceae	<i>Carex longibrachiata</i>	

Status	Family	Genus species	Common Name
	Vitaceae	<i>Cayratia clematidea</i>	Native Grape
	Apiaceae	<i>Centella asiatica</i>	Indian Pennywort
*	Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen
	Chenopodiaceae	<i>Chenopodium pumilio</i>	Small Crumbweed
*	Poaceae	<i>Chloris gayana</i>	Rhodes Grass
*	Anthericaceae	<i>Chlorophytum comosum</i>	Spider Plant
	Vitaceae	<i>Cissus hypoglauca</i>	Water Vine
	Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard
	Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum
	Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed
*	Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane
*	Crassulaceae	<i>Crassula multicava</i>	
	Cyatheaceae	<i>Cyathea australis</i>	Black Tree-fern
	Rubiaceae	<i>Cyclophyllum longipetalum</i>	Coast Canthium
EN, E1	Apocynaceae	<i>Cynanchum elegans</i>	
	Poaceae	<i>Cynodon dactylon</i>	Couch
	Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge
	Cyperaceae	<i>Cyperus imbecillis</i>	
*	Cyperaceae	<i>Cyperus sp</i>	
*	Asteraceae	<i>Delairea odorata</i>	Cape Ivy
	Fabaceae - Faboideae	<i>Desmodium varians</i>	Slender Tick-trefoil
	Phormiaceae	<i>Dianella revoluta ssp revoluta</i>	Blueberry Lily
	Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass

Status	Family	Genus species	Common Name
	Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
*	Poaceae	<i>Digitaria sanguinalis</i>	Summer Grass
	Sapindaceae	<i>Dodonaea viscosa ssp angustifolia</i>	Sticky Hop-bush
*	Poaceae	<i>Echinochloa crus-galli</i>	Barnyard Grass
	Poaceae	<i>Echinopogon caespitosus var caespitosus</i>	Tufted Hedgehog-grass
	Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass
*	Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass
	Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush
	Chenopodiaceae	<i>Einadia trigonos ssp trigonos</i>	Fishweed
	Celastraceae	<i>Elaeodendron australe</i>	
	Poaceae	<i>Entolasia marginata</i>	Bordered Panic
	Poaceae	<i>Entolasia stricta</i>	Wiry Panic
	Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass
	Myrtaceae	<i>Eucalyptus amplifolia ssp amplifolia</i>	Cabbage Gum
	Myrtaceae	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark
	Myrtaceae	<i>Eucalyptus quadrangulata</i>	White-topped Box
	Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed
	Asteraceae	<i>Euchiton sphaericus</i>	
*	Euphorbiaceae	<i>Euphorbia peplus</i>	Petty Spurge
	Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
	Santalaceae	<i>Exocarpos cupressiformis</i>	Cherry Ballart
	Moraceae	<i>Ficus macrophylla</i>	Moreton Bay Fig

Status	Family	Genus species	Common Name
*	Fumariaceae	<i>Fumaria bastardii</i>	Bastards Fumitory
	Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge
*	Asteraceae	<i>Gamochaeta americana</i>	Cudweed
*	Asteraceae	<i>Gamochaeta</i> sp	
	Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
	Geraniaceae	<i>Geranium homeanum</i>	Native Geranium
	Geraniaceae	<i>Geranium solanderi</i> ssp <i>solanderi</i>	Native Geranium
	Poaceae	<i>Glyceria</i> sp	
	Fabaceae - Faboideae	<i>Glycine clandestina</i>	
	Fabaceae - Faboideae	<i>Glycine microphylla</i>	Small-leaf glycine
	Fabaceae - Faboideae	<i>Glycine tabacina</i>	
*	Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush
	Fabaceae - Faboideae	<i>Hardenbergia violacea</i>	Purple Coral Pea
	Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower
	Malvaceae	<i>Hibiscus heterophyllus</i> ssp <i>heterophyllus</i>	Native Rosella
	Clusiaceae	<i>Hypericum japonicum</i>	
*	Asteraceae	<i>Hypochaeris radicata</i>	Catsear
*	Asteraceae	<i>Hypochaeris</i> sp	White Flatweed
	Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Golden Weather-grass
*	Balsaminaceae	<i>Impatiens walleriana</i>	
	Fabaceae - Faboideae	<i>Indigofera australis</i>	Australian Indigo
	Poaceae	<i>Joycea pallida</i>	Silvertop Wallaby Grass
	Juncaceae	<i>Juncus usitatus</i>	Common Rush

Status	Family	Genus species	Common Name
	Fabaceae - Faboideae	<i>Kennedia rubicunda</i>	Dusky Coral Pea
**RR	Verbenaceae	<i>Lantana camara</i>	Lantana
	Menispermaceae	<i>Legnephora moorei</i>	Round-leaf Vine
*	Brassicaceae	<i>Lepidium</i> sp	
	Ericaceae - Styphelioideae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath
*	Oleaceae	<i>Ligustrum lucidum</i>	Large Leaved Privet
	Arecaceae	<i>Livistona australis</i>	Cabbage Fan-palm
*	Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass
	Moraceae	<i>Maclura cochinchinensis</i>	Cockspur Thorn
	Apocynaceae	<i>Marsdenia rostrata</i>	Milk Vine
*	Fabaceae - Faboideae	<i>Medicago lupulina</i>	Black Medic
	Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree
	Meliaceae	<i>Melia azedarach</i>	White Cedar
	Violaceae	<i>Melicytus dentatus</i>	Tree Violet
	Poaceae	<i>Microlaena stipoides</i> var <i>stipoides</i>	Weeping Grass
*	Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow
	Myrsinaceae	<i>Myrsine variabilis</i>	
	Oleaceae	<i>Notelaea ovata</i>	
	Oleaceae	<i>Notelaea venosa</i>	Veined Mock-olive
	Asteraceae	<i>Olearia viscidula</i>	Wallaby Weed
	Poaceae	<i>Oplismenus aemulus</i>	Oplismenus
	Poaceae	<i>Oplismenus imbecillis</i>	Oplismenus
*	Oxalidaceae	<i>Oxalis corniculata</i>	

Status	Family	Genus species	Common Name
	Oxalidaceae	<i>Oxalis exilis</i>	
	Oxalidaceae	<i>Oxalis perennans</i>	
	Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine
*	Caryophyllaceae	<i>Paronychia brasiliensis</i>	Chilean Whitlow Wort
	Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
*	Poaceae	<i>Paspalum dilatatum</i>	Paspalum
*	Passifloraceae	<i>Passiflora subpeltata</i>	White Passionflower
*	Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass
*	Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed
*	Pinaceae	<i>Pinus radiata</i>	Radiata Pine
	Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn
	Pittosporaceae	<i>Pittosporum revolutum</i>	Wild Yellow Jasmine
	Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
*	Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues
	Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower
	Poaceae	<i>Poa affinis</i>	Poa
	Poaceae	<i>Poa labillardierei</i>	Tussock Grass
	Euphorbiaceae	<i>Poranthera microphylla</i>	
	Portulacaceae	<i>Portulaca oleracea</i>	Pigweed
	Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
	Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
	Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry
	Santalaceae	<i>Santalum obtusifolium</i>	Blunt Sandalwood

Status	Family	Genus species	Common Name
*	Asteraceae	<i>Senecio madagascariensis</i>	Fireweed
*	Fabaceae - Caesalpinioideae	<i>Senna pendula</i> var <i>glabrata</i>	
*	Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass
*	Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne
	Asteraceae	<i>Sigesbeckia orientalis</i> ssp <i>orientalis</i>	
*	Solanaceae	<i>Solanum linnaeanum</i>	
*	Solanaceae	<i>Solanum mauritianum</i>	
*	Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade
*	Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle
*	Poaceae	<i>Sporobolus africanus</i>	Parramatta Grass
	Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass
*	Caryophyllaceae	<i>Stellaria media</i>	Common Chickweed
*	Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass
	Moraceae	<i>Streblus brunonianus</i>	Whalebone Tree
*	Asteraceae	<i>Tagetes minuta</i>	Stinking Roger
*	Asteraceae	<i>Taraxacum officinale</i>	Dandelion
*	Bignoniaceae	<i>Tecoma capensis</i>	Cape Honeysuckle
	Poaceae	<i>Themeda australis</i>	Kangaroo Grass
*	Commelinaceae	<i>Tradescantia fluminensis</i>	Wandering Jew
*	Fabaceae - Faboideae	<i>Trifolium repens</i>	White Clover
	Apocynaceae	<i>Tylophora barbata</i>	Bearded Tylophora
*	Verbenaceae	<i>Verbena bonariensis</i>	Purpletop
	Asteraceae	<i>Vernonia cinerea</i> ssp <i>cinerea</i>	

Status	Family	Genus species	Common Name
	Scrophulariaceae	<i>Veronica calycina</i>	Hairy Speedwell
	Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell
*	Poaceae	<i>Vulpia muralis</i>	
	Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell
	Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell
*	Asteraceae	<i>Xanthium occidentale</i>	Noogoora Burr
	Asteraceae	<i>Xerochrysum bracteatum</i>	Golden Everlasting
	Fabaceae - Faboideae	<i>Zornia dyctiocarpa</i>	Zornia

Appendix 2: Revegetation List

Table 5: Revegetation list and specifications for Environmental Management Area



Scientific name	Common name	Planting Density	
Trees			
*Appropriate for planting in MZ2 – Outer APZ		MZ2 – Outer APZ	MZ3 – Retained Vegetation
Acacia falcata		1 plant per 25 m²	3 plants per 100 m² for appropriate APZ species
Acacia implexa	Hickory Wattle		
Acacia maidenii*	Maiden's Wattle		
Acacia mearnsii	Black Wattle		
Allocasuarina littoralis*	Black She-Oak		
Alphitonia excelsa *			
Angophora floribunda*	Rough-barked Apple		
Brachychiton populneus*	Kurrajong		
Bursaria spinosa*	Native Blackthorn		
Callistemon salignus	Willow Bottlebrush		
Eucalyptus amplifolia*	Cabbage Gum		
Eucalyptus bosistoana*	Coast Grey Box		
Eucalyptus eugenioides*	Thin-leaved Stringybark		
Eucalyptus tereticornis*	Forest Red Gum		
Melaleuca decora			
Melaleuca styphelioides	Prickly-leaved Tea Tree		
Shrubs			
Citriobatus pauciflorus*	Orange Thorn	5 plants per 25 m²	20 plants per 100 m² for appropriate APZ species
Daviesia genistifolia*	Broom Bitter Pea		
Daviesia ulicifolia*	Gorse Bitter Pea		
Dodonaea viscosa var angustifolia*			
Indigofera australis*	Australian Indigo		
Jacksonia scoparia*	Dogwood		
Leucopogon juniperinum*			



Scientific name	Common name	Planting Density	
<i>Pittosporum revolutum</i> *			
<i>Pultenaea retusa</i> *			
<i>Pultenaea villosa</i> *	Hairy Bush-pea		
Grasses & Groundcovers			
<i>Aristida ramosa</i>	Purple Wiregrass	3 plants per 1 m²	3 plants per 1 m²
<i>Aristida vagans</i>	Threeawn Speargrass		
<i>Athropodium milleflorum</i> *			
<i>Bothriochloa macra</i>	Red Grass		
<i>Carex longibrachiata</i> *			
<i>Cheilanthes sieberi</i> *	Rock Fern		
<i>Cymbopogon refractus</i>	Barbed Wire Grass		
<i>Desmodium rhytidophyllum</i> *			
<i>Desmodium varians</i> *	Slender Tick-trefoil		
<i>Dianella revoluta</i> *	Blueberry Lily		
<i>Dichondra repens</i> *	Kidney Weed		
<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass		
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass		
<i>Entolasia stricta</i>	Wiry Panic		
<i>Eragrostis leptostachya</i>	Paddock Lovegrass		
<i>Gahnia radula</i> *			
<i>Geitonoplesium cymosum</i> *	Scrambling Lily		
<i>Goodenia hederacea subsp hederacea</i> *			
<i>Hardenbergia violacea</i> *	False Sarsaparilla		
<i>Hibbertia aspera</i> *	Rough Guinea Flower		
<i>Kennedia rubicunda</i> *	Dusky Coral Pea		
<i>Lepidosperma laterale</i> *	Variable Sword-sedge		
<i>Lomandra filiformis</i> *	Wattle Matt-rush		
<i>Lomandra multiflora</i> *	Many-flowered Mat-rush		
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		


Scientific name	Common name	Planting Density	
<i>Microlaena stipoides</i> *	Weeping Grass		
<i>Oplismenus aemulus</i>			
<i>Oplismenus imbecillis</i>			
<i>Parsonsia straminea</i>	Common Silkpod		
<i>Plectranthus parviflorus</i> *			
<i>Poa labillardieri</i>			
<i>Pratia purpurascens</i> *	Whiteroot		
<i>Rubus parvifolius</i> *	Native Raspberry		
<i>Stellaria flaccida</i> *			
<i>Themeda australis</i>	Kangaroo Grass		


Appendix 3: Hollow-bearing tree inventory

Table 6 Hollow bearing trees recorded within the environmental management area

HBT label	Hollow size/features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
6	15 cm branch hollow, very shallow	Unsuitable habitat	No, not Applicable	Not Applicable	Not Applicable	
7	10cm branch hollow	Small parrot species	No, retained within Lot 73	Not required		

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo	
8	10cm trunk hollow, rubble filled.	Unsuitable habitat.	Not Applicable	Not Applicable	Not Applicable		
9	5cm, dead branch	Microbat species	No, retained within Lot 73	Not required	Not required		


HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
10	10 cm trunk hollow	Small parrot species	No, retained within Lot 73	Not required		
11	10cm trunk hollow	Small parrot species	No, retained within Lot 73	Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	10cm trunk hollow	Small parrot species		Not required	Not required	
	20 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
12	5cm trunk hollow	Microbat species	No, retained within Lot 73	Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
13	5cm tube hollow in branch	Microbat species	No, retained within Lot 73	Not required	Not required	
14	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	
	20cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	

HBT label	Hollow size/features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	30 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
15	15cm tube hollow in branch	Medium sized parrots and small possums	No, retained within Lot 73	Not required	Not required	
16	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	10 cm branch hollow	Microbat species		Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	10 cm trunk hollow	Small parrot species		Not required	Not required	
	25 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
	30 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
17	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	5cm branch hollow	Microbat species		Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo	
18	15cm trunk hollow, obstructed	Unsuitable habitat	Not Applicable	Not Applicable	Not Applicable		

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

Biosis offices

AUSTRALIAN CAPITAL TERRITORY

Canberra

Floor 1, Unit 3, 38 Essington Street
Mitchell ACT 2911

Phone: (02) 6241 2333
Fax: (03) 9646 9242
Email: canberra@biosis.com.au

NEW SOUTH WALES

Sydney

Unit 14, 17-27 Power Avenue
Alexandria NSW 2015

Phone: (02) 9690 2777
Fax: (02) 9690 2577
Email: sydney@biosis.com.au

Wollongong

8 Tate Street
Wollongong NSW 2500

Phone: (02) 4229 5222
Fax: (02) 4229 5500
Email: wollongong@biosis.com.au

QUEENSLAND

Brisbane

Suite 4 First Floor, 72 Wickham Street
Fortitude Valley QLD 4006

Phone: (07) 3831 7400
Fax: (07) 3831 7411
Email: brisbane@biosis.com.au

VICTORIA

Ballarat

506 Macarthur Street
Ballarat VIC 3350

Phone: (03) 5331 7000
Fax: (03) 5331 7033
Email: ballarat@biosis.com.au

Melbourne (Head Office)

38 Bertie Street
Port Melbourne VIC 3207

Phone: (03) 9646 9499
Fax: (03) 9646 9242
Email: melbourne@biosis.com.au

Wangaratta

16 Templeton Street
Wangaratta VIC 3677

Phone: (03) 5721 9453
Fax: (03) 5721 9454
Email: wangaratta@biosis.com.au

Document information

Report to: Martin Morris and Jones
on behalf of Spinitu Pty Ltd

Prepared by: Brett Morrisey
Nathan Garvey

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:

© Biosis Pty Ltd

This document is and shall remain the property of Biosis Pty Ltd. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

Summary	v
1. Introduction	7
1.1 Project background	7
1.2 Scope of assessment	7
1.3 Location of the study area	8
2. Methods	11
2.1 Literature and database review	11
2.2 Definitions of significance	11
2.2.1 Species and ecological communities	11
2.3 Likelihood of occurrence	12
2.4 Site investigation	12
2.4.1 General flora and fauna	12
2.5 BioBanking	12
2.5.1 Landscape Value	13
2.5.2 Vegetation Zones and Threatened Species Subzones	13
2.5.3 Geographic and Habitat Features	14
2.5.4 Site Survey Details	15
2.5.5 Site Values	16
2.5.6 Threatened Species Survey Results	17
2.6 Permits and Licences	18
2.7 Qualifications	18
2.8 Legislation and policy	18
2.9 Mapping	19
3. Results	23
3.1 Site context	23
3.1.1 <i>Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study, City of Shellharbour</i> (Mills, 2007)	23
3.1.2 <i>Flora and Fauna Assessment, Lot 1011 DP 785139 Crest Road, Albion Park</i> (ELA, 2009)	23
3.2 Vegetation Communities and Fauna Habitat	24
3.3 Significant Species - EPBC Act & TSC Act listed species	27
3.4 Significant ecological communities	28
3.5 Further survey recommendations	29
3.6 BioBanking – Credit Requirements	29
4. Biodiversity Legislation and Government Policy	34
4.1 Commonwealth	34
4.1.1 <i>Environment Protection and Biodiversity Conservation Act 1999</i>	34
4.2 State	35

4.2.1 Threatened Species Conservation Act 1995	35
4.2.2 Environmental Planning and Assessment Act 1979	35
4.2.3 Native Vegetation Act 2003	36
5. Recommendations	37
References	39
Appendices	40
Appendix 1: Quadrat / Transect Data	41
Appendix 2: BioBanking Data Collection Methods	42
Appendix 3: Flora	43
Appendix 4: Fauna	66

List of Figures

Figure 1: Location of the subject site, Crest Road, Albion Park, NSW	9
Figure 2: Proposed rezoning of Lot 101 DP 785139 (Courtesy of Martin Morris and Jones)	10
Figure 3: Landscape value assessment circles, showing vegetation cover in 100 ha and 1000ha assessment circles (Tozer <i>et al.</i> 2010)	20
Figure 4: Vegetation zones and threatened species subzones, showing the location of quadrats / transects	21
Figure 5: Management zones	22
Figure 6: Vegetation mapping of the subject site (Tozer <i>et al.</i> 2010)	32
Figure 7: Vegetation mapping of the subject site (Biosis), including locations of <i>C.elegans</i> and hollow bearing trees	33

List of Tables

Table 1: Criteria for determining significance of species & ecological communities	11
Table 2: Assessment Circle Information	13
Table 3: Threatened species subzones	14
Table 4: Geographic and habitat feature questions and answers	15
Table 5: Predicted threatened species assessment	15
Table 6: Management zones	17
Table 7: Threatened species surveys results for the BioBanking Assessment	17
Table 8: Forest Red Gum - Thin-leaved Stringybark Grassy Woodland	24
Table 9: Closed Grassland	26
Table 10: Summary of significant species most likely to occur in the subject site	27
Table 11: Credit requirements, Lot 101 DP785139, Crest Road, Albion Park	29
Table 12: Red flag variation criteria and their relevance to the current assessment	30
Table 13: Assessment of the project against the EPBC Act	34
Table 14: Summary of potential implications of proposed rezoning and recommendations to avoid and minimise ecological impacts	37
Table 15: Quadrat / transect data	41

Table 16: Attributes and data collection method for the BBAM.....	42
Table 17: Flora species recorded from the study area.	44
Table 18: Significant flora species recorded / predicted to occur within 5 km of the study area.	59
Table 19: Vertebrate fauna recorded from the study area (present assessment).....	67
Table 20: Significant fauna species recorded, or predicted to occur, within 5 km of the study area.....	70
Table 21: Migratory fauna species recorded or predicted to occur within 5 km of the study area.	89

List of Plates

Plate 1: ILGW, higher plateau area	25
Plate 2: ILGW, north east slopes	26
Plate 3: Closed grassland	27

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	<i>Cynanchum elegans</i> 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 <i>Cynanchum elegans</i> <i>Zieria granulata</i> 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:

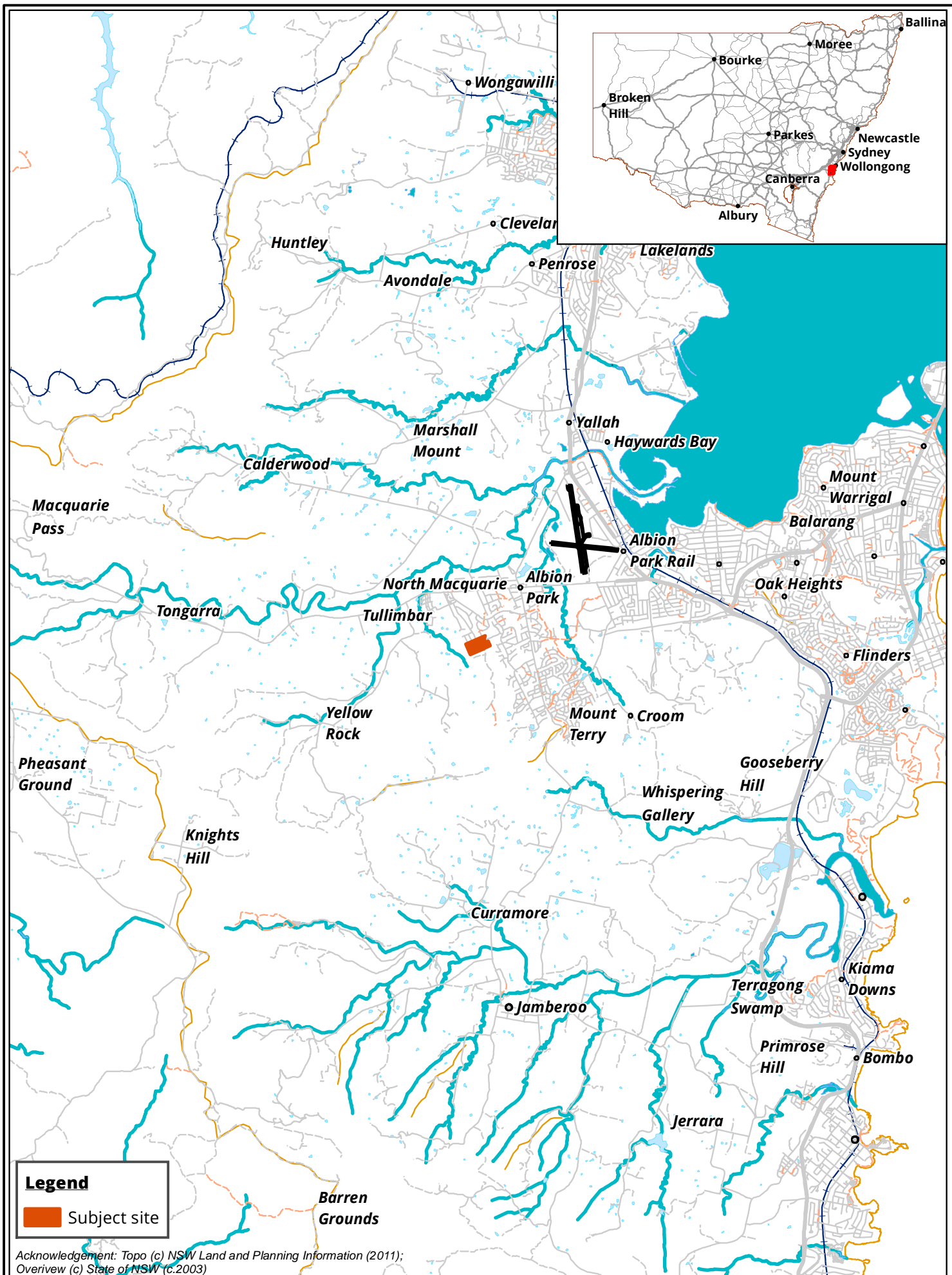
- Review previous terrestrial biodiversity surveys and assessments of the subject site;
- Undertake a survey and assessment of the subject site according to the BioBanking Assessment Methodology (BBAM) as described by DECC (2009), including an assessment of species diversity and habitat condition from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





Legend

 Study Area

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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F2_20121221

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 (SCVI)*. (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
<i>land within 40 m of heath, woodland or forest with sandy or friable soils?</i>	No Soils clay based
<i>land within 40 m of rainforest, coastal scrub, riparian or estuarine communities?</i>	No Subject site located on top of ridge greater than 40 m from these communities
<i>land containing caves or similar structures?</i>	No No caves within the subject site
<i>hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone?</i>	No Subject site not located within 200 m of a riparian zone
<i>land north of Batemans Bay in Bateman CMA subregion?</i>	No Subject site located within the Illawarra CMA subregion
<i>land within Shellharbour and Wollongong LGAs in Illawarra CMA subregion?</i>	Yes
<i>land within Wollongong LGA in Illawarra CMA subregion?</i>	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
<i>Burhinus grallarius</i>	Bush Stone-curlew	No	Surveys undertaken.
<i>Calyptrorhynchus lathamii</i>	Glossy Black-cockatoo	No	Preferred foraging habitat not

			present.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	No	Suitable habitat not present.
<i>Glossopsitta pusilla</i>	Little Lorikeet	Yes	Assumed due to presence of suitable habitat. Potential to occur.
<i>Lathamus discolor</i>	Swift Parrot	Yes	Assumed due to presence of suitable habitat. Potential to occur.
<i>Myotis macropus</i>	Large-footed Myotis	No	Survey. Targeted surveys did not record this species. Subject site not located in proximity to preferred foraging habitat.
<i>Neophema pulchella</i>	Turquoise Parrot	Yes	Assumed due to presence of suitable habitat. Potential to occur.
<i>Ninox connivens</i>	Barking Owl	No	No potential breeding sites or suitable foraging habitat
<i>Petroica boodang</i>	Scarlet Robin	Yes	Assumed due to presence of suitable habitat. Potential to occur.
<i>Petroica phoenicea</i>	Flame Robin	Yes	Recorded by ELA (2011).
<i>Phascolarctos cinereus</i>	Koala	No	No recent records from the Illawarra floodplain. No evidence of occupation.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	No	Suitable habitat not present.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	No	Survey. Targeted surveys did not record this species.
<i>Tyto novaehollandiae</i>	Masked Owl	No	No potential breeding sites or suitable foraging habitat.
<i>Xanthomyza phrygia</i>	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
<i>Pimelea spicata</i>	Spiked Rice-flower	No	Targeted surveys failed to locate this species. Habitat not present on site.
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	No	Targeted surveys failed to locate this species. Only marginal habitat present on site.
<i>Zieria granulata</i>	Illawarra Zieria	No	Potential habitat in areas proposed for E3 zoning. Species habitat will not be impacted

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

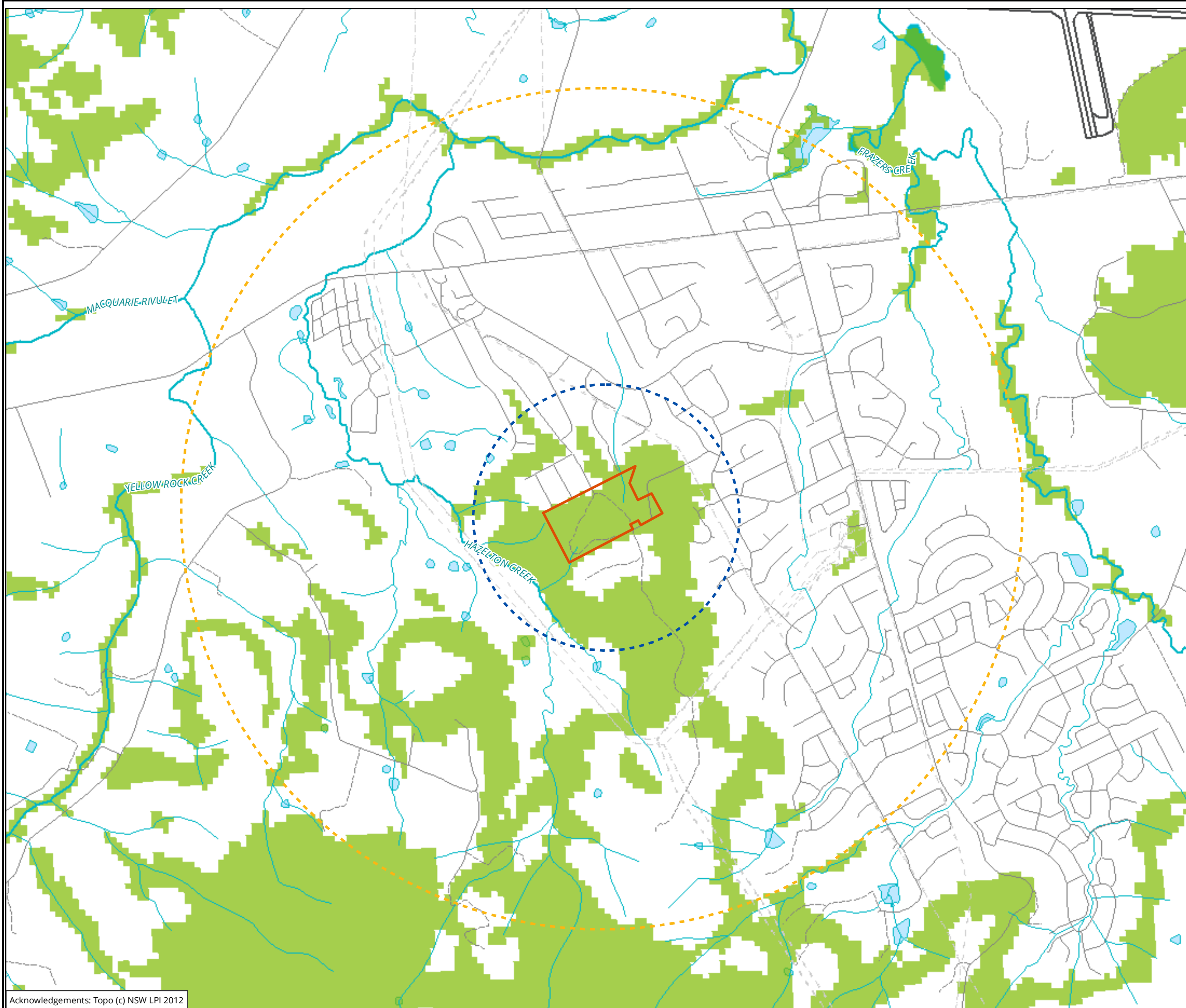
- *Draft Shellharbour Local Environment Plan 2011.*

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

- Study Area
- Vegetation mapping (SCIV)
- Assessment Circles**
 - 1000 ha
 - 100 ha

Figure 3: Landscape assessment circles showing vegetation 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




Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F3_20121221



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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F4_20121221



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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\
15634_F5_20121221

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

	<i>odorata</i> Cape Ivy, <i>Ehrharta erecta</i> Panic Veldtgrass and <i>Eustrephus latifolius</i> Wombat Berry.
Condition	<p>Areas where canopy cover is less than 25% of the benchmark for the vegetation type were assessed as low.</p> <p>Other areas were assessed as moderate to good. These areas were further classified dependent upon the cover of <i>Lantana camara</i>.</p> <p>The overall resilience and recovery potential of the FRGTLSGW is assessed as poor in low condition areas and moderate in other areas.</p>
Fauna habitat	<p>Fauna habitat across the site varies in condition dependent upon the understorey and presence of hollow bearing trees.</p> <p>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 <i>Lantana camara</i>. This provides significant foraging habitat for a number of woodland birds.</p> <p>Groundcover in areas where <i>Lantana camara</i> 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.</p>
Threatened species	<p>Seven <i>Cynanchum elegans</i> were recorded at two locations in FRGTLSGW. <i>Zieria granulata</i> Illawarra Zieria considered a Medium likelihood of occurrence in areas if FRGTLSGW.</p> <p>One threatened bird (Flame Robin <i>Petroica phoenicea</i>) was recorded by ELA (2011). One additional bird (Varied Sitella <i>Daphoenositta chrysoptera</i>) is considered a medium likelihood of occurrence.</p> <p>One megachiropteran bat (Grey-headed Flying-fox <i>Pteropus poliocephalus</i>) was recorded overflying the subject site by ELA (2011). Three microchiropteran bats (Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i>, Little Bentwing-bat <i>Miniopterus australis</i> and Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>) were recorded within the Subject Site by ELA (2011). One additional microchiropteran bat (Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>) 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.</p>
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 <i>Paspalum dilatatum</i> Paspalum, <i>Pennisetum clandestinum</i> Kikuyu Grass dominate with other common exotic herbs and grasses including <i>Acetosella vulgaris</i> Sorrel, <i>Bidens pilosa</i> Cobblers Pegs, <i>Cirsium vulgare</i> Spear Thistle, <i>Conyza</i> sp. Fleabane, <i>Oxalis corniculata</i> , <i>Senecio madagascariensis</i> Fireweed, <i>Euphorbia peplus</i> Petty Spurge and <i>Sida rhombifolia</i> Paddy's Lucerne. Native grasses and herbs also occur mixed through the exotic groundcovers and common species are <i>Cotula australis</i> Common Cotula, <i>Einadia trigonos</i> ssp. <i>trigonos</i> Fishweed, <i>Geranium homeanum</i> Native Geranium, <i>Microlaena stipoides</i> var. <i>stipoides</i> Weeping Grass and <i>Poa labillardierei</i> 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	
<i>Cynanchum elegans</i> White-flowered Wax Plant	FRGTLGW on north east facing slopes; the location of records of this species are provided in Figure 7. Discussed further below.
<i>Zieria granulata</i> Illawarra Zieria	FRGTLGW on the upper rocky north east facing slopes; the location of records of this species are provided in Figure 7.
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	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 <i>Daphoenositta chrysoptera</i>	Potential for this species to occur within the subject site on occasion, particularly areas of <i>Lantana camara</i> where high

	habitat complexity provides shelter.
Flame Robin <i>Petroica phoenicea</i>	This species was recorded by ELA (2011) along the northern boundary of the subject site.
Hollow roosting microchiropteran bats Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	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 bentwing-bat <i>Miniopterus schreibersii oceanensis</i> Little Bentwing-bat <i>Miniopterus australis</i>	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 FRGTLGW 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 obtain 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	FRGTLGW 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 <i>et al.</i> (2010) maps 3100 ha of SCGW (corresponding with FRGTLGW) including 180 ha in conservation reserves. The cleared estimate within the Sothorn 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
 - South Coast Grassy Woodland
- Tozer et al. (2010)**

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

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F6_20121221



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



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 15634
Date: 21 December 2012,
Checked by: JMS, Drawn by: NMG
Location: P:\15600s\15634\Mapping\Report Figures\15634_F7_20121221

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 (<i>Cynanchum elegans</i> White-flowered Wax Plant) and one fauna (Grey-headed Flying-fox <i>Pteropus poliocephalus</i>) 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).	<p>Most of these species are not likely to occur and development unlikely to constitute a significant impact.</p> <p>The retention of <i>Cynanchum elegans</i> 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.</p> <p>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.</p> <p>Once these recommendations have been implemented a significance of assessment to determine the need for a referral to the Federal Environment Minister is recommended.</p>
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 elegans* 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 an 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	<p>The permanent removal of up to 6.14 ha of native vegetation, including 3.54 ha of ILGW EEC.</p> <p>Removal of up to 23 hollow bearing trees.</p>	<p>Avoid and minimise removal of native vegetation.</p> <p>Retained trees, particularly hollow bearing trees, in road reserves and private allotments where possible.</p>
Threatened species	<p>Removal of known habitat for <i>Cynanchum elegans</i> and potential habitat for <i>Zieria granulata</i>.</p> <p>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.</p>	<p>Undertake further targeted survey for <i>Cynanchum elegans</i> and <i>Zieria granulata</i> to inform the management plan and determine the need for a referral under the EPBC Act.</p> <p>Incorporate management of threatened species into the management plan (see below). The management of <i>Cynanchum elegans</i> may consider philanthropic translocation of specimens into conservation areas, or other measures, to contribute to the recovery of this species.</p> <p>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).</p>
Retained areas	<p>Reduced viability of flora and fauna species in the retained areas in the longer term due to reductions in habitat area</p>	<p>Put in place a conservation agreement / covenant over areas of retained native vegetation in the proposed E3 zone.</p>

Ecological feature (Error! Reference source not found.)	Implications of development	Recommendations
	<p>and influence of adjacent land use/s e.g. encroachment of weeds, increased predation by domestic pets.</p>	<p>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 <i>Cynanchum elegans</i>. The management plan should outline measures to improve the quality of retained vegetation, including staged approach to the removal of <i>Lantana camara</i> 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.</p>

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

References

- DECC (2009). *BioBanking Assessment Methodology and Credit Calculator Operational Manual*. Department of Environment and Climate Change NSW, Sydney.
- ELA (2011). *Bushfire Protection Assessment. Proposed Rezoning. Lot 101 DP 785139 Crest Road, Albion Park*. EcoLogical Australia, Sydney.
- ELA (2011). *Flora and Fauna Assessment. Lot 101 DP 785139 Crest Road, Albion Park*. EcoLogical Australia, Sydney.
- Keith, D. (2004) *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*. NSW Department of Environment and Conservation, Hurstville.
- Mills, K (2007). *Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study. City of Shellharbour*. Kevin Mills and Associates. Jamberoo.
- MMJ (2011). *Planning Submission. Draft Shellharbour Local Environmental Plan 2011. Lot 101 DP 785139, Crest Road, Albion Park*. Martin Morris and Jones, Wollongong.
- NPWS (2002a). *Threatened Species Information. Cynanchum elegans*. NSW National Parks and Wildlife Service, Hurstville.
- NPWS (2002b). *Environmental Impact Assessment Guidelines. Cynanchum elegans*. NSW National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee (2008). *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion - endangered ecological community listing. NSW Scientific Committee final determination*. NSW Scientific Committee, Sydney.
- OEH (2012a). *Vegetation Types Database*. Office of Environment and Heritage, Sydney.
<http://www.environment.nsw.gov.au/BioBanking/vegtypedatabase.htm>.
- OEH (2012b). *BioBanking Credit Calculator Version 2*. Office of Environment and Heritage, Sydney.
- OEH (2012c). *NSW National Parks and Wildlife Service (NPWS) Wildlife Atlas*. © The State of New South Wales. Office of Environment and Heritage, Sydney.
- SCC (2011). *Draft Shellharbour Local Environment Plan 2011*. Shellharbour City Council, Shellharbour.
- The Royal Botanic Gardens and Domain Trust (December 2012). *PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia (version 2)*.
<http://plantnet.rbgsyd.nsw.gov.au>.
- Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B, Beukers P (2010). *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*. *Cunninghamia* 11, 359-406.
- WCC et al. (2010) *Draft Illawarra Biodiversity Strategy. Volume 2 Background Information*. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

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 (diameter greater than 10 cm and length greater than 50 cm) in the 50 m x 20 m plot.

Appendix 3: Flora

EPBC Act: CR - Critically Endangered EN - Endangered VU - Vulnerable	TSC Act: 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: # - Native species outside natural range * - Exotic (not native to Australia) ** - Noxious weed species declared under the <i>Noxious Weeds Act</i> 1993	Noxious weed status: 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	<i>Acacia binervata</i>	Two-veined Hickory					1		#	#
	Fabaceae - Mimosoideae	<i>Acacia fimbriata</i>	Fringed Wattle							#	
	Fabaceae - Mimosoideae	<i>Acacia implexa</i>	Hickory Wattle							#	#
	Fabaceae - Mimosoideae	<i>Acacia maidenii</i>	Maiden's Wattle	1						#	#
	Fabaceae - Mimosoideae	<i>Acacia mearnsii</i>	Black Wattle							#	#
	Fabaceae - Mimosoideae	<i>Acacia parramattensis</i>	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	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle							#	
	Fabaceae - Mimosoideae	<i>Acacia saliciformis</i>								#	
*	Polygonaceae	<i>Acetosella vulgaris</i>	Sorrel							#	
	Myrtaceae	<i>Acmena smithii</i>	Lilly Pilly							#	
	Sapindaceae	<i>Alectryon subcinereus</i>	Native Quince							#	
	Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash			1				#	
	Loranthaceae	<i>Amyema pendulum ssp</i>								#	
*	Primulaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	2						#	
	Commelinaceae	<i>Aneilema acuminatum</i>								#	
	Aphanopetalaceae	<i>Aphanopetalum resinosum</i>	Gum Vine				1				
*	Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	1						#	
*	Asparagaceae	<i>Asparagus aethiopicus</i>	Asparagus Fern	1	1					#	
**RR	Asparagaceae	<i>Asparagus asparagoides</i>	Bridal Creeper		1					#	
	Poaceae	<i>Austrostipa ramosissima</i>	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	<i>Bidens pilosa</i>	Cobblers Pegs							#	
	Poaceae	<i>Bothriochloa macra</i>	Red Grass								#
	Sterculiaceae	<i>Brachychiton populneus</i>	Kurrajong								#
	Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush		1			1		#	#
*	Poaceae	<i>Briza subaristata</i>								#	
*	Poaceae	<i>Bromus catharticus</i>	Praire Grass	3				3	2	#	
	Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush							#	
	Cyperaceae	<i>Carex inversa</i>								#	#
	Cyperaceae	<i>Carex longibrachiata</i>								#	#
	Vitaceae	<i>Cayratia clematidea</i>	Native Grape		1					#	
	Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	1						#	#
*	Chenopodiaceae	<i>Chenopodium album</i>	Fat Hen	1				2		#	
	Chenopodiaceae	<i>Chenopodium pumilio</i>	Small Crumbweed								#
*	Poaceae	<i>Chloris gayana</i>	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	<i>Chlorophytum comosum</i>	Spider Plant							#	
	Vitaceae	<i>Cissus hypoglauca</i>	Water Vine		2						
	Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard							#	#
	Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum	1	1					#	#
	Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed	2	2	2	2	3		#	#
*	Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	3							
*	Crassulaceae	<i>Crassula multicava</i>								#	
	Cyatheaceae	<i>Cyathea australis</i>	Black Tree-fern							#	
	Rubiaceae	<i>Cyclophyllum longipetalum</i>	Coast Canthium							#	
EN, E1	Apocynaceae	<i>Cynanchum elegans</i>								#	
	Poaceae	<i>Cynodon dactylon</i>	Couch						3	#	#
	Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	4				4	4		
	Cyperaceae	<i>Cyperus imbecillis</i>								#	
*	Cyperaceae	<i>Cyperus sp</i>		1							

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	Asteraceae	<i>Delairea odorata</i>	Cape Ivy		3	3	2			#	
	Fabaceae - Faboideae	<i>Desmodium varians</i>	Slender Tick-trefoil	2				2		#	#
	Phormiaceae	<i>Dianella revoluta ssp revoluta</i>	Blueberry Lily							#	
	Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass							#	
	Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	3	2			2		#	#
*	Poaceae	<i>Digitaria sanguinalis</i>	Summer Grass	2							
	Sapindaceae	<i>Dodonaea viscosa ssp angustifolia</i>	Sticky Hop-bush		1		1			#	#
*	Poaceae	<i>Echinochloa crus-galli</i>	Barnyard Grass							#	
	Poaceae	<i>Echinopogon caespitosus var caespitosus</i>	Tufted Hedgehog-grass							#	#
	Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass								#
*	Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	1	2	2	2			#	
	Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	2				1		#	#
	Chenopodiaceae	<i>Einadia trigonos ssp trigonos</i>	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	<i>Elaeodendron australe</i>									#
	Poaceae	<i>Entolasia marginata</i>	Bordered Panic							#	
	Poaceae	<i>Entolasia stricta</i>	Wiry Panic							#	
	Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass							#	
	Myrtaceae	<i>Eucalyptus amplifolia</i> ssp <i>amplifolia</i>	Cabbage Gum							#	
	Myrtaceae	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark	1			2	1		#	#
	Myrtaceae	<i>Eucalyptus quadrangulata</i>	White-topped Box							#	
	Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	1	1	3	3	4	1	#	#
	Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed							#	
	Asteraceae	<i>Euchiton sphaericus</i>									#
*	Euphorbiaceae	<i>Euphorbia peplus</i>	Petty Spurge							#	
	Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry		2		2			#	
	Santalaceae	<i>Exocarpos cupressiformis</i>	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	<i>Ficus macrophylla</i>	Moreton Bay Fig							#	
*	Fumariaceae	<i>Fumaria bastardii</i>	Bastards Fumitory							#	
	Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge		1					#	
*	Asteraceae	<i>Gamochaeta americana</i>	Cudweed	2					3		
*	Asteraceae	<i>Gamochaeta</i> sp								#	
	Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	1	2	2	2			#	#
	Geraniaceae	<i>Geranium homeanum</i>	Native Geranium							#	
	Geraniaceae	<i>Geranium solanderi</i> ssp <i>solanderi</i>	Native Geranium							#	#
	Poaceae	<i>Glyceria</i> sp								#	
	Fabaceae - Faboideae	<i>Glycine clandestina</i>			2			2		#	#
	Fabaceae - Faboideae	<i>Glycine microphylla</i>	Small-leaf glycine								#
	Fabaceae - Faboideae	<i>Glycine tabacina</i>		2					2	#	#
*	Apocynaceae	<i>Gomphocarpus fruticosus</i>	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	<i>Hardenbergia violacea</i>	Purple Coral Pea							#	#
	Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower							#	#
	Malvaceae	<i>Hibiscus heterophyllus</i> ssp <i>heterophyllus</i>	Native Rosella							#	
	Clusiaceae	<i>Hypericum japonicum</i>								#	
*	Asteraceae	<i>Hypochaeris radicata</i>	Catsear					2		#	
*	Asteraceae	<i>Hypochaeris</i> sp	White Flatweed							#	
	Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Golden Weather-grass								#
*	Balsaminaceae	<i>Impatiens walleriana</i>								#	
	Fabaceae - Faboideae	<i>Indigofera australis</i>	Australian Indigo							#	#
	Poaceae	<i>Joycea pallida</i>	Silvertop Wallaby Grass							#	
	Juncaceae	<i>Juncus usitatus</i>	Common Rush							#	
	Fabaceae - Faboideae	<i>Kennedia rubicunda</i>	Dusky Coral Pea							#	
**RR	Verbenaceae	<i>Lantana camara</i>	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	<i>Legnephora moorei</i>	Round-leaf Vine							#	
*	Brassicaceae	<i>Lepidium</i> sp		2				2			
	Ericaceae - Styphelioideae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath							#	
*	Oleaceae	<i>Ligustrum lucidum</i>	Large Leaved Privet							#	
	Arecaceae	<i>Livistona australis</i>	Cabbage Fan-palm							#	
*	Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass							#	
	Moraceae	<i>Maclura cochinchinensis</i>	Cockspur Thorn		1		1			#	
	Apocynaceae	<i>Marsdenia rostrata</i>	Milk Vine				1			#	
*	Fabaceae - Faboideae	<i>Medicago lupulina</i>	Black Medic	1							
	Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree							#	
	Meliaceae	<i>Melia azedarach</i>	White Cedar							#	#
	Violaceae	<i>Melicytus dentatus</i>	Tree Violet							#	
	Poaceae	<i>Microlaena stipoides</i> var <i>stipoides</i>	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	<i>Modiola caroliniana</i>	Red-flowered Mallow	3				3	3		
	Myrsinaceae	<i>Myrsine variabilis</i>		1	2					#	
	Oleaceae	<i>Notelaea ovata</i>								#	
	Oleaceae	<i>Notelaea venosa</i>	Veined Mock-olive							#	#
	Asteraceae	<i>Olearia viscidula</i>	Wallaby Weed							#	
	Poaceae	<i>Oplismenus aemulus</i>	Oplismenus	2						#	#
	Poaceae	<i>Oplismenus imbecillis</i>	Oplismenus		3						#
*	Oxalidaceae	<i>Oxalis corniculata</i>		2				2	2	#	
	Oxalidaceae	<i>Oxalis exilis</i>									#
	Oxalidaceae	<i>Oxalis perennans</i>								#	
	Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine		2		2			#	#
*	Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort							#	
	Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod				1			#	#
*	Poaceae	<i>Paspalum dilatatum</i>	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	<i>Passiflora subpeltata</i>	White Passionflower		1		2			#	
*	Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass						3	#	
*	Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed							#	
*	Pinaceae	<i>Pinus radiata</i>	Radiata Pine							#	
	Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn		1		1			#	#
	Pittosporaceae	<i>Pittosporum revolutum</i>	Wild Yellow Jasmine							#	#
	Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum							#	#
*	Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	2				3		#	
	Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower							#	
	Poaceae	<i>Poa affinis</i>	Poa						2		
	Poaceae	<i>Poa labillardierei</i>	Tussock Grass							#	
	Euphorbiaceae	<i>Poranthera microphylla</i>								#	
	Portulacaceae	<i>Portulaca oleracea</i>	Pigweed								#
	Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot							#	

Status	Family	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower	3	2		2		2	#	#
	Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry							#	
	Santalaceae	<i>Santalum obtusifolium</i>	Blunt Sandalwood							#	
*	Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	3				3	2	#	
*	Fabaceae - Caesalpinioideae	<i>Senna pendula</i> var <i>glabrata</i>				1				#	
*	Poaceae	<i>Setaria gracilis</i>	Slender Pigeon Grass							#	
*	Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	4				4	3	#	
	Asteraceae	<i>Sigesbeckia orientalis</i> ssp <i>orientalis</i>								#	#
*	Solanaceae	<i>Solanum linnaeanum</i>								#	
*	Solanaceae	<i>Solanum mauritianum</i>		1		1					
*	Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade							#	
*	Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	2						#	
*	Poaceae	<i>Sporobolus africanus</i>	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	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass								#
*	Caryophyllaceae	<i>Stellaria media</i>	Common Chickweed							#	
*	Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass							#	
	Moraceae	<i>Streblus brunonianus</i>	Whalebone Tree							#	
*	Asteraceae	<i>Tagetes minuta</i>	Stinking Roger							#	
*	Asteraceae	<i>Taraxacum officinale</i>	Dandelion					2		#	
*	Bignoniaceae	<i>Tecoma capensis</i>	Cape Honeysuckle							#	
	Poaceae	<i>Themeda australis</i>	Kangaroo Grass							#	
*	Commelinaceae	<i>Tradescantia fluminensis</i>	Wandering Jew							#	
*	Fabaceae - Faboideae	<i>Trifolium repens</i>	White Clover							#	
	Apocynaceae	<i>Tylophora barbata</i>	Bearded Tylophora		2		2			#	
*	Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	2						#	
	Asteraceae	<i>Vernonia cinerea ssp cinerea</i>								#	
	Scrophulariaceae	<i>Veronica calycina</i>	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	<i>Veronica plebeia</i>	Trailing Speedwell	1				1		#	#
*	Poaceae	<i>Vulpia muralis</i>								#	
	Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell								#
	Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell							#	#
*	Asteraceae	<i>Xanthium occidentale</i>	Noogoora Burr							#	
	Asteraceae	<i>Xerochrysum bracteatum</i>	Golden Everlasting							#	#
	Fabaceae - Faboideae	<i>Zornia dyctiocarpa</i>	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	<ul style="list-style-type: none"> Species recorded on site during current or previous assessment/s. Sufficient good quality habitat is present on site.
Medium	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> No records within 5 km of the site. Marginal habitat present (low quality & extent). Substantial loss of habitat since any previous record(s).
Negligible	<ul style="list-style-type: none"> 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
<i>Boronia deanei</i>	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.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	VU	E1	#		Low	Marginal habitat present (low quality & extent).	<i>Caladenia tessellata</i> 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
<i>Chorizema parviflorum</i>	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 <i>Eucalyptus tereticornis</i> and/or Woollybutt <i>E. longifolia</i> . At Austinmer, the species is recorded from a coastal headland.
<i>Cryptostylis hunteriana</i>	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 <i>E.sclerophylla</i> , <i>E. sieberi</i> , <i>Corymbia gummifera</i> and <i>Allocasuarina littoralis</i> ; appears to prefer open areas in the understorey of this community and is often found in association with the <i>Cryptostylus subulata</i> . 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
<i>Cynanchum elegans</i>	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. <i>Cynanchum elegans</i> usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; <i>Leptospermum laevigatum</i> , <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> ; <i>E. tereticornis</i> open forest and woodland; <i>E. maculata</i> open forest and woodland; and <i>Melaleuca armillaris</i> 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.
<i>Daphnandra johnsonii</i>		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
<i>Irenepharsus trypherus</i>	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 <i>Backhousia myrtifolia</i> thicket, and rainforest.
<i>Melaleuca biconvexa</i>	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
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	#		Negligible	Habitat not present on site	<p>Once widespread on the Cumberland Plain, <i>Pimelea spicata</i> occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment.</p> <p>In western Sydney, <i>P. spicata</i> 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: <i>E. moluccana</i>, <i>E. tereticornis</i>, <i>E. crebra</i>, <i>Bursaria spinosa</i>, and <i>Themeda australis</i>.</p> <p>In the Illawarra region, <i>P. spicata</i> is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include <i>E. tereticornis</i>, <i>E. eugenoides</i>, <i>Themeda australis</i>, and <i>Lomandra longifolia</i>. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey.</p> <p><i>Pimelea spicata</i> flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for <i>P. spicata</i> vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.</p>

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	EN	E1	2007/#		Low	Marginal habitat present (low quality & extent).	<p>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 <i>Eucal</i> White-flowered Wax Plant <i>yptus tereticornis</i>, <i>E. longifolia</i> and <i>Melaleuca decora</i>. Near Nowra, the species grows in an open forest of <i>Corymbia maculata</i>, <i>E.tereticornis</i> and <i>E. paniculata</i>. In the Hunter region, the species grows in open woodland dominated by <i>E. crebra</i>, Forest Red Gum and <i>Callitris endlicherii</i>.</p> <p>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.</p>
<i>Solanum celatum</i>			E1	2010		Low	Marginal habitat present (low quality & extent).	<p>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</p>

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Streblus pendulinus</i>	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.
<i>Thesium australe</i>	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. <i>Thesium australe</i> 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 <i>Themeda australis</i> , but also found on other grass species at inland sites. Occurs on clay soils in grassy woodlands or coastal headlands.
<i>Zieria granulata</i>	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 <i>Melaleuca armillaris</i> scrub, <i>E. tereticornis</i> 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:

EX - Extinct
CR - Critically Endangered
EN - Endangered
VU - Vulnerable
CD - Conservation dependent

TSC Act:

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

		<i>Streptopelia chinensis</i>	Spotted Turtle-Dove *	#	#
		<i>Pardalotus striatus</i>	Striated Pardalote		#
		<i>Acanthiza lineata</i>	Striated Thornbill	#	#
		<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	#	#
		<i>Malurus cyaneus</i>	Superb Fairy-wren	#	
		<i>Rhipidura leucophrys</i>	Willie Wagtail		#
		<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	#	
		<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	#	#
		<i>Felis catus</i>	Cat *		#
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat		#
		<i>Trichosurus vulpecula</i>	Common Brushtail Possum		#
	V	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		#
	V	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		#
		<i>Macropus giganteus</i>	Eastern Grey Kangaroo		#
		<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat		#
		<i>Vulpes vulpes</i>	Fox *		#
		<i>Mormopterus</i> sp. 2	Freetail Bat		#
VU	V	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox		#
		<i>Equus caballus</i>	Horse *	#	#
		<i>Vespadelus darlingtoni</i>	Large Forest Bat		#
		<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		#
	V	<i>Miniopterus australis</i>	Little Bentwing-bat		#
		<i>Vespadelus vulturnus</i>	Little Forest Bat		#
		<i>Oryctolagus cuniculus</i>	Rabbit *	#	#
		<i>Wallabia bicolor</i>	Swamp Wallaby	#	
		<i>Tadarida australis</i>	White-striped Freetail-bat		#
		<i>Litoria dentata</i>	Bleating Tree Frog		#
		<i>Crinia signifera</i>	Common Eastern Froglet		#
		<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	#	
		<i>Amphibolurus muricatus</i>	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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
	<ul style="list-style-type: none"> 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							
<i>Botaurus poiciloptilus</i>	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 <i>Typha</i> spp. and <i>Eleocharis</i> 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.
<i>Rostratula australis</i>	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.
<i>Ninox connivens</i>	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.
<i>Ixobrychus flavicollis</i>	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.
<i>Ephippiorhynchus asiaticus</i>	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.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	EN	E1	#	Negligible	Suitable habitat not present.	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.
<i>Sternula nereis nereis</i>	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
<i>Petroica phoenicea</i>	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.
<i>Stictonetta naevosa</i>	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.
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo		V, E2	1999	Low	Although individuals may overfly the study area on occasion significant habitat features, including breeding habitat and foraging resources, not present	Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> 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
<i>Neophema chrysogaster</i>	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 <i>Sarcocornia quinqueflora</i> Beaded Glasswort and <i>Sclerostegia arbuscula</i> 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.
<i>Erythroriorchis radiatus</i>	Red Goshawk	VU	E4A	#	Negligible	Suitable habitat not present.	Occur in forest and woodland habitat near permanent water. In NSW prefer <i>Melaleuca</i> 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.
<i>Anthochaera phrygia</i>	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: <i>E. microcarpa</i> , <i>E. punctata</i> , <i>E. polyanthemos</i> , <i>E. mollucana</i> , <i>Corymbia robusta</i> , <i>E. crebra</i> , <i>E. caleyi</i> , <i>C. maculata</i> , <i>E. mckieana</i> , <i>E. macrorhyncha</i> , <i>E. laevopinea</i> and <i>Angophora floribunda</i> . Nectar and fruit from the mistletoes <i>A. miquelii</i> , <i>A. pendula</i> , <i>A. cambagei</i> 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
<i>Lathamus discolor</i>	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 <i>E. robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . 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
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V	2009	Medium	Suitable habitat present. The Varied Sittella, although rare, is occasionally 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							
<i>Hoplocephalus bungaroides</i>	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							
<i>Mixophyes iteratus</i>	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.
<i>Heleioporus australiacus</i>	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
<i>Litoria aurea</i>	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
<i>Litoria littlejohni</i>	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
<i>Mixophyes balbus</i>	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							
<i>Petrogale penicillata</i>	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
<i>Miniopterus schreibersii oceanensis</i>	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.
<i>Falsistrellus tasmaniensis</i>	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.
<i>Scoteanax rueppellii</i>	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
<i>Pteropus poliocephalus</i>	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.
<i>Phascolarctos cinereus</i> (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 <i>E. robusta</i> , <i>E. tereticornis</i> , <i>E. punctata</i> , <i>E. haemostoma</i> and <i>E. signata</i> . 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
<i>Chalinolobus dwyeri</i>	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.
<i>Miniopterus australis</i>	Little Bentwing-bat		V	2011	Recorded (?)	This species was purportedly 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.
<i>Potorous tridactylus tridactylus</i>	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, but 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
<i>Pseudomys novaehollandiae</i>	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.
<i>Pseudomys fumeus</i>	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
<i>Isoodon obesulus obesulus</i>	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.
<i>Dasyurus maculatus</i>	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 corridor 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
<i>Anthochaera phrygia</i>	Regent Honeyeater
<i>Apus pacificus</i>	Fork-tailed Swift
<i>Ardea ibis</i>	Cattle Egret
<i>Ardea modesta</i>	Eastern Great Egret
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper
<i>Calidris melanotos</i>	Pectoral Sandpiper
<i>Caretta caretta</i>	Loggerhead Turtle
<i>Chelonia mydas</i>	Green Turtle
<i>Danaus plexippus</i>	Monarch Butterfly
<i>Dermochelys coriacea</i>	Leathery Turtle
<i>Eretmochelys imbricata</i>	Hawksbill Turtle
<i>Gallinago hardwickii</i>	Latham's Snipe
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle
<i>Hirundapus caudacutus</i>	White-throated Needletail
<i>Lamna nasus</i>	Porbeagle, mackerel shark
<i>Merops ornatus</i>	Rainbow Bee-eater
<i>Monarcha melanopsis</i>	Black-faced Monarch
<i>Myiagra cyanoleuca</i>	Satin Flycatcher
<i>Neophema chrysogaster</i>	Orange-bellied Parrot
<i>Plegadis falcinellus</i>	Glossy Ibis
<i>Pluvialis fulva</i>	Pacific Golden Plover
<i>Rhipidura rufifrons</i>	Rufous Fantail
<i>Rostratula australis</i>	Australian Painted Snipe
<i>Tringa stagnatilis</i>	Marsh Sandpiper

Appendix 6: Flora and fauna assessment (Biosis 2017c)



Lot 101 DP 785139 Crest Road, Albion Park: Flora and Fauna Assessment

FINAL REPORT V03

Prepared for MMJ Real Estate on behalf of Spinitu Pty Ltd

18 April 2017

Biosis offices

AUSTRALIAN CAPITAL TERRITORY

Canberra

Floor 1, Unit 3, 38 Essington Street
Mitchell ACT 2911

Phone: (02) 6102 1200

Email: canberra@biosis.com.au

NEW SOUTH WALES

Newcastle

39 Platt Street
Waratah NSW 2298

Phone: (02) 4911 4040

Email: newcastle@biosis.com.au

Sydney

Unit 14 17-27 Power Avenue
Alexandria NSW 2015

Phone: (02) 9101 8700

Email: sydney@biosis.com.au

Wollongong

8 Tate Street
Wollongong NSW 2500

Phone: (02) 4201 1090

Email: wollongong@biosis.com.au

QUEENSLAND

Brisbane

Suite 4 First Floor, 72 Wickham Street
Fortitude Valley QLD 4006

Phone: (07) 3831 7400

Email: brisbane@biosis.com.au

VICTORIA

Ballarat

506 Macarthur Street
Ballarat VIC 3350

Phone: (03) 5304 4250

Email: ballarat@biosis.com.au

Melbourne (Head Office)

38 Bertie Street
Port Melbourne VIC 3207

Phone: (03) 8686 4800

Fax: (03) 9646 9242

Email: melbourne@biosis.com.au

Wangaratta

16 Templeton Street
Wangaratta VIC 3677

Phone: (03) 5721 9453

Email: wangaratta@biosis.com.au

Document information

Report to: Spinitu Pty Ltd

Prepared by: Nathan Garvey

Biosis project no.: 18852

File name: 18852.Crest.Rd.Albion Park.FFA.FIN03.20170418.no_markup

Citation: Biosis (2016). Flora and Fauna Assessment for Crest Road, Albion Park. Report for MMJ Real Estate and Spinitu Pty Ltd. Authors: N. Garvey, Biosis Pty Ltd, Wollongong. Project no 18852.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Stefan Rose	30/11/2015
Final version 01	Nathan Garvey	11/02/2016
Final version 02	Mathew Misdale	19/07/2016
Final version 03	Kylie Reed	13/04/2017
Final version 04		

Acknowledgements

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

- Spinitu Pty Ltd: Peter Robertson
- MMJ Real Estate: Luke Rollinson
- LandTeam Australia: Dijana Harrison and Alex Gollan

Biosis staff involved in this project were:

- Mathew Misdale, Craig Dunne and Axton Aguiar (assistance in the field).
- Lauren Harley and Ashleigh Pritchard (mapping)

© Biosis Pty Ltd

This document is and shall remain the property of Biosis Pty Ltd. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

Summary	vi
1. Introduction	10
1.1 Project background	10
1.2 Scope of assessment	10
1.3 Location of the study area	11
2. Methods	14
2.1 Nomenclature	14
2.2 Literature and database review	14
2.3 Site investigation	15
2.3.1 Flora and fauna assessment	15
2.3.2 Permits and Licences	15
2.4 Mapping	16
2.5 Limitations	16
3. Legislative context	17
3.1 Commonwealth	17
3.1.1 Environment Protection and Biodiversity Conservation Act 1999	17
3.2 State	17
3.2.1 Environmental Planning and Assessment Act 1979	17
3.2.2 Threatened Species Conservation Act 1995	19
3.2.3 Native Vegetation Act 2003	19
3.2.4 Noxious Weeds Act 1993	19
4. Results	20
4.1 Landscape context	20
4.1.1 Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study, City of Shellharbour (Mills 2007)	20
4.1.2 Flora and Fauna Assessment, Lot 1011 DP 785139 Crest Road, Albion Park (Eco Logical 2011)	20
4.1.3 Habitat connectivity	21
4.2 Flora and fauna	21
4.3 Vegetation communities and fauna habitat	22
4.4 Threatened biota	26
5. Ecological impacts and recommendations	31
5.1 Potential impacts before avoidance, minimisation and offset considerations	31
5.2 Impact avoidance and minimisation recommendations	31
5.3 Residual impacts	33

5.4	Based on these residual impacts to Illawarra Lowlands Grassy Woodland listed under the EPBC Act, the project will require suitable offsets that are consistent with the EPBC Act Environmental Offsets Policy (CoA 2012). Biodiversity legislation and government policy	35
5.4.1	Environment Protection and Biodiversity Conservation Act 1999	35
5.4.2	Environmental Planning and Assessment Act 1979	36
5.4.3	Threatened Species Conservation Act 1995	37
5.4.4	Noxious Weeds Act 1993	37
6.	Conclusion	39
	References	41
	Appendices	43
	Appendix 1: Flora	44
	Appendix 2: Fauna	65
	Appendix 3: Assessments of Significance	114
	Appendix 4: Significant Impact Criteria assessments	120
	Appendix 5: Vegetation management plan	124
	Appendix 6: EcoLogical FFA (2011)	125

List of Figures

Figure 1: Location of the study area, Albion Park, NSW	12
Figure 2: Location of the subject site (proposed works) within the study area	13
Figure 3: Ecological features of the study area	28
Figure 4: Threatened flora species recorded within five kilometres of the study area	29
Figure 5: Threatened fauna species recorded within five kilometres of the study area	30
Figure 6: Management of native vegetation and fauna habitat within the study area	38

List of Tables

Table 1: Vegetation communities and fauna habitat of the study area	22
Table 2: Summary of threatened biota likely to occur in the study area	26
Table 3: Recommendations to avoid, minimise and mitigate impacts to identified ecological features..	32
Table 4: Vegetation removal within the subdivision	34
Table 5: Assessment of the project against the EPBC Act	35
Table 6: Flora species recorded from the study area	45
Table 7: Threatened flora species recorded / predicted to occur within five kilometres of the study area .	58
Table 8: Vertebrate fauna recorded from the study area (current assessment)	65
Table 9: Threatened fauna species recorded, or predicted to occur, within five kilometres of the study area	69
Table 10: Migratory fauna species recorded or predicted to occur within five of the study area	93

Table 11: Hollow bearing trees recorded within the study area	95
---	----

List of Plates

Plate 1: Illawarra Lowlands Grassy Woodland, higher plateau area.....	24
Plate 2: Illawarra Lowlands Grassy Woodland, north east slopes.....	24
Plate 3: Scattered trees	26

Glossary

AoS	Assessment of Significance
APZ	Asset Protection Zone
BA	Birds Australia
CAVs	Census of Australian Vertebrates
CBD	Central Business District
DA	Development Application
DBH	Diameter at Breast Height
DEE	Department of the Environment and Energy (Commonwealth)
DP&E	Department of Planning and Environment (NSW)
EEC	Endangered Ecological Community
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FM Act	<i>NSW Fisheries Management Act 1994</i> (NSW)
HBT	Hollow Bearing Tree
GIS	Geographic Information System
KTP	Key Threatening Process
LEP	Local Environment Plan
LGA	Local Government Area
MNES	(Matter of) National Environmental Significance
NSW	New South Wales
NV Act	<i>Native Vegetation Act 2003</i> (NSW)
NW Act	<i>Noxious Weed Act 1993</i> (NSW)
OEH	NSW Office of Environment and Heritage
SEPP	State Environmental Planning Policy
study area	Lot 101 DP 785139, Crest Road, Albion Park
subject site	The area of impact for the proposed works within the study area
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
VMP	Vegetation Management Plan

Summary

Biosis Pty Ltd was commissioned by MMJ Real Estate (MMJ), on behalf of Spinitu Pty Ltd, to undertake a flora and fauna assessment (FFA) for Lot 101 DP 785139, Crest Road, Albion Park (the study area).

MMJ previously submitted a Planning Proposal to rezone land in the study area to a mix of E3 Environmental Management and R2 Low Density Residential. To inform the rezoning application, Biosis has previously undertaken a BioBanking Assessment of the study area (Biosis 2012). Shellharbour City Council (Council) has since adopted the proposed rezoning outcome and is currently in the process of finalising the application with the NSW Department of Planning & Environment (DP&E). Landowners now wish to progress with the preparation of a land subdivision Development Application (DA) for the creation of approximately 72 housing lots within the study area for which Biosis has been requested to provide a FFA.

A number of previous ecological assessments of the study area have been undertaken by Biosis (2012), Kevin Mills (2007) and Eco Logical (2011) (Appendix 6). This FFA utilises the information from these previous ecological assessments to identify potential impacts to biodiversity values present within the study area.

Ecological values

Key ecological values identified within the study area include:

- 8.36 hectares of Forest Red Gum – Thin-leaved Stringybark grassy woodland, including 5.76 hectares which is consistent with the TSC Act listed *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion*, endangered ecological community (EEC) and the EPBC Act listed *Illawarra and south coast lowland forest and woodland ecological community*, critically endangered ecological community (CEEC) consistent with the moderate condition class*.
- The presence of seven White-flowered Wax Plants *Cynanchum elegans*, listed under both the TSC Act and EPBC Act, at two locations.
- The presence of the one threatened bird species (Flame Robin *Petroica phoenicea*), four threatened mammal species (Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*, Little Bentwing-bat *Miniopterus australis*, Eastern False Pipistrelle *Falsistrellus tasmaniensis* and the Grey-headed Flying-fox *Pteropus poliocephalus*, listed under the TSC and EPBC Acts.
- Potential habitat for an additional threatened flora species (Illawarra Zieria *Zieria granulata*) and two threatened fauna species (Greater Broad-nosed Bat *Scoteanax rueppellii* and Varied Sitella *Daphoenositta chrysoptera*).
- 33 hollow bearing trees, 24 providing potential habitat for a number of general and threatened flora and fauna species, including roosting habitat for two threatened microchiropteran bats.

*On 16 September 2016, *Illawarra and south coast lowland forest and woodland ecological community*, was newly listed as a Matter of National Environmental Significance (MNES) under the Environmental Protection and Biodiversity Protection Act 1999 (EPBC Act) as a Critically Endangered Ecological Community (CEEC). Assessments of the vegetation have been updated to take into account the Approved Conservation Advice (incorporating listing advice) for the Illawarra and South Coast Lowland Forest and Woodland Ecological Community (TSSC 2016).

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
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	White-flowered Wax Plant and Illawarra and south coast lowland forest and woodland ecological community are present within the study area.	Significant Impact Criteria assessments have been undertaken for White-flowered Wax Plant and Illawarra and south coast lowland forest and woodland ecological community. Referral for White-flowered Wax Plant is not required. Referral for the removal of moderate condition Illawarra and south coast lowland forest and woodland ecological community is recommended.
<i>Threatened Species Conservation Act 1995</i>	Threatened species and ecological communities including Illawarra Lowlands Grassy Woodland, White-flowered Wax Plant, Flame Robin, Eastern Bentwing-bat, Little Bentwing-bat, Eastern False Pipistrelle and the Grey-headed Flying-fox are present within the study area.	The proposed subdivision is unlikely to result in a significant effect to these species. A Species Impact Statement is not required.
<i>Environmental Planning & Assessment Act 1979</i>	Threatened species and ecological communities	Assessment of Significance is required under S.5A of the EP&A Act were completed. Significant effect is unlikely to result from the proposed subdivision.
<i>State Environmental Planning Policy No 44</i>	SEPP44 does not apply to the Shellharbour City Council Local Government Area.	
<i>Noxious Weeds Act 1993</i>	<p>The following noxious weeds are present within the study area:</p> <ul style="list-style-type: none"> • Lantana <i>Lantana camara</i> • Blackberry <i>Rubus fruticosus</i> • Fireweed <i>Senecio madagascariensis</i>. • Ground Asparagus <i>Asparagus aethiopus</i> • Bridal creeper <i>Asparagus asparagoides</i>. 	<p>All five noxious weeds are listed as Class 4, meaning that "the growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold, propagated or knowingly distributed".</p> <p>Land owners within the study</p>

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required
		area have an obligation under the Noxious Weeds Act 1993 to control all noxious weeds on their land according to the specified control class.

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

Overall, the native vegetation to be removed supports a variable, but mostly degraded midstorey and groundcover within the study area. In its current form the development will result in the removal of 3.06 hectares of Illawarra Lowlands Grassy Woodland listed under the TSC Act and EPBC Act. This will include a further 1.10 hectares of permanent modification to Illawarra Lowlands Grassy Woodland CEEC for Asset Protection Zones (APZ). The project design includes 2.7 hectares of Illawarra Lowlands Grassy Woodland that will be retained and managed within an EMA (EMA) (Figure 6). An Assessment of Significance (AoS) did not find the removal of this vegetation significant as the reduction in area was unlikely to result in direct and indirect effects that would cause local extinction of the EEC (Appendix 3).

When considering the project impacts to the EPBC Act listed vegetation under the Approved Conservation Advice (TSSC 2016), the areas to be removed satisfy the moderate condition class for the CEEC. As such the vegetation and adjacent buffers are considered critical to the survival of the community (TSSC 2016). A Significant Impact Criteria (SIC) assessment (CoA 2013) found that the residual impacts to the CEEC are likely to have a significant impact.

The creation of the EMA will result in the entire known population of the White-flowered Wax Plant being retained within the study area, with the potential for a net positive effect for this species. The areas surrounding the White-flowered Wax Plant will be subject to management buffers with stringent controls. In addition, the EMA will result in the retention and improvement to 2.7 hectares of Illawarra Lowlands Grassy Woodland. A Vegetation Management Plan (VMP) for the EMA will also provide directions for weed removal and revegetation that will provide threat abatement from Lantana and Blackberry, as well as improvements in habitat condition for the White-flowered Wax Plant and Illawarra Lowlands Grassy Woodland in perpetuity.

The removal of hollow-bearing trees from the development footprint will be compensated with the provision of nest boxes at a 1:1 replacement rate (Table 11) to maintain limiting fauna habitat within the study area.

AoS (Appendix 3) and SIC assessments (Appendix 4) for White-flowered Wax Plant and hollow roosting microbats found that the proposed design is unlikely to cause a significant effect of impact.

Recommendations

The primary measure for the development to minimise impacts to the ecological values identified within the subject site is to avoid and minimise the removal of native vegetation and habitat. In addition to the retention of 2.7 hectares of Illawarra Lowlands Grassy Woodland and White-flowered Wax Plant habitat within the EMA, the area has been rezoned as an E3 Environmental Management zone. This will provide additional development controls to maintain the site for environmental outcomes in the future.

Other measures to mitigate impacts to identified ecological features include:

- Retention of all hollow-bearing trees within the EMA.
- Retention of hollow-bearing trees within the development area, where not occurring within development envelopes, fence lines, soil cut areas, and if safe to do so.

- Installation of bushfire asset protection zones within the development and EMA area will prioritise retention of trees in the following sequence:
 - Hollow-bearing trees.
 - Canopy tree species (Forest Red Gum *Eucalyptus tereticornis* and Thin-leaved Stringybark *E. eugenoides*) over midstorey species of *Acacia*, *Melaleuca* and *Callistemon*
 - Largest to smallest DBH.
- Any hollow-bearing limbs, removed as a part of the subdivision, should be relocated into the EMA.
- Locating residential dwellings and the dwelling envelope within the EMA away from known locations of the White-flowered Wax Plant.
- Ensuring appropriate management of known locations for the White-flowered Wax Plant through strict adherence to the VMP.

The extent of clearing of Illawarra Lowlands Grassy Woodland CEEC listed under the EPBC Act for the proposed residential design is considered a significant impact and the preparation of a referral to the Commonwealth Minister for the Department of Environment and Energy for assessment of the project is recommended.

Under the EPBC Act Offsets Policy (Commonwealth of Australia 2012), any significant residual impact following the consideration of impact avoidance and minimisation measures will require offsets. This includes direct impacts arising from the removal of the CEEC, as well as indirect impacts within a 30 metre buffer.

1. Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by MMJ Real Estate (MMJ) on behalf of Spinutu Pty Ltd to undertake a flora and fauna assessment (FFA) of land at Lot 101 DP 785139 Crest Road, Albion Park (the study area; Figure 1). MMJ is currently preparing a Development Application (DA) for the subdivision of land into 71 residential lots, one environmental lot and one public reserve plus associated roads, infrastructure and asset protection zones (the subject site; Figure 2).

Biosis has previously undertaken a preliminary BioBanking Assessment of the study area (Biosis 2012) for the planning submission (MMJ 2011) which identified the biodiversity values present within the study area. The outcome of the Planning Proposal was to rezone land in the study area to a mix of R2 Low Density Residential, across the disturbed western portion, and E3 Environmental Management in areas supporting less disturbed native vegetation and threatened species.

The FFA identifies the impact of the proposed residential subdivision on existing biodiversity values and outlines measures to manage the E3 zoned area to ensure existing biodiversity values are appropriately protected and managed. The FFA has been compiled based on previous ecological assessments conducted within the study area and existing database records for threatened species, populations and communities known and expected to occur within the study area.

The FFA incorporates the listing for Illawarra Lowlands Grassy Woodland CEEC on 16 September 2016 and provides a summary of impacts and requirements that are required under the EPBC Act.

1.2 Scope of assessment

The objectives of this investigation are to:

- Update previous database searches relating to flora and terrestrial fauna issues relevant to the study area, including the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife and the Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool.
- Review previous assessment work undertaken by Biosis (2012), Ecological (2011) and Kevin Mills (2007).
- Preparation of a flora and fauna assessment report that will:
 - Discuss the ecological values present within the study area, including vegetation communities and the potential for threatened species and communities to occur.
 - Review the implications of relevant biodiversity legislation and policy.
 - Identify potential implications of the proposed development and provide recommendations to assist with development design.
 - Recommend any further assessments of the study area that may be required.

1.3 Location of the study area

The study area is located at Albion Park in the Shellharbour Local Government Area (LGA) (Figure 1) and encompasses approximately 9.65 hectares of privately owned land at the end of Crest Rd, Albion Park (Figure 2). Following the support of the Planning Proposal (MMJ 2011) the study area is zoned R2 Low Density Residential and E3 Environmental Management under the Shellharbour Local Environment Plan (LEP) 2013.

The study area is within the:

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

Figure 1: Location of the study area, Albion Park, NSW

Figure 2: Location of the subject site (proposed works) within the study area

2. Methods

2.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2000, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 1.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the Commonwealth Department of Environment and Energy (DEE) (Commonwealth of Australia 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only. Common and scientific names are included in the fauna list in Appendix 2.

2.2 Literature and database review

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

- DEE Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW BioNet – the database for the Atlas of NSW Wildlife, OEH for threatened species, populations and communities listed under the *Threatened Species Conservation Act 1995* (TSC Act).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2013 (BA).

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 (SCIV) (Tozer et al. 2010).
 - Native Vegetation of the Illawarra Escarpment and Coastal Plain (NPWS 2002a).

The following reports were also reviewed:

- Illawarra Biodiversity Strategy. Volume 1 and Volume 2 (WCC et al. 2011a and 2011b).
- 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).
- Flora and Fauna Assessment. Lot 1011 DP 785139 Crest Road, Albion Park. (Ecological 2011) (Appendix 6).

- Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment (Biosis 2012).

2.3 Site investigation

2.3.1 Flora and fauna assessment

Initial diurnal flora and fauna surveys were carried out over the study area on 11 December 2012 as part of the Biobanking Assessment prepared by Biosis (2012). A subsequent site investigation for vegetation condition was undertaken on 5 June 2015, and an updated fauna habitat assessment on 23 June 2016. Sections from Biosis (2012) relevant to the flora and fauna assessment have been reviewed and updated in this report. Flora surveys have included:

- Mapping of vegetation communities, including an assessment of floristic composition and condition.
- Review of collated data and condition assessment to confirm the presence of Illawarra Lowlands Grassy Woodland EEC and CEEC under the TSC Act and EPBC Act, respectively.
- Random meanders over the study area 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:
 - Eastern Flame Pea *Chorizema parviflorum* (threatened population)
 - White-flowered Wax Plant *Cynanchum elegans*
 - *Solanum celatum*
 - Illawarra Zieria *Zieria granulata*.
- Searches to locate and confirm the continued presence of threatened flora species recorded in previous surveys by Eco Logical (2011).

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 Eco Logical (2011) or identified during database review and their habitats. Fauna species were recorded with a view to characterising the values of the site as the investigation was not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

During fauna surveys, a hollow bearing tree assessment was carried out in order to determine the habitat values present for hollow-dependent fauna species (11 December 2012 and 23 June 2016). All trees within the study area were visually inspected for hollows, and signs of fauna occupation. When a hollow-bearing tree was identified, a waypoint was taken and details of hollow size, height and suitability were recorded (Table 11).

A list of flora and fauna species was compiled and are presented in Appendix 1 (flora) and Appendix 2 (fauna). Records of all flora and fauna species will be submitted to OEH for incorporation into the Atlas of NSW Wildlife.

2.3.2 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 under the *National Parks and Wildlife Act 1973* (SL100758, expiry date 31

March 2017). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2017).

2.4 Mapping

LandTeam Australia Pty Ltd has provided a subdivision plan. This subdivision plan is shown in Figure 2 and includes:

- Zone boundaries.
- The proposed lot layout, including lot boundaries, roads, soil cuts, and stormwater infrastructure.
- The location of asset protection zones (APZs).

The subdivision plan was digitised 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 computer with GPS capability. The accuracy of the hand held GPS mapping is subject to the accuracy of the GPS units (generally ± 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 the Illawarra Lowlands Grassy Woodland EEC.

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

2.5 Limitations

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.

Biosis (2012) conducted initial survey effort for their Biobanking Assessment over one day in summer 2012. The survey effort was based on the nature of the proposal, the scope and the objectives of the BBAM. This inspection was updated in June 2015 and provided a seasonal comparison of condition of vegetation and re-assessment of hollow-bearing trees in June 2016.

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 in the study area have been made from desktop assessments, background research the 2012, 2015 and 2016 surveys and previous site inspections by Eco Logical (2011).

Tree counts for the site are based on Moore Trees (2016) that did not cover the entire site. Estimates of the number of trees present within the study area and EMA have been based on the number of trees per area found within the IPA area and extrapolated for the APZ Outer Protection Zone (104) and residual EMA areas (254).

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.

3. Legislative context

This section provides an overview of key biodiversity legislation and government policy considered in this assessment. 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.

3.1 Commonwealth

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation. 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.

Nine Matters of NES are identified under the EPBC Act:

- World heritage properties
- National heritage places
- Wetlands of international importance (also known as 'Ramsar' wetlands)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on Matters of NES must be referred to the Commonwealth Minister for the Environment for assessment.

Matters of NES relevant to the current project include nationally threatened species and ecological communities, migratory species and Ramsar wetlands. Threatened species and ecological communities protected by the EPBC Act are outlined in Section 4.4. An assessment of potential impacts to all Matters of NES under the provisions of the EPBC Act is provided in Section 5.4.1 with Significant Impact Criteria (SIC) assessments provided in Appendix 4.

3.2 State

3.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (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 EP&A Act is administered by the NSW Department of Planning and Environment (DP&E).

The EP&A Act provides the overarching structure for planning in NSW and is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

Assessment of Significance (Part 1, Section 5A)

Section 5A of the EP&A Act is an integral part of environmental impact assessment and 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 *Fisheries Management Act 1994* (FM Act). The objective of the Assessment of Significance (AoS) (also known as the “7-part test”) is to improve the standard of, and make transparent, the considerations given to threatened species, populations and ecological communities, and their habitats. Section 5A (and Section 94 of the TSC Act) outlines seven factors that must be taken into account. Typically, where any AoS determines that a development will result in a significant effect to a threatened species, population or community, a Species Impact Statement (SIS) is required.

Threatened species, populations and communities listed under the TSC Act are discussed in Section 4.4. An assessment of whether the project will result in a significant effect to these threatened species, populations and communities is summarised in Section 5.4.2, with AoS's provided in Appendix 3.

State Environmental Planning Policies (Part 3, Division 2)

State Environmental Planning Policies (SEPPs) are environmental planning instruments under the EP&A Act that outline policy objectives relevant to State or regional environmental planning issues. There are over 65 SEPPs; however, only those relevant to the proposed development have been considered and are detailed below.

SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP.

The study area is located within the Shellharbour LGA, which is not listed within Schedule 1. Therefore SEPP No. 44 is not relevant to the current assessment.

Local Environment Plans (Part 3, Division 4)

Local Environment Plans (LEP) are created by councils in consultation with their community and guide planning decisions for LGAs. They apply either to the whole or part of a LGA and make provision for the protection or utilisation of the environment through zoning of land and development controls.

The study area is subject to the Shellharbour LEP 2013 and is zoned R2 Low Density Residential and E3 Environmental Management. The objectives of R2 zoning are to:

- Provide for the housing needs of the community within a low density residential environment.
- Enable other land uses that provide facilities or services to meet the day to day needs of residents.

The objectives of E3 zoning are to:

- Protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.
- Provide for a limited range of development that does not have an adverse effect on those values.
- Retain and enhance the visual and scenic qualities of the Illawarra Escarpment.

The development application includes subdivision for the purposes of low density residential, including associated infrastructure. Low density residential development is located entirely within the R2 zone. Some development of roads and management of vegetation for asset protection zones (APZs) will occur within the E3 zone.

3.2.2 Threatened Species Conservation Act 1995

The TSC Act is the key piece of legislation providing 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. Impacts to threatened species, populations and communities are assessed under Section 5A of the EP&A Act (see above).

The potential for threatened species, populations and communities to occur within and be impacted by the proposed subdivision is assessed in Section 4.4. An assessment of whether the project will result in a significant effect to these threatened species, populations and communities is summarised in Section 5.4.3, with AoS's provided in Appendix 3.

3.2.3 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) provides for, encourages and promotes the management of native vegetation on a regional basis and regulates the clearing of native vegetation on land in NSW. 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.

The study area is zoned R2 Low Density Residential and E3 Environmental Management. Clearing of native vegetation in the R2 zone does not require approval under the NV Act as this zone is considered an 'urban area' under Schedule 1 of the NV Act. Some clearing of native vegetation within the E3 zone will be required for management of APZs. However, as this clearing will be carried out in accordance with a bush fire management plan under the *Rural Fires Act 1997*, approval under the NV Act is not required.

3.2.4 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) was enacted to provide for the identification, classification and control of noxious weeds. The NW Act aims to reduce the negative impact of weeds on the economy, community and environment of NSW by:

- Establishing controls to prevent the establishment of significant new weeds in NSW.
- Preventing, eliminating or restricting the spread of particular significant weeds in NSW.
- Effectively managing widespread significant weeds in NSW.

Plants declared as noxious weeds are currently listed under *Noxious Weeds (Weed Control) Order 2014* published in the NSW Government Gazette No. 23. The NW Act is supported by a number of regulations and is administered by the DPI.

Noxious weeds are discussed further in Section 4.2 with recommendations for adhering to the NW Act provided in Section 5.4.4.

4. Results

The key ecological features of the subject site and study area are described below and mapped in Figure 3. Species recorded during the flora and fauna assessment are listed in Appendix 1 (flora) and Appendix 2 (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.

4.1 Landscape context

The study area has been partially cleared and subject to ongoing disturbance through the use of the site for horse agistment. Grazing and trampling of the flatter, low relief sections of the study area (western two thirds and south-eastern corner) by horses has resulted in a high degree of disturbance in these areas. These areas support mature trees over a low, grazed groundcover consisting of a mix of native and exotic species. The mid-storey in these areas is limited to scattered shrubs around the perimeter.

In the slopes associated with the gully in the north-eastern section of the study area, mature canopy trees occur over a dense mid-storey of Lantana *Lantana camara*. Groundcover is largely denuded, with native species scattered throughout.

A summary of the two previous ecological surveys and assessments that have been carried out on the subject site is provided below

4.1.1 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 Illawarra Lowlands Grassy Woodland on certain properties"* included in the Shellharbour Urban Fringe Local Environment Plan. The study area is referred to by Mills (2007) as 'Study Area 2'. The Mills (2007) investigation was restricted to flora surveys over only part of the study area.

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 Illawarra Lowlands Grassy Woodland compared to other areas of the community in the vicinity . . . 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 western section of the study area.

4.1.2 Flora and Fauna Assessment, Lot 1011 DP 785139 Crest Road, Albion Park (Eco Logical 2011)

Eco Logical (2011) undertook a more detailed terrestrial flora and fauna assessment and constraints analysis of the study area. The main constraints to future rezoning and development identified by Eco Logical included threatened biodiversity listed under the TSC and EPBC Acts including:

- Confirmation of the presence of the Illawarra Lowlands Grassy Woodland EEC, listed under the TSC Act, within the study area.
- Records of the White-flowered Wax Plant *Cynanchum elegans*, listed under the TSC and EPBC Act, in the eastern portion of the study area.

- The potential for the Eastern False Pipistrelle *Falsistrellus tasmaniensis* and Gang-Gang Cockatoo *Callocephalon fimbriatum*, both listed under the TSC Act, to roost in hollow-bearing trees within the study area.

Eco Logical (2011) outlined that the condition of Illawarra Lowlands Grassy Woodland is variable and that this primarily reflects the level of past disturbance. The report recommended that any impacts to the ecological values of the study area through the rezoning be offset using the following measures:

- Restoration of Illawarra Lowlands Grassy Woodland EEC guided by a Vegetation Management Plan (VMP).
- Enhancement of habitat for threatened plant species White-flowered Wax Plant.
- Replacement or replication of hollows to compensate for the loss of hollow-bearing trees.

4.1.3 Habitat connectivity

The study area forms part of vegetated corridor extending north and south of the study area, connecting to the Tongarra – Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al. 2011). Within this corridor, the study area forms part of a partially cleared area along the upper crest, with cleared land extending further south. This land is also proposed for future residential development. On a local scale, the study area acts as a dispersal corridor for more mobile species including avifauna and arboreal mammals. It provides connectivity to interspersed remnant vegetation found among the adjacent rural development.

The surrounding landscape has been modified through clearing for agriculture to the south and west, and for residential development to the north and east.

These developments will not result in the fragmentation of this corridor, with native vegetation to the east and west remaining connected and being maintained.

4.2 Flora and fauna

Species recorded in the current and previous flora and fauna assessments are listed in Appendix 1 (flora) and Appendix 2 (fauna). Unless of particular note, these species are not discussed further. A list of threatened species and populations 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.

Hollow-bearing trees recorded within the study area are detailed in Appendix 2.4, Table 11. A total of 33 hollow-bearing trees were recorded within the study area. Nine trees were assessed as being unsuitable to provide habitat. The remaining 24 trees contained hollows suitable for fauna including:

- Hollow-roosting microbats.
- Hollow breeding small parrot species.
- Hollow breeding medium parrots or small possums.

Of these 24 trees, 16 are located within the residential development footprint, with 8 likely to be removed due to their occurrence within road, fence or building footprints. The trees that fall within these footprints contain a total of 12 hollows.

During the site investigation four noxious weeds as defined by DPI for the Shellharbour LGA were recorded. These noxious weeds include: Lantana, Blackberry *Rubus fruticosus* species aggregate, Fireweed *Senecio madagascariensis*, Ground Asparagus *Asparagus aethiopicus* and Bridal creeper *Asparagus asparagoides*. Management of these noxious weeds is discussed further in Section 5.4.4.

4.3 Vegetation communities and fauna habitat

The vegetation and fauna habitat throughout the majority of the study area has been modified by past disturbances, including clearing and horse agistment, resulting in significant grazing, nutrient loading, erosion and trampling by horses. The north-eastern section of the study area, associated with the gully slopes, supports a high degree of weed cover.

The study area supports a limited number of ecological features, including areas of native vegetation, the presence of the Illawarra Lowlands Grassy Woodland, the presence of the threatened White-flowered Wax Plant and hollow-bearing trees. The vegetation occurs as contiguous vegetation and scattered trees within modified pasture. In total, Moore Trees (Moore Trees 2016) mapped 747 trees consistent with the definitions within the Shellharbour City Council Tree Management Order, Biosis extrapolated that and additional 175 trees are estimated to occur within the Outer APZ and EMA based on the number of trees per mapped within the Inner APZ, making the total estimate of 922 trees within the study area.

The ecological features of the study area are outlined below (refer also to Figure 3).

Table 1: Vegetation communities and fauna habitat of the study area

Illawarra Lowlands Grassy Woodland	
Extent within study area	<p>5.75 hectares of Illawarra Lowlands Grassy Woodland EEC and CEEC is mapped across the study area, as outlined below:</p> <ul style="list-style-type: none"> • 3.06 hectares in the development site • 0.44 hectares in the inner APZ • 0.65 hectares in the outer APZ • 1.60 hectares in the EMA.
Description including fauna habitat	<p>The canopy of this community is dominated by Forest Red Gum <i>Eucalyptus tereticornis</i> over both the flatter plateau area and north east slopes, with Thin-leaved Stringybark <i>Eucalyptus eugenioides</i> also present. Both areas have a very sparse midstorey of regenerating canopy species with occasional Hickory Wattle <i>Acacia implexa</i>, Maiden's Wattle <i>Acacia maidenii</i>, Red Ash <i>Alphitonia excelsa</i>, Sticky Hop-bush <i>Dodonaea viscosa</i> ssp. <i>angustifolia</i> and Muttonwood <i>Myrsine variabilis</i>. The understorey on the higher plateau is absent as a result of intensive grazing resulting from horse agistment (Plate 1), whilst the understorey on the north east slopes is entirely dominated by Lantana with occasional native shrubs on the higher slopes (Plate 2). The groundcover stratum on the higher plateau is in a moderate condition supporting a range of native grasses and herbs including Scurvy Weed <i>Commelina cyanea</i>, Slender Flat-sedge <i>Cyperus gracilis</i>, Slender Tick-trefoil <i>Desmodium varians</i>, Kidney Weed <i>Dichondra repens</i>, Weeping Grass <i>Microlaena stipoides</i> var. <i>stipoides</i> and Oplismenus <i>Oplismenus imbecillis</i>. Groundcover under the thickets of Lantana on the north-east slopes is virtually absent with sparse cover of native and exotic grasses, herbs and scramblers such as Asparagus Fern <i>Asparagus aethiopicus</i>, Indian Pennywort <i>Centella asiatica</i>, Scurvy Weed <i>Commelina cyanea</i>, Cape Ivy <i>Delairea odorata</i>, Panic Veldtgrass <i>Ehrharta erecta</i> and Wombat Berry <i>Eustrephus latifolius</i>.</p> <p>Fauna habitat within this vegetation community is largely dependent upon the understorey and presence of hollow-bearing trees. Areas dominated by Lantana provide foraging and sheltering habitat for a number of common woodland birds. 24 hollow-bearing trees were mapped as occurring within this community.</p>

Illawarra Lowlands Grassy Woodland	
	<p>These hollow-bearing trees generally support only small hollows between 5 and 20 cm in diameter. Other fauna habitat features, such as a complex understorey, hollow logs or leaf litter, are absent.</p>
Condition	<p>This community is generally in poor condition, with the higher plateau area impacted by grazing by horses and the north-east slopes dominated by Lantana. These areas are considered of low resilience without significant management.</p>
Threatened ecological community	<p>Commonwealth EPBC Act: Critically Endangered <i>Justification:</i> Assessment against the TSSC (2016) concluded that the areas of vegetation equivalent to Illawarra Lowlands Grassy Woodland were consistent with the following category 'D. moderate condition class' because it satisfied the following attributes:</p> <ul style="list-style-type: none"> • Patch size greater than 0.5 hectares • At least 30% of the total perennial understorey vegetation cover is composed of native species • The patch is contiguous with another patch of native vegetation (at least 1 hectare in area) • The patch has large locally indigenous trees with DBH at least 50 cm DBH and tree with hollows. <p>NSW TSC Act: Endangered <i>Justification:</i> The floristic composition and landscape position of this vegetation community is consistent with the Illawarra Lowlands Grassy Woodland EEC final determination.</p>
Threatened species habitat	<p>The White-flowered Wax Plant was recorded at five locations within the study area, with a total of seven plants recorded during targeted surveys. One additional flora species, Illawarra Zieria, is considered a medium likelihood of occurring within this vegetation community.</p> <p>Surveys undertaken by Eco Logical (2011) recorded three threatened microbat species within the study area (Eastern False Pipistrelle, Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i> and Little Bentwing-bat <i>Miniopterus australis</i>). The Grey-headed Flying-fox <i>Pteropus poliocephalus</i> was also recorded overflying the study area, while the Flame Robin <i>Petroica phoenicea</i> was recorded along the northern boundary. One additional micobat (Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>) is considered to have a medium likelihood of occurrence.</p>

Illawarra Lowlands Grassy Woodland

Plates

Plate 1: Illawarra Lowlands Grassy Woodland, higher plateau area



Plate 2: Illawarra Lowlands Grassy Woodland, north east slopes



Scattered trees	
Extent within study area	<p>2.60 hectares of scattered trees are mapped across the study area, as outlined below:</p> <ul style="list-style-type: none"> • 2.59 hectares in the development site • 0.01 hectares in the inner APZ
Description including fauna habitat	<p>This community supports a scattered canopy of Forest Red Gum and Thin-leaved Stringybark over a low groundcover of exotic pasture grasses and annual and perennial weeds. Exotic grasses such as <i>Paspalum dilatatum</i>, Kikuyu Grass <i>Pennisetum clandestinum</i> dominate with other common exotic herbs and grasses including Sorrel <i>Acetosella vulgaris</i>, Cobblers Pegs <i>Bidens pilosa</i>, Spear Thistle <i>Cirsium vulgare</i>, Fleabane <i>Conyza</i> sp., <i>Oxalis corniculata</i>, Fireweed <i>Senecio madagascariensis</i>, Petty Spurge <i>Euphorbia peplus</i> and Paddy's Lucerne <i>Sida rhombifolia</i>. Native grasses and herbs also occur mixed through the exotic groundcovers and common species include Common Cotula <i>Cotula australis</i>, Fishweed <i>Einadia trigonos</i> ssp. <i>trigonos</i>, Native Geranium <i>Geranium homeanum</i>, Weeping Grass and Tussock Grass <i>Poa labillardierei</i>.</p> <p>Fauna habitat within this vegetation community is limited to the presence of hollow-bearing trees. A total of 9 hollow-bearing trees were mapped as occurring within this community. These hollow-bearing trees generally support only small hollows between 5 and 20 cm in diameter. Other fauna habitat features, such as a complex understorey, hollow logs or leaf litter, are absent.</p>
Condition	This community is in poor condition, with a high cover of exotic species.
Threatened ecological community	<p>Commonwealth EPBC Act: Not listed</p> <p>NSW TSC Act: Not listed</p>
Threatened species habitat	None recorded. Low likelihood of occurrence for all species.

Scattered trees

Plates

Plate 3: Scattered trees



Other sections of the study area are mapped as cleared.

4.4 Threatened biota

Lists of threatened species, populations and communities recorded or predicted to occur within five kilometres of the study area are provided in Appendix 1 (flora) and Appendix 2 (fauna). Previous records of threatened biota within the locality are shown in Figure 4 (flora) and Figure 5 (fauna). An assessment of the likelihood of these species occurring in the study area, and an indication of where within the subject site (i.e. which habitats or features of relevance to the species), is included.

A summary of the threatened species recorded or with a medium or higher likelihood of occurring in the study area is provided in Table 2 below.

Table 2: Summary of threatened biota likely to occur in the study area

Species name	Area of value within the study area
EPBC Act and TSC Act listed biota	
White-flowered Wax Plant	The species was recorded in Illawarra Lowlands Grassy Woodland in the north-eastern section of the site, with seven plants recorded at two locations. The species occurs under a dense cover of Lantana (Figure 3). This species is discussed further below.

Species name	Area of value within the study area
Illawarra Zieria	The species was not recoded during targeted surveys, but may occur within Illawarra Lowlands Grassy Woodland seedbank on the upper rocky north east facing slopes. This area will form part of the vegetation management zone, with consequent improvement in habitat. This species is not discussed further.
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	This species was recorded by Eco Logical (2011) over-flying the subject site. Subject site does not support significant habitat. Some individuals may forage on flowering Forest Red Gum on occasion. This species is not discussed further.
Illawarra and south coast lowland forest and woodland ecological community	5.76 hectares of <i>Illawarra and south coast lowland forest and woodland ecological community</i> is mapped within the study area. Under the EPBC Act, this community is considered to be in moderate condition as assessed by TSSC (2016). Under the TSC Act however, this community is considered to be in poor condition as a result of past clearing, ongoing impacts from horse agistment and weed invasion. This community is discussed further below.
TSC Act only listed biota	
Flame Robin <i>Petroica phoenicea</i>	This species was recorded by Eco Logical (2011) along the northern boundary of the subject site. The species is highly mobile and although it may forage within the study area on occasion it is unlikely to be a resident species. This species is not discussed further.
Hollow roosting microchiropteran bats: Greater Broad-nosed Bat Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	The Eastern False Pipistrelle was recorded within the study area by Eco Logical (2011), while the Greater Broad-nosed bat is considered a medium likelihood of occurrence. These species are likely to forage within the study area. Additionally, There are 16 Hollow-bearing trees within the study area which may provide potential roosting habitat for these species; 6 of which (containing 8 hollows in total) are expected to be removed. These species are discussed further below.
Cave roosting microchiropteran bats: Eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i> Little Bentwing-bat <i>Miniopterus australis</i>	These species were recorded within the study area by Eco Logical (2011). The two species are likely to forage widely across the subject site. Suitable roosting habitat not present for these cave roosting species. These species are not discussed further.

Figure 3: Ecological features of the study area

Figure 4: Threatened flora species recorded within five kilometres of the study area

Figure 5: Threatened fauna species recorded within five kilometres of the study area

5. Ecological impacts and recommendations

This section identifies the potential impacts of the proposed subdivision on the ecological values of the study area, and includes recommendations to assist MMJ and Spinitu Pty Ltd to design a development to avoid and minimise impacts on these values. It should be noted, that measures to avoid and minimise impacts to these values were discussed and implemented during the development of the Planning Proposal for the study area (MMJ 2011).

5.1 Potential impacts before avoidance, minimisation and offset considerations

This section discusses the potential impacts to the ecological values identified without any impact avoidance, minimisation or mitigation measures. Potential impacts arising from the project include:

- The permanent removal of 4.15 hectares of native vegetation, including:
 - 4.15 hectares of Illawarra Lowland Grassy Woodland EEC and CEEC.
- Removal of up to 922 trees.
- The ongoing deterioration of retained vegetation.
- The permanent removal of 8 hollow-bearing trees containing 12 hollows suitable for:
 - Hollow-roosting microbats.
 - Hollow breeding small parrot species.
 - Hollow breeding medium parrots or small possums.
- Impacts to threatened species and their habitats, including:
 - The permanent removal of seven White-flowered Wax Plants.
 - Permanent removal of potential habitat for the Illawarra Zieria.
 - The permanent removal of 8 hollow-bearing trees which may provide suitable roosting habitat for the Greater broad-nosed Bat and Eastern False Pipistrelle.
 - The permanent removal of potential foraging habitat for the Flame Robin, Grey-headed Flying-fox, Eastern Bentwing-bat, Little Bentwing-bat Greater broad-nosed Bat and Eastern False Pipistrelle.
- Erosion of steep slopes due to management of vegetation within APZs.

5.2 Impact avoidance and minimisation recommendations

During the development of the Planning Proposal (MMJ 2011) and subdivision plan MMJ, Spinitu Pty Ltd and Biosis have worked closely together to design a development that carefully considers the ecological values of the study area. Table 3 summarises the impact avoidance, minimisation and mitigation measures that have been and will be implemented.

Table 3: Recommendations to avoid, minimise and mitigate impacts to identified ecological features

Ecological feature	Recommendations
<p>Native vegetation, including Illawarra Lowlands Grassy Woodland EEC (TSC Act)/CEEC (EPBC Act)</p> <p>Ongoing deterioration of retained vegetation</p>	<ul style="list-style-type: none"> • Rezoning of the eastern section of the site, supporting Illawarra Lowlands Grassy Woodland, to E3 Environmental Management. • Utilising roads as a part of APZs, where possible, to avoid removal of native vegetation. • Fencing of the boundary between the outer APZ and the remainder of the EMA to delineate management areas (see VMP). • Protection and management of retained vegetation through the development and implementation of a VMP (Appendix 5). • The VMP should outline plans for the removal of Lantana, and measures to improve the resilience of retained areas and revegetation of these areas if natural regeneration does not occur. • The VMP should include measures for the appropriate management of vegetation within APZs consistent with the recommendations of the bushfire assessment (Bushfire & Evacuation Solutions 2015) whilst achieving a positive conservation outcome. • Management of fine fuels within the outer APZ should be limited to the raking or manual removal of fine fuels, with mowing limited to immediately prior to the fire season. • The VMP should have an operational period in perpetuity and be reviewed by the certifying authority on an annual basis.
<p>Impacts to threatened species and their habitat</p> <p>Hollow-bearing trees</p>	<ul style="list-style-type: none"> • Locating residential development away from known locations of the White-flowered Wax Plant. • Rezoning of the eastern section of the site, supporting the White-flowered Wax Plant, to E3 Environmental Management. • Ensuring appropriate management of known locations for the White-flowered Wax Plant within the VMP through the retention of a 20 metre buffer. Management of APZs within the buffer will be undertaken by a Bush Regenerator holding a Section 132 licence from the NSW OEH and subject to the specifications within the VMP. • Retention of hollow-bearing trees within the EMA, includes any thinning of trees to reduce tree canopy cover to less than 15 per cent in the inner APZ and 30 per cent in the outer APZ will avoid removal of hollow-bearing trees. • Where the removal of hollow-bearing trees cannot be avoided, compensatory hollow/nest boxes should be provided at a 1:1 ratio in areas of vegetation to be retained. These nest boxes will be designed to support the native species which would otherwise utilise the hollows to be removed as detailed in Appendix 2, Table 11. • Nest boxes will be installed by a suitably qualified ecologist one month prior to trees removal.

Ecological feature	Recommendations
	<ul style="list-style-type: none"> An ecologist should be present during the removal of hollow-bearing trees to salvage any fauna species from hollows. Any hollow-bearing limbs, removed as a part of the subdivision, should be relocated into the EMA. Hollow logs should be placed on the ground (outside of APZs) to provide supplementary habitat.
General fauna habitat removal Tree removal protocols	<ul style="list-style-type: none"> Pre-clearing survey conducted by an ecologist to identify and clearly mark any significant habitat features present or relocate onsite if feasible. Remove all vegetation that is not marked in the pre-clearance survey as being significant habitat. Remove identified and marked areas of habitat 24 hours after the initial clearing to allow fauna to move from the disturbed area. This stage of habitat removal must be completed under the supervision of an ecologist.
Erosion of steep slopes due to management for APZs	<ul style="list-style-type: none"> Soil stabilisation using open weave jute-mesh and fire resistant native species indigenous to the local area and the Illawarra Lowlands Grassy Woodland.

The principal means to reduce impacts on biodiversity values will be the retention and management of vegetation with the EMA. A VMP for this area has been developed, and is included at Appendix 5.

5.3 Residual impacts

Native vegetation within the study area will be subject to clearing within the R2 zone. The E3 Zone - EMA will retain vegetation for conservation, with some canopy reduction for APZs impacting this area. In total, the management of native vegetation within each of these areas will include:

- Subdivision – selected clearing of vegetation for roads, fencing and building envelopes.
- EMA: Inner APZ – thinning of canopy trees to achieve a tree canopy cover of less than 15 per cent, pruning of lower limbs of trees to 2 metres above the ground, removal of all fine fuels and maintenance of a low and green groundcover (where possible).
- EMA: Outer APZ – thinning of canopy trees to achieve a tree canopy cover of less than 30 per cent, removal of fine fuels and maintenance of a shrub cover of less than 20 per cent of the area.
- EMA – management of vegetation for conservation purposes (weed control and revegetation in selected areas).

Table 4 provides a breakdown of native vegetation within each area.

Table 4: Vegetation removal within the subdivision

Vegetation community	Subdivision (complete clearing)	EMA - Inner APZ (canopy thinning to 15% cover and slashing)	EMA - Outer APZ (canopy thinning to 30% cover and slashing)	EMA - Conservation (retention and improvement of vegetation)
Illawarra Lowlands Grassy Woodland	3.06	0.44	0.65	1.61
Scattered trees	2.59	0.01	0.00	0.00
Grand Total	5.65	0.45	0.65	1.61

Following on from the recommendations outlined above, the proposed subdivision will result in the following residual impacts to the ecological values of the study area:

- The permanent removal of 4.15 hectares of native vegetation, including:
 - 3.06 hectares of Illawarra Lowlands Grassy Woodland EEC (TSC Act)/CEEC (EPBC Act)
- Clearance of vegetation will involve the removal of up to 318 trees including removal of:
 - 278 trees with DBH less than or equal to 500 mm (~ 88%)
 - 26 trees with DBH less than or equal to 600 mm DBH (~8%)
 - 14 trees less than or equal to 1100 mm (~4%) for roads, fences and building envelopes.
- 1.09 hectares of Illawarra Lowlands Grassy Woodland EEC (TSC Act)/CEEC (EPBC Act) permanently modified for the management of APZs, including:
 - Clearance of up to a 60 trees for APZs based on estimates that 30% of the canopy will be removed.
- The permanent removal of 8 hollow-bearing trees (containing 12 hollows).

These residual impacts will be addressed by:

- The retention and management of 2.69 hectares of native vegetation within the EMA, including:
 - Management of 0.44 hectares of Illawarra Lowlands Grassy Woodland within the Inner APZ.
 - Management of 0.65 hectares of Illawarra Lowlands Grassy Woodland within the Outer APZ.
 - Management of 1.60 hectares of Illawarra Lowlands Grassy Woodland for conservation purposes.
- Retention of six hollow-bearing trees (containing 11 hollows) within the subdivision lots.
- Retention of 11 hollow-bearing trees (containing 20 hollows) within the EMA.
- Installation of 12 nest boxes within the EMA as per Appendix 2, Table 11.
- The retention and management of all individuals of the White-flowered Wax Plant within the EMA and subject to on-going management as per specifications within a VMP.

5.4 Based on these residual impacts to Illawarra Lowlands Grassy Woodland listed under the EPBC Act, the project will require suitable offsets that are consistent with the EPBC Act Environmental Offsets Policy (CoA 2012). Biodiversity legislation and government policy

This section provides an assessment of the residual impacts arising from the proposed subdivision against key biodiversity legislation and government policy outlined in Section 3.

5.4.1 Environment Protection and Biodiversity Conservation Act 1999

Matters of NES relevant to the project are summarised in Table 5 with Appendix 4 outlining Significant Impact Criteria assessments against the *Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013) for matters of NES likely to be impacted by the project.

Table 5: Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Significant Impact Criteria assessment findings
Threatened species (flora and fauna)	One flora species, the White-flowered Wax Plant, and one fauna Grey-headed Flying-fox, were recorded in the study area. An additional 11 flora and 33 fauna species have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area is provided in Appendix 1 (flora) and Appendix 2 (fauna).	Most of these species are not likely to occur and development unlikely to constitute a significant impact. A SIC assessment for impacts to the White-flowered Wax Plant is provided in Appendix 4. The retention of White-flowered Wax Plant in the EMA and protection via a VMP will result in negligible impact to this species.
Threatened ecological communities	<i>Illawarra and south coast lowland forest and woodland ecological community</i> CEEC was recorded within the study area.	3.06 ha of the CEEC will be removed and a further 1.09 ha of direct impact through permanent modification through management as an APZ. A SIC assessment for impacts the CEEC concluded a significant impact is likely to result due to the removal and permanent modification of 4.15 hectares of vegetation that is considered critical to the survival of the CEEC. A referral to the minister is strongly recommended.
Migratory species	24 migratory species have been recorded or are predicted to occur in the project search area (Appendix 2).	While some of these species would be expected to use the study area on occasions, some may do so regularly and others may be resident, the study area does not provide important habitat for an ecologically significant proportion of any of these species.
Wetlands of	The study area is not identified as	N/A

Matter of NES	Project specifics	Significant Impact Criteria assessment findings
international importance (Ramsar sites)	being within the catchment of any Ramsar sites.	

On the basis of criteria outlined in the relevant Commonwealth of Australia (2013) it is considered likely that a significant impact on a MNES would result from the proposed action. Therefore a referral of the proposed subdivision to the Commonwealth Minister for the Environment is strongly recommended. Assessment of a referral to the minister is likely to require offsets for clearing of a CEEC as the current residual impacts are not adequate to satisfy the EPBC Act.

5.4.2 Environmental Planning and Assessment Act 1979

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

Assessment of Significance (Part 1, Section 5A)

Section 4.4 provides an assessment of the potential for threatened species, populations and communities to be impacted by the proposed development. Based on this, AoS have been prepared for the following species and community:

- White-flowered Wax Plant
- Illawarra Lowlands Grassy Woodland
- Hollow roosting microchiropteran bats, including the Greater Broad-nosed Bat and Eastern False Pipistrelle

Based on the project design the removal of Illawarra Lowlands Grassy Woodland was found unlikely to result in a significant effect as the proposal would not significantly reduce local connectivity, the vegetation to be removed was of low floristic diversity and its removal was unlikely to lead to local extinction of the EEC.

An AOS for White-flowered Wax Plant found that there will be no direct impact from the proposal as the population is to be retained within the EMA. A VMP for this area will provide for weed controls and safeguards for management of these plants which should have a positive effect.

An AOS for Hollow roosting microchiropteran bats found that the habitat to be removed was not limiting in extent or quality within the locality for these species, therefore will not result in a significant effect for this group.

The AoS demonstrate that a significant effect is not likely to result from the proposed subdivision, and SISs for these endangered biota are not required (Appendix 3).

SEPP No. 44 – Koala Habitat Protection

Forest Red Gum constitutes greater than 15 per cent of the total number of trees in the upper strata. Therefore, the study area constitutes potential Koala habitat as defined under SEPP No. 44. However, no evidence of occupation of the study area by Koalas was observed. No records of the Koala were returned during database searches of the local area, and the Koala has rarely been recorded in the Illawarra floodplain and not in recent times.

The study area does not support Core Koala Habitat and a Plan of Management is not required.

5.4.3 Threatened Species Conservation Act 1995

Impacts to threatened species, populations and communities have been assessed to determine if a significant effect is likely to result from the proposed subdivision (see Section 5.4.2). This assessment indicates a significant effect is not likely to result from the proposed subdivision and an SIS is therefore not required.

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.

5.4.4 Noxious Weeds Act 1993

Five declared noxious weeds listed under Noxious Weed (Control Order) 2014 for the Shellharbour LGA were recorded within the EMA.

Two Class 4 noxious weeds that require 'the growth of the plant to be suppressed in a manner that continuously inhibits the ability of the plant to spread':

- Lantana
- Blackberry *Rubus fruticosus* aggregate species.

Three additional Class 4 weeds, including Blackberry require that 'the plant must not be knowingly distributed':

- Bridal Creeper *Asparagus asparagoides*
- Ground Asparagus *Asparagus aethiopicus*
- Fireweed *Senecio madagascariensis*

Methods for control of these noxious and environmental weeds are included in the VMP (Appendix 5).

Figure 6: Management of native vegetation and fauna habitat within the study area

6. Conclusion

This report is an assessment of the potential impact of the proposed subdivision of land at Lot 101 DP 785139 Crest Road, Albion Park on ecological values within the study area in accordance with the provision of relevant biodiversity legislation outlined in Section 3.

One threatened flora species (White-flowered Wax Plant) and five threatened fauna species (Eastern False Pipistrelle, Eastern Bentwing-bat, Little Bentwing-bat, Grey-headed Flying-fox and Flame Robin) were recorded within the study area.

Native vegetation that is consistent with Illawarra Lowlands Grassy Woodland EEC and CEEC was also mapped within the study area.

One additional threatened flora species (Illawarra Zieria) has potential to exist within the soil seed bank within the EMA and one additional fauna species (Greater Broad-nosed Bat) were considered a medium of greater likelihood of occurrence.

Through the implementation of the recommendations outlined in Section 5.2, residual impacts arising from the project include:

- The permanent removal of 4.15 hectares of degraded native vegetation, including 3.06 hectares of Illawarra Lowlands Grassy Woodland EEC and CEEC in moderate condition.
- Direct impact to 1.09 ha of Illawarra Lowlands Grassy Woodland CEEC through Installation of APZs.
- Clearance of vegetation will involve the removal of up to 378 (41% in the study area) trees including:
 - 318 trees from subdivision of the land
 - Up to 60 trees for APZ installation.
- The permanent removal of 8 hollow-bearing trees.

Measures to address the above residual impacts include:

- The retention and management for conservation of 2.68 hectares of native vegetation within the EMA, including 2.68 hectares of Illawarra Lowlands Grassy Woodland EEC, including up to 59 % of trees in the study area.
- Retention of 11 hollow-bearing trees within the EMA.
- The retention and management of all individuals of the White-flowered Wax Plant within the EMA.
- Management of the EMA according to a VMP.
- Installation of bushfire asset protection zones within the development EMA prioritising retained trees in the following sequence:
 - Hollow-bearing trees.
 - Large DBH canopy tree (Forest Red Gum *Eucalyptus tereticornis* and Thin-leaved Stringybark *E. eugenoides*) over midstorey species of *Acacia*, *Melaleuca* and *Callistemon*.
 - Largest to smallest DBH.
- Retention of hollow-bearing trees within the development area, where not occurring within development envelopes, roads, fence lines, stormwater infrastructure, and if safe to do so.

- Installation and management of 12 nest boxes within the EMA.

The implementation of these recommendations will result in the improvement of areas of retained Illawarra Lowlands Grassy Woodland through management in accordance with the VMP (Appendix 5). This management provides ongoing protection for the population of the White-flowered Wax Plant within the study area, with the potential for ongoing management and weed removal to result in net positive impact for this species. The retention of trees within the EMA will also result in the protection of 11 hollow-bearing trees, including 6 which may provide roosting habitat for threatened microchiropteran species. The protection and improvement of native vegetation and threatened species within the EMA will compensate for the removal of high degraded vegetation and fauna habitat.

While the project is not considered to have a significant impact on any TSC Act listed threatened species, populations or communities, a significant impact is likely to result from the removal and modification of 4.15 hectares of moderate condition Illawarra Lowlands Grassy Woodland CEEC listed under the EPBC. Therefore, a referral to the Commonwealth Minister of the Environment and Energy is strongly recommended and EPBC Act offsets are likely to be required based on the residual impacts of the current design.

References

- Australian National Botanic Gardens 2007. On-line Australian Plant Name Index. Australian National Botanic Gardens, Canberra, ACT.
- Biosis 2012. Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment. Report for Martin Morris and Jones. Authors: A. Aguiar, N.Garvey, Biosis Pty Ltd, Wollongong. Project no 15634.
- Bushfire & Evacuation Solutions 2015. Bushfire Hazard Risk Assessment & Compliance Report: Proposed Residential Subdivision, Lot 101 DP 785139 Crest Road, Albion Park, NSW. Report prepared for Spinitu Pty Ltd.
- Commonwealth of Australia 2012. *Environment Protection and Biodiversity Conservation Act 1999: Environmental Offsets Policy*. Department of the Environment, Canberra, ACT.
- Commonwealth of Australia 2013. Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Canberra, ACT.
- Commonwealth of Australia 2009. Census of Australian Vertebrates. Department of Environment, Water, Heritage and the Arts Population and Communities.
- Eco Logical 2011. Flora and Fauna Assessment. Lot 101 DP 785139 Crest Road, Albion Park. Eco Logical Australia, Sydney.
- Harden G 1992. Flora of New South Wales Volume 3. NSW University Press. Kensington.
- Harden G 1993. Flora of New South Wales Volume 4. NSW University Press. Kensington.
- Harden G 2000. Flora of New South Wales Volume 1 (Revised Edition). NSW University Press. Kensington.
- Harden G 2002. Flora of New South Wales Volume 2 (Revised Edition). NSW University Press. Kensington.
- Mills, K. 2007. Draft Urban Fringe Local Environmental Plan. Additional Flora Assessment for the Urban Fringe Local Environmental Study. City of Shellharbour. Kevin Mills and Associates. Jamberoo.
- MMJ 2011. Planning Submission. Draft Shellharbour Local Environmental Plan 2011. Lot 101 DP 785139, Crest Road, Albion Park. Martin Morris and Jones, Wollongong.
- Moore Trees 2016. Arboricultural development assessment report: Lot 101 Crest Road, Albion Park. Report prepared for Spinitu Pty Ltd.
- NPWS 2002a. Native Vegetation of the Illawarra Escarpment and Coastal Plain. NSW National Parks and Wildlife Service, Hurstville, NSW.
- NPWS 2002. Threatened Species Information. *Cynanchum elegans*. NSW National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee 2008. Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion - endangered ecological community listing. NSW Scientific Committee final determination. NSW Scientific Committee, Sydney.
- Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B and Beukers P. 2010. Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11, 359-406.

Threatened Species Scientific Committee (TSSC) 2016. *Approved Conservation Advice (incorporating listing advice) for the Illawarra and South Coast Lowland Forest and Woodland Ecological Community*. Canberra: Department of the Environment and Energy.

WCC et al. 2011a. Illawarra Biodiversity Strategy. Volume 1: Action Plan. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

WCC et al. 2011b. Illawarra Biodiversity Strategy. Volume 2: Background Information. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

Appendices

Appendix 1: Flora

A1.1 Flora species recorded from the study area

Notes to tables:

EPBC Act: CR - Critically Endangered EN - Endangered VU - Vulnerable	TSC Act: 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: # - Native species outside natural range * - Exotic (not native to Australia) ** - Terrestrial or freshwater weed under the <i>Biosecurity Act 2015</i> for Shellharbour LGA.	Terrestrial or freshwater weed status: PM – Prohibited matter BCO – Biosecurity control order BZ – Biosecurity zone MM– Mandatory measure (limit spread) RRM - Regional Recommended Measure (limit spread)
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%	

Table 6: Flora species recorded from the study area

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Acacia binervata</i>	Two-veined Hickory					1		#	#
	<i>Acacia fimbriata</i>	Fringed Wattle							#	
	<i>Acacia implexa</i>	Hickory Wattle							#	#
	<i>Acacia maidenii</i>	Maiden's Wattle	1						#	#
	<i>Acacia mearnsii</i>	Black Wattle							#	#
	<i>Acacia parramattensis</i>	Sydney Green Wattle							#	
*	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle							#	
	<i>Acacia saliciformis</i>								#	
*	<i>Acetosella vulgaris</i>	Sorrel							#	
	<i>Acmena smithii</i>	Lilly Pilly							#	
	<i>Alectryon subcinereus</i>	Native Quince							#	
	<i>Alphitonia excelsa</i>	Red Ash			1				#	
	<i>Amyema pendulum ssp</i>								#	
*	<i>Anagallis arvensis</i>	Scarlet Pimpernel	2						#	

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Aneilema acuminatum</i>								#	
	<i>Aphanopetalum resinosum</i>	Gum Vine				1				
*	<i>Araujia sericifera</i>	Moth Vine	1						#	
*	<i>Asparagus aethiopicus</i>	Asparagus Fern	1	1					#	
**MM	<i>Asparagus asparagoides</i>	Bridal Creeper		1					#	
	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass							#	
*	<i>Bidens pilosa</i>	Cobblers Pegs							#	
	<i>Bothriochloa macra</i>	Red Grass								#
	<i>Brachychiton populneus</i>	Kurrajong								#
	<i>Breynia oblongifolia</i>	Coffee Bush		1			1		#	#
*	<i>Briza subaristata</i>								#	
*	<i>Bromus catharticus</i>	Praire Grass	3				3	2	#	
	<i>Callistemon salignus</i>	Willow Bottlebrush							#	
	<i>Carex inversa</i>								#	#
	<i>Carex longibrachiata</i>								#	#

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Cayratia clematidea</i>	Native Grape		1					#	
	<i>Centella asiatica</i>	Indian Pennywort	1						#	#
*	<i>Chenopodium album</i>	Fat Hen	1				2		#	
	<i>Chenopodium pumilio</i>	Small Crumbweed								#
*	<i>Chloris gayana</i>	Rhodes Grass				2			#	
*	<i>Chlorophytum comosum</i>	Spider Plant							#	
	<i>Cissus hypoglauca</i>	Water Vine		2						
	<i>Clematis aristata</i>	Old Man's Beard							#	#
	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum	1	1					#	#
	<i>Commelina cyanea</i>	Scurvy Weed	2	2	2	2	3		#	#
*	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	3							
*	<i>Crassula multicava</i>								#	
	<i>Cyathea australis</i>	Black Tree-fern							#	
	<i>Cyclophyllum longipetalum</i>	Coast Canthium							#	
EN, E1	<i>Cynanchum elegans</i>								#	

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Cynodon dactylon</i>	Couch						3	#	#
	<i>Cyperus gracilis</i>	Slender Flat-sedge	4				4	4		
	<i>Cyperus imbecillis</i>								#	
*	<i>Cyperus sp</i>		1							
*	<i>Delairea odorata</i>	Cape Ivy		3	3	2			#	
	<i>Desmodium varians</i>	Slender Tick-trefoil	2				2		#	#
	<i>Dianella revoluta ssp revoluta</i>	Blueberry Lily							#	
	<i>Dichelachne micrantha</i>	Shorthair Plumegrass							#	
	<i>Dichondra repens</i>	Kidney Weed	3	2			2		#	#
*	<i>Digitaria sanguinalis</i>	Summer Grass	2							
	<i>Dodonaea viscosa ssp angustifolia</i>	Sticky Hop-bush		1		1			#	#
*	<i>Echinochloa crus-galli</i>	Barnyard Grass							#	
	<i>Echinopogon caespitosus var caespitosus</i>	Tufted Hedgehog-grass							#	#
	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass								#

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	<i>Ehrharta erecta</i>	Panic Veldtgrass	1	2	2	2			#	
	<i>Einadia hastata</i>	Berry Saltbush	2				1		#	#
	<i>Einadia trigonos ssp trigonos</i>	Fishweed	3				3		#	#
	<i>Elaeodendron australe</i>									#
	<i>Entolasia marginata</i>	Bordered Panic							#	
	<i>Entolasia stricta</i>	Wiry Panic							#	
	<i>Eragrostis leptostachya</i>	Paddock Lovegrass							#	
	<i>Eucalyptus amplifolia ssp amplifolia</i>	Cabbage Gum							#	
	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark	1			2	1		#	#
	<i>Eucalyptus quadrangulata</i>	White-topped Box							#	
	<i>Eucalyptus tereticornis</i>	Forest Red Gum	1	1	3	3	4	1	#	#
	<i>Euchiton involucratus</i>	Star Cudweed							#	
	<i>Euchiton sphaericus</i>									#
*	<i>Euphorbia peplus</i>	Petty Spurge							#	
	<i>Eustrephus latifolius</i>	Wombat Berry		2		2			#	

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Exocarpos cupressiformis</i>	Cherry Ballart							#	#
	<i>Ficus macrophylla</i>	Moreton Bay Fig							#	
*	<i>Fumaria bastardii</i>	Bastards Fumitory							#	
	<i>Gahnia aspera</i>	Rough Saw-sedge		1					#	
*	<i>Gamochaeta americana</i>	Cudweed	2					3		
*	<i>Gamochaeta</i> sp								#	
	<i>Geitonoplesium cymosum</i>	Scrambling Lily	1	2	2	2			#	#
	<i>Geranium homeanum</i>	Native Geranium							#	
	<i>Geranium solanderi</i> ssp <i>solanderi</i>	Native Geranium							#	#
	<i>Glyceria</i> sp								#	
	<i>Glycine clandestina</i>			2			2		#	#
	<i>Glycine microphylla</i>	Small-leaf glycine								#
	<i>Glycine tabacina</i>		2					2	#	#
*	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush							#	
	<i>Hardenbergia violacea</i>	Purple Coral Pea							#	#

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Hibbertia scandens</i>	Climbing Guinea Flower							#	#
	<i>Hibiscus heterophyllus</i> ssp <i>heterophyllus</i>	Native Rosella							#	
	<i>Hypericum japonicum</i>								#	
*	<i>Hypochaeris radicata</i>	Catsear					2		#	
*	<i>Hypochaeris</i> sp	White Flatweed							#	
	<i>Hypoxis hygrometrica</i>	Golden Weather-grass								#
*	<i>Impatiens walleriana</i>								#	
	<i>Indigofera australis</i>	Australian Indigo							#	#
	<i>Joycea pallida</i>	Silvertop Wallaby Grass							#	
	<i>Juncus usitatus</i>	Common Rush							#	
	<i>Kennedia rubicunda</i>	Dusky Coral Pea							#	
**RRM	<i>Lantana camara</i>	Lantana		7	7	7			#	
	<i>Legnephora moorei</i>	Round-leaf Vine							#	
*	<i>Lepidium</i> sp		2				2			

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Leucopogon juniperinus</i>	Prickly Beard-heath							#	
*	<i>Ligustrum lucidum</i>	Large Leaved Privet							#	
	<i>Livistona australis</i>	Cabbage Fan-palm							#	
*	<i>Lolium perenne</i>	Perennial Ryegrass							#	
	<i>Maclura cochinchinensis</i>	Cockspur Thorn		1		1			#	
	<i>Marsdenia rostrata</i>	Milk Vine				1			#	
*	<i>Medicago lupulina</i>	Black Medic	1							
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree							#	
	<i>Melia azedarach</i>	White Cedar							#	#
	<i>Melicytus dentatus</i>	Tree Violet							#	
	<i>Microlaena stipoides</i> var <i>stipoides</i>	Weeping Grass	3				6	4	#	#
*	<i>Modiola caroliniana</i>	Red-flowered Mallow	3				3	3		
	<i>Myrsine variabilis</i>		1	2					#	
	<i>Notelaea ovata</i>								#	
	<i>Notelaea venosa</i>	Veined Mock-olive							#	#

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Olearia viscidula</i>	Wallaby Weed							#	
	<i>Oplismenus aemulus</i>	Oplismenus	2						#	#
	<i>Oplismenus imbecillis</i>	Oplismenus		3						#
*	<i>Oxalis corniculata</i>		2				2	2	#	
	<i>Oxalis exilis</i>									#
	<i>Oxalis perennans</i>								#	
	<i>Pandorea pandorana</i>	Wonga Wonga Vine		2		2			#	#
*	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort							#	
	<i>Parsonsia straminea</i>	Common Silkpod				1			#	#
*	<i>Paspalum dilatatum</i>	Paspalum						3	#	
*	<i>Passiflora subpeltata</i>	White Passionflower		1		2			#	
*	<i>Pennisetum clandestinum</i>	Kikuyu Grass						3	#	
*	<i>Phytolacca octandra</i>	Inkweed							#	
*	<i>Pinus radiata</i>	Radiata Pine							#	
	<i>Pittosporum multiflorum</i>	Orange Thorn		1		1			#	#

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Pittosporum revolutum</i>	Wild Yellow Jasmine							#	#
	<i>Pittosporum undulatum</i>	Sweet Pittosporum							#	#
*	<i>Plantago lanceolata</i>	Lamb's Tongues	2				3		#	
	<i>Plectranthus parviflorus</i>	Cockspur Flower							#	
	<i>Poa affinis</i>	Poa						2		
	<i>Poa labillardierei</i>	Tussock Grass							#	
	<i>Poranthera microphylla</i>								#	
	<i>Portulaca oleracea</i>	Pigweed								#
	<i>Pratia purpurascens</i>	Whiteroot							#	
	<i>Pseuderanthemum variabile</i>	Pastel Flower	3	2		2		2	#	#
**MM	<i>Rubus fruticosus</i> aggregate species	Blackberry								
	<i>Rubus parvifolius</i>	Native Raspberry							#	
	<i>Santalum obtusifolium</i>	Blunt Sandalwood							#	
**RRM	<i>Senecio madagascariensis</i>	Fireweed	3				3	2	#	
*	<i>Senna pendula</i> var <i>glabrata</i>				1				#	

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
*	<i>Setaria gracilis</i>	Slender Pigeon Grass							#	
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	4				4	3	#	
	<i>Sigesbeckia orientalis</i> ssp <i>orientalis</i>								#	#
*	<i>Solanum linnaeanum</i>								#	
*	<i>Solanum mauritianum</i>		1		1					
*	<i>Solanum nigrum</i>	Black-berry Nightshade							#	
*	<i>Sonchus oleraceus</i>	Common Sowthistle	2						#	
*	<i>Sporobolus africanus</i>	Parramatta Grass							#	
	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass								#
*	<i>Stellaria media</i>	Common Chickweed							#	
*	<i>Stenotaphrum secundatum</i>	Buffalo Grass							#	
	<i>Streblus brunonianus</i>	Whalebone Tree							#	
*	<i>Tagetes minuta</i>	Stinking Roger							#	
*	<i>Taraxacum officinale</i>	Dandelion					2		#	
*	<i>Tecoma capensis</i>	Cape Honeysuckle							#	

Status	Genus species	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	ELA 2011	Mills 2007
	<i>Themeda australis</i>	Kangaroo Grass							#	
*	<i>Tradescantia fluminensis</i>	Wandering Jew							#	
*	<i>Trifolium repens</i>	White Clover							#	
	<i>Tylophora barbata</i>	Bearded Tylophora		2		2			#	
*	<i>Verbena bonariensis</i>	Purpletop	2						#	
	<i>Vernonia cinerea ssp cinerea</i>								#	
	<i>Veronica calycina</i>	Hairy Speedwell							#	
	<i>Veronica plebeia</i>	Trailing Speedwell	1				1		#	#
*	<i>Vulpia muralis</i>								#	
	<i>Wahlenbergia communis</i>	Tufted Bluebell								#
	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell							#	#
*	<i>Xanthium occidentale</i>	Noogoora Burr							#	
	<i>Xerochrysum bracteatum</i>	Golden Everlasting							#	#
	<i>Zornia dyctiocarpa</i>	Zornia								#

A1.2 Threatened flora species and ecological communities

The following table includes a list of the threatened flora species and ecological communities that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas and the Protected Matters Search Tool (DoE; accessed on 15/07/2015).

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
High	<ul style="list-style-type: none"> Species/ecological communities recorded in study area during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). Study area is within species natural distributional range (if known). Species has been recorded within five kilometres or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial biota within five kilometres of the study area 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	<ul style="list-style-type: none"> No records within five kilometres of the study area 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	<ul style="list-style-type: none"> Habitat not present in study area Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 7: Threatened flora species recorded / predicted to occur within five kilometres 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
<i>Boronia deanei</i>	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.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	VU	E1	#		Low	Marginal habitat present (low quality & extent).	<i>Caladenia tessellata</i> 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
<i>Chorizema parviflorum</i>	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 <i>Eucalyptus tereticornis</i> and/or Woollybutt <i>E. longifolia</i> . At Austinmer, the species is recorded from a coastal headland.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	VU	V	#		Low	Marginal habitat present (low quality & extent).	<p>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 <i>E.sclerophylla</i>, <i>E. sieberi</i>, <i>Corymbia gummifera</i> and <i>Allocasuarina littoralis</i>; appears to prefer open areas in the understorey of this community and is often found in association with the <i>Cryptostylus subulata</i>.</p> <p>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)</p>

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Cynanchum elegans</i>	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. <i>Cynanchum elegans</i> usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; <i>Leptospermum laevigatum</i> , <i>Banksia integrifolia subsp. integrifolia</i> ; <i>E. tereticornis</i> open forest and woodland; <i>E. maculata</i> open forest and woodland; and <i>Melaleuca armillaris</i> 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.
<i>Daphnandra johnsonii</i>		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
<i>Irenepharsus trypherus</i>	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 <i>Backhousia myrtifolia</i> thicket, and rainforest.
<i>Melaleuca biconvexa</i>	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
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	#		Low	Marginal habitat present (low quality & extent).	<p>Once widespread on the Cumberland Plain, <i>Pimelea spicata</i> occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment.</p> <p>In western Sydney, <i>P. spicata</i> 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: <i>E. moluccana</i>, <i>E. tereticornis</i>, <i>E. crebra</i>, <i>Bursaria spinosa</i>, and <i>Themeda australis</i>.</p> <p>In the Illawarra region, <i>P. spicata</i> is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include <i>E. tereticornis</i>, <i>E. eugenioides</i>, <i>Themeda australis</i>, and <i>Lomandra longifolia</i>. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey.</p> <p><i>Pimelea spicata</i> flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for <i>P. spicata</i> vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.</p>

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	EN	E1	2007/#		Low	Marginal habitat present (low quality & extent).	<p>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).</p> <p>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 <i>Eucal</i> White-flowered Wax Plant <i>yptus tereticornis</i>, <i>E. longifolia</i> and <i>Melaleuca decora</i>. Near Nowra, the species grows in an open forest of <i>Corymbia maculata</i>, <i>E.tereticornis</i> and <i>E. paniculata</i>. In the Hunter region, the species grows in open woodland dominated by <i>E. crebra</i>, Forest Red Gum and <i>Callitris endlicherii</i>.</p> <p>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.</p>
<i>Solanum celatum</i>			E1	2010		Low	Marginal habitat present (low	<p>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</p>

Scientific Name	Common Name	EPBC status	TSC status	Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
							quality & extent).	
<i>Thesium australe</i>	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. <i>Thesium australe</i> 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 <i>Themeda australis</i> , but also found on other grass species at inland sites. Occurs on clay soils in grassy woodlands or coastal headlands.
<i>Zieria granulata</i>	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 <i>Melaleuca armillaris</i> scrub, <i>E. tereticornis</i> woodland and rainforest margins, although the species has been recorded from a number of other vegetation types

* - habitat descriptions have been adapted by qualified ecologists from the DoE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Appendix 2: Fauna

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

Appendix 2.1 Fauna species recorded from the study area

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 five kilometres of the study area.

Notes to table:

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

Table 8: Vertebrate fauna recorded from the study area (current assessment)

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		<i>Alisterus scapularis</i>	Australian King-parrot		#
		<i>Cracticus tibicen</i>	Australian Magpie	#	
		<i>Corvus coronoides</i>	Australian Raven	#	#
		<i>Ceyx azureus</i>	Azure Kingfisher	#	
		<i>Elanus axillaris</i>	Black-shouldered Kite		#
		<i>Acanthiza pusilla</i>	Brown Thornbill	#	
		<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	#	#
		<i>Sturnus tristis</i>	Common Myna *	#	#
		<i>Ocyphaps lophotes</i>	Crested Pigeon	#	#
		<i>Platycercus elegans</i>	Crimson Rosella		#
		<i>Eudynamys orientalis</i>	Eastern Koel	#	
		<i>Platycercus eximius</i>	Eastern Rosella		#
		<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	#	
		<i>Psophodes olivaceus</i>	Eastern Whipbird	#	
	V	<i>Petroica phoenicea</i>	Flame Robin		#
		<i>Eolophus roseicapillus</i>	Galah	#	#
		<i>Cracticus torquatus</i>	Grey Butcherbird	#	#

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		<i>Rhipidura albiscapa</i>	Grey Fantail	#	#
		<i>Dacelo novaeguineae</i>	Laughing Kookaburra	#	#
		<i>Grallina cyanoleuca</i>	Magpie-lark	#	#
		<i>Vanellus miles</i>	Masked Lapwing		#
		<i>Philemon corniculatus</i>	Noisy Friarbird		#
		<i>Manorina melanocephala</i>	Noisy Miner	#	#
		<i>Strepera graculina</i>	Pied Currawong		#
		<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		#
		<i>Anthochaera carunculata</i>	Red Wattlebird		#
		<i>Todiramphus sanctus</i>	Sacred Kingfisher		#
		<i>Zosterops lateralis</i>	Silvereye	#	
		<i>Pardalotus punctatus</i>	Spotted Pardalote		#
		<i>Streptopelia chinensis</i>	Spotted Turtle-Dove *	#	#
		<i>Pardalotus striatus</i>	Striated Pardalote		#
		<i>Acanthiza lineata</i>	Striated Thornbill	#	#
		<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	#	#
		<i>Malurus cyaneus</i>	Superb Fairy-wren	#	
		<i>Rhipidura leucophrys</i>	Willie Wagtail		#
		<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	#	
		<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	#	#
		<i>Felis catus</i>	Cat *		#
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat		#
		<i>Trichosurus vulpecula</i>	Common Brushtail Possum		#
	V	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		#
	V	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		#
		<i>Macropus giganteus</i>	Eastern Grey Kangaroo		#
		<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat		#
		<i>Vulpes vulpes</i>	Fox *		#
		<i>Mormopterus</i> sp. 2	Freetail Bat		#
VU	V	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox		#
		<i>Equus caballus</i>	Horse *	#	#

EPBC status	TSC status	Scientific Name	Common Name	Biosis 2012	ELA 2011
		<i>Vespadelus darlingtoni</i>	Large Forest Bat		#
		<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		#
	V	<i>Miniopterus australis</i>	Little Bentwing-bat		#
		<i>Vespadelus vulturnus</i>	Little Forest Bat		#
		<i>Oryctolagus cuniculus</i>	Rabbit *	#	#
		<i>Wallabia bicolor</i>	Swamp Wallaby	#	
		<i>Tadarida australis</i>	White-striped Freetail-bat		#
		<i>Litoria dentata</i>	Bleating Tree Frog		#
		<i>Crinia signifera</i>	Common Eastern Froglet		#
		<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	#	
		<i>Amphibolurus muricatus</i>	Jacky Lizard		#

A2.2 Threatened 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 NSW BioNet Wildlife Atlas, BirdLife Australia data search and the Protected Matters Search Tool (DoE; accessed on 15/07/2015).

Notes to table:

#	species predicted to occur by the DoE 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
2015	recorded during current survey

Likelihood of occurrence	Potential criteria
High	<ul style="list-style-type: none"> Species recorded in study area during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). Study area is within species natural distributional range (if known). Species has been recorded within <five or ten kilometres> or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial species within five kilometres of the study area 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	<ul style="list-style-type: none"> No records within five kilometres of the study area 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	<ul style="list-style-type: none"> Habitat not present in study area Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 9: Threatened fauna species recorded, or predicted to occur, within five kilometres 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							
<i>Botaurus poiciloptilus</i>	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 <i>Typha</i> spp. and <i>Eleocharis</i> 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.
<i>Rostratula australis</i>	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 permanent, although they have been recorded in brackish waters.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Ninox connivens</i>	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.
<i>Ixobrychus flavicollis</i>	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 constructed of reeds and sticks in branches overhanging the water.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Ephippiorhynchus asiaticus</i>	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.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	EN	E1	#	Negligible	Suitable habitat not present.	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.
<i>Sternula nereis nereis</i>	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
<i>Petroica phoenicea</i>	Flame Robin		V	2011	Recorded	This species was recorded by ELA (2011) along the northern boundary of the site. Unlikely to be resident.	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.
<i>Stictonetta naevosa</i>	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.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V	##	Low	Ecological (2011a) predicted that this species may forage within the study area on occasion. Hollows unsuitable for roosting or breeding.	The Gang-gang Cockatoo occurs from Victoria to central, south and eastern NSW (Hunter region, Central Tablelands and south-west slopes). It favours old growth nesting and roosting, inhabiting mountain forests and mature wet sclerophyll forests in spring and summer, moving to lower altitudes and drier, more open eucalypt forests and woodlands (e.g. box-gum and box-ironbark assemblages) in autumn and winter. It occasionally occurs in sub-alpine Snow Gum Eucalyptus pauciflora woodland and temperate rainforests.
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo		V, E2	1999	Low	Although individuals may overfly the study area on occasion significant habitat features, including breeding habitat and foraging resources, not present	Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> 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
<i>Neophema chrysogaster</i>	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 <i>Sarcocornia quinqueflora</i> Beaded Glasswort and <i>Sclerostegia arbuscula</i> 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.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU	E4A	#	Negligible	Suitable habitat not present.	Occur in forest and woodland habitat near permanent water. In NSW prefer <i>Melaleuca</i> swamp forest and open eucalypt woodland. Require greater than 20 m tall trees for nesting.
<i>Anthochaera phrygia</i>	Regent Honeyeater	EN	E4A	#	Low	Whilst the species may forage within the study area on occasion it is considered vagrant in this area.	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: <i>E. microcarpa</i> , <i>E. punctata</i> , <i>E. polyanthemus</i> , <i>E. mollucana</i> , <i>Corymbia robusta</i> , <i>E. crebra</i> , <i>E. caleyi</i> , <i>C. maculata</i> , <i>E. mckieana</i> , <i>E. macrorhyncha</i> , <i>E. laevopinea</i> and <i>Angophora floribunda</i> . Nectar and fruit from the mistletoes <i>A. miquelii</i> , <i>A. pendula</i> , <i>A. cambagei</i> 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
<i>Lathamus discolor</i>	Swift Parrot	EN	E1	#	Low	Whilst the species may forage within the study area on occasion it is considered vagrant in this area.	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 <i>E. robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . 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
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V	2009	Low	Study area largely lacks rough-barked eucalypt species which provide foraging habitat. Disturbance further makes the study area unsuitable.	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							
<i>Hoplocephalus bungaroides</i>	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							
<i>Mixophyes iteratus</i>	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.
<i>Heleioporus australiacus</i>	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
<i>Litoria aurea</i>	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
<i>Litoria littlejohni</i>	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
<i>Mixophyes balbus</i>	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							
<i>Petrogale penicillata</i>	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
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		V	2015	Recorded	This species was recorded by Ecological (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.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		V	2015	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. Hollow bearing trees which may provide roosting habitat for the species also occur within the study area.	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 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.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat		V	2015	Moderate	Species is likely to forage within the study area. Species may also roost within tree hollows within the study area.	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat		V	2015	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 forage within the study area on occasion. Hollow bearing trees which may provide roosting habitat for the species also occur within the study area.	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
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	#	Recorded	This species was recorded by Ecological (2011a) 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.
<i>Phascolarctos cinereus</i> (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 <i>E. robusta</i> , <i>E. tereticornis</i> , <i>E. punctata</i> , <i>E. haemostoma</i> and <i>E. signata</i> . 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
<i>Chalinolobus dwyeri</i>	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.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Miniopterus australis</i>	Little Bentwing-bat		V	2011	Recorded	This species was recorded by Ecological (2011a) within the study area.	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 canopy of densely vegetated habitats.

Scientific Name	Common Name	EPBC Status	TSC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
<i>Potorous tridactylus tridactylus</i>	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, but 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
<i>Pseudomys novaehollandiae</i>	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.
<i>Pseudomys fumeus</i>	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
<i>Isoodon obesulus obesulus</i>	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.
<i>Dasyurus maculatus</i>	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 corridor 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.

* - habitat descriptions have been adapted by qualified ecologists from the DoE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Appendix 2.3 Migratory species (EPBC Act listed)

Includes records from the following sources:

- NSW BioNet Wildlife Atlas (refer to Section 2.1)
- DoE database (accessed on 15/07/2015)
- BirdLife Australia data search
- Current survey

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

Table 10: Migratory fauna species recorded or predicted to occur within five of the study area



Scientific Name	Common Name	Conservation Status		Most recent record
		EPBC	TSC	
<i>Anthochaera phrygia</i>	Regent Honeyeater	EN	E4A	#
<i>Apus pacificus</i>	Fork-tailed Swift			#
<i>Ardea ibis</i>	Cattle Egret			2015/#
<i>Ardea modesta</i>	Eastern Great Egret			2014/#
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper			2007
<i>Calidris melanotos</i>	Pectoral Sandpiper			2007
<i>Calidris ruficollis</i>	Red-necked Stint			2014
<i>Chalcophaps indica</i>	Emerald Dove			2000
<i>Danaus plexippus</i>	Monarch Butterfly			2009
<i>Gallinago hardwickii</i>	Latham's Snipe			2011/#
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle			2014/#
<i>Hirundapus caudacutus</i>	White-throated Needletail			2010/#
<i>Hydroprogne caspia</i>	Caspian Tern			2012
<i>Lamna nasus</i>	Porbeagle, mackerel shark			#
<i>Limosa lapponica</i>	Bar-tailed Godwit			2011
<i>Merops ornatus</i>	Rainbow Bee-eater			#
<i>Monarcha melanopsis</i>	Black-faced Monarch			2013/#


Scientific Name	Common Name	Conservation Status		Most recent record
		EPBC	TSC	
<i>Myiagra cyanoleuca</i>	Satin Flycatcher			#
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	CE	E4A	#
<i>Numenius madagascariensis</i>	Eastern Curlew	CE		2002
<i>Pandion haliaetus</i>	Osprey		V	2014/#
<i>Plegadis falcinellus</i>	Glossy Ibis			1985
<i>Pluvialis fulva</i>	Pacific Golden Plover			1999
<i>Rhipidura rufifrons</i>	Rufous Fantail			2012/#
<i>Rostratula australis</i>	Australian Painted Snipe	EN	E1	2011/#
<i>Symposiachrus trivirgatus</i>	Spectacled Monarch			#
<i>Tringa nebularia</i>	Common Greenshank			2011
<i>Tringa stagnatilis</i>	Marsh Sandpiper			1987



* - habitat descriptions have been adapted by qualified ecologists from the DSEWPac Species Profile for listed migratory species, references within the above table are provided within the report reference list.



Appendix 2.4 Hollow-bearing tree and nest box replacement inventory



Table 11: Hollow bearing trees recorded within the study area

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
1	5cm branch hollow	Microbat species	Yes, road	<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
2	5cm branch hollow	Microbat species	Yes, building envelope.	<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	


HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	5cm branch hollow			<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
3	Large opening on dead branch	Microbat species	Yes, building envelope	<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
4	Small vertical fissure one 15cm trunk hollow	Microbat species	Yes, building envelope	<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	


HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	Small vertical fissure	Microbat species		<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
	15cm trunk hollow	Medium sized parrots and small possums		<ul style="list-style-type: none"> – Galah – Little Corella – King Parrot – Ringtailed Possum 	Medium opening vertical nest box.	
5	5cm trunk hollow, low to the ground	Unsuitable habitat	Yes, not Applicable	Not Applicable	Not Applicable	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
6	15 cm branch hollow, very shallow	Unsuitable habitat	No, not Applicable	Not Applicable	Not Applicable	
7	10cm branch hollow	Small parrot species	No, retained within Lot 73	Not required		

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
8	10cm trunk hollow, rubble filled.	Unsuitable habitat.	Not Applicable	Not Applicable	Not Applicable	
9	5cm, dead branch	Microbat species	No, retained within Lot 73	Not required	Not required	



HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
10	10 cm trunk hollow	Small parrot species	No, retained within Lot 73	Not required		
11	10cm trunk hollow	Small parrot species	No, retained within Lot 73	Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	



HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	10cm trunk hollow	Small parrot species		Not required	Not required	
	20 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
12	5cm trunk hollow	Microbat species	No, retained within Lot 73	Not required	Not required	



HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
13	5cm tube hollow in branch	Microbat species	No, retained within Lot 73	Not required	Not required	
14	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	10cm trunk hollow	Small parrot species		Not required	Not required	
	20cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	30 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
15	15cm tube hollow in branch	Medium sized parrots and small possums	No, retained within Lot 73	Not required	Not required	
16	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	10 cm branch hollow	Microbat species		Not required	Not required	



HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
	10 cm trunk hollow	Small parrot species		Not required	Not required	
	25 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
	30 cm trunk hollow	Medium sized parrots and small possums		Not required	Not required	
17	5cm branch hollow	Microbat species	No, retained within Lot 73	Not required	Not required	
	5cm branch hollow	Microbat species		Not required	Not required	



HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
18	15cm trunk hollow, obstructed	Unsuitable habitat	Not Applicable	Not Applicable	Not Applicable	
19	15cm hollow in dead branch	Unsuitable habitat	Not Applicable	Not Applicable	Not Applicable	

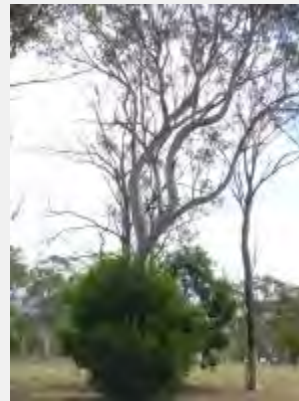

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
20	10cm fissure in trunk	Small parrot species	No, retained within Lot	Not required	Not required	
	5cm branch tube hollow	Microbat species		Not required	Not required	
21	10cm vertical fissure	Small parrot	Yes, road	<ul style="list-style-type: none"> – Eastern rosella – Crimson rosella – Rainbow Lorikeet – Red-rumped Parrot 	Small opening, vertical nest box	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
22	Fissure in dead branch	Threatened microbat species	Yes, unsafe stag tree.	<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
	Fissure in dead branch	Threatened microbat species		<ul style="list-style-type: none"> – Eastern False Pipistrelle – Greater Broad-nosed Bat – Other non-threatened microbat species 	Microbat box	
23	Shallow fissure on trunk, 10 x 50cm	Unsuitable habitat	Not Applicable	Not Applicable	Not Applicable	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
24	15 cm trunk hollow	Medium sized parrots and small possums	No, retained within Lot	Not required	Not required	
25	Cracked trunk with vertical fissure	Threatened microbat species	No, retained within Lot	Not required	Not required	
	10 cm branch hollow	Small parrot species		Not required	Not required	
	10 cm trunk hollow	Small parrot species		Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
26	10 cm trunk hollow	Small parrot species	Yes, building envelope	<ul style="list-style-type: none"> – Eastern rosella – Crimson rosella – Rainbow Lorikeet – Red-rumped Parrot 	Small opening, vertical nest box	
27	20cm trunk hollow with woody rubble	Unsuitable habitat	Yes, fence line - Not Applicable	Not Applicable	Not Applicable	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
28	Small crack on branch	Unsuitable habitat	Yes, road - Not Applicable	Not Applicable	Not Applicable	
29	15cm bowl shaped hollow on trunk	Medium sized parrots and small possums	Yes, building envelope	Galah Little Corella King Parrot Ringtailed Possum	Medium opening vertical nest box.	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
30	5 cm tube hollow	Threatened microbat species	No, retained within Lot	Not required	Not required	
31	5cm tube hollow	Threatened microbat species	No, retained within Lot	Not required	Not required	

HBT label	Hollow size/ features	Suitability for fauna occupancy	Removal predicted	Species Targeted	Type of compensatory habitat	Photo
32	Large fissure in trunk	Threatened microbat species	No, retained within Lot	Not required	Not required	
	15cm branch hollow	Medium sized parrots and small possums				
	15cm branch hollow	Medium sized parrots and small possums				
33	10 – 20 cm open fissure in trunk	Unsuitable habitat	Not applicable	Not required	Not required	

Appendix 3: Assessments of Significance

The following section provides for Assessments of Significance according to the seven factors outlined in Section 5A of the EP&A Act for all species listed as a medium likelihood or greater in Appendix 1 and Appendix 2.

Illawarra Lowlands Grassy Woodland

Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion is an endangered ecological community listed under the TSC Act.

5.76 hectares was identified within the study area. There are 3.06 hectares of this community proposed for removal in the study area; however it has been highly modified due to past clearing and use of the study area for horse agistment. 2.68 hectares will be retained and managed for conservation.

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

Not applicable.

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

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Illawarra Lowlands Grassy Woodland within the study area forms part of a habitat corridor extending to the south and east, with extensive stands of the community to the south. This is defined as the local occurrence. The proposed subdivision will result in the permanent removal of 3.06 hectares of the community in a degraded condition. 2.68 hectares will be retained and managed for conservation in the EMA, resulting in the improvement of retained vegetation.

Illawarra Lowlands Grassy Woodland within the study area is in a degraded condition due to past clearing and ongoing impacts from horse agistment. Within the study area, the community is represented by an overstorey of mature trees over a low, grazed groundcover with high levels of weeds. No midstorey is present. The extent of the community within the study area shows a low level of ecological functioning and low resilience.

The proposed subdivision will not have an adverse effect on the extent of the community or modify the community to such an extent that the community will be placed at an increased risk of extinction.

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

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

- (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

The proposed subdivision will result in the permanent removal of 3.06 hectares and the retention and management for conservation of 2.68 hectares of Illawarra Lowlands Grassy Woodland.

The proposed subdivision will not result in the fragmentation or isolation of any areas, with vegetated corridors to be retained within the EMAs and to the east and west of the study area.

Illawarra Lowlands Grassy Woodland within the study area shows a high degree of disturbance and, as a result, has a low level of ecological functioning and low resilience. Impacts from horse agistment have significantly degraded the community over time. In comparison to other stands within the locality this vegetation is considered of low importance due to the low structural and species diversity.

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

There is no critical habitat declared for this community.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no recovery plan for this community.

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

The proposed residential subdivision is likely to result in the operation of, or increase the impact of, the following key threatening processes relevant to the community:

- Clearing of native vegetation.

The VMP has been developed to mitigate the impacts of these key threatening processes on this community.

Conclusion

The proposal is unlikely to result in a significant effect on *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* as:

- 2.68 hectares will be retained and managed for conservation, resulting in improvement in the quality of retained areas.
- Habitat to be removed within the study area is already highly degraded and of poor structural condition and low species diversity.
- The extent of habitat to be removed is considered of low importance in the locality.

Based on the above assessment, an SIS is not considered necessary.

White-flowered Wax Plant *Cynanchum elegans*

The White-flowered Wax Plant is listed as endangered under the TSC Act.

Targeted surveys have been undertaken throughout native vegetation within the study area. Seven plants were recorded at two locations within the study area. This is defined as the 'local population'. Habitat is substantially degraded due to a dense cover of Lantana.

The proposed subdivision will not result in the removal of any plants. There is potential for indirect impacts to five plants at one location, including modification of habitat, through the management of vegetation within the outer APZ. No negative impacts to remaining plants will occur.

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

The species was recorded within the EMA, at two locations. One location is within the conservation area and will be managed purely for conservation, resulting in beneficial impacts. One location, supporting the majority of plants is located within the outer APZ.

The management of vegetation within the outer APZ has the potential to result in impacts to life cycle of this species, resulting in the prevention of suckering by adult plants and preventing the spread of seeds. Provided the measures outlined in Section 5.2 are implemented, including retention of a 20 metre buffer and fencing of this population, the life cycle of this species will not be adversely affected. Any works undertaken within APZ areas will be completed by a s 132 licenced bush regenerator.

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

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

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

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

No plants will be permanently removed as a result of the proposed subdivision. There is some potential for modification to the habitat for this species within the inner and outer APZs. However, the majority of habitat for this species will be retained within the EMA and managed for conservation purposes.

No areas of habitat will become isolated or fragmented as a result of the proposed subdivision.

The habitat to be removed is considered of low importance for the species due to significant ongoing degradation due to horse agistment.

Provided the measures outlined in Section 5.2 are implemented, including protection of 2.68 hectares of habitat within the EMA, and management of retained vegetation in accordance with the VMP there is potential for beneficial impact for this species.

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

Critical habitat has not been declared for this species.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no recovery plan for this species.

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

The proposed residential subdivision is likely to result in the operation of, or increase the impact of, the following key threatening processes relevant to the community:

- Clearing of native vegetation.

The VMP has been developed to mitigate the impacts of these key threatening processes on this community.

Conclusion

The proposal is unlikely to result in a significant effect on the White-flowered Wax Plant as:

- No plants will be removed.
- Although habitat will be removed within the study area, it is already highly degraded.
- Provided the recommendations outlined in Section 5.2 are implemented indirect impacts to retained plants can be effectively managed.
- There is potential for beneficial impacts to this species due to the retention and management of habitat within the EMA.

Based on the above assessment, an SIS is not considered necessary.

Hollow roosting microchiropteran bats (Greater Broad-nosed Bat *Scoteanax rueppellii* and Eastern False Pipistrelle *Falsistrellus tasmaniensis*)

Both species are listed as vulnerable under the TSC Act.

The Eastern False Pipistrelle was recorded within the study area by Ecological (2011) while the Greater Broad-nosed Bat is considered a medium likelihood of occurrence. The species are likely to forage within the study area and there is potential for these species to roost within hollow-bearing trees within the study area.

The 'local population' of these species is defined as all individuals that may forage within the study area on occasion. Given the mobility and nightly foraging range of these species, this would conservatively be estimated as all individuals within the locality.

The proposed subdivision will impact 4.15 hectares of foraging habitat as well include the removal of 21 hollow-bearing trees which may provide roosting habitat for these species. 2.68 hectares of foraging habitat and 12 hollow-bearing trees will be retained within the EMA.

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

Both species are likely to utilise the study area for foraging on occasion, with hollow-bearing trees providing potential roosting habitat. The proposed residential subdivision will result in the removal of 3.06 hectares of foraging habitat and 21 hollow-bearing trees which may provide roosting habitat for these species.

Foraging and roosting habitat within the subject site is not considered limiting within the locality, with abundant foraging habitat and potential roosting habitat present. In addition, 2.68 hectares of foraging habitat and 12 hollow-bearing trees will be retained within the EMA.

Given the small amount of habitat proposed to be removed, the retention of habitat within the EMA, the high mobility of the species and abundance of habitat within the locality it is considered unlikely that the proposed subdivision would result in an adverse effect on the life cycle of these two microbat species to such an extent that it would place the local populations at risk of extinction.

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

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

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

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

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

The proposed subdivision will result in the removal of 3.06 hectares of foraging habitat and 21 hollow-bearing trees which may provide roosting habitat for these species. 2.68 hectares of foraging habitat and 12 hollow-bearing trees will be retained within the EMA.

No fragmentation or isolation or habitat will result from the proposed subdivision, with maintenance of habitat corridors to the east, south and west.

Habitat to be removed is not considered limiting in the locality. Although hollow-bearing trees provide potential roosting habitat for these species, there was no evidence of occupation. In addition, both species tend to prefer moist environments for roosting, with the study area located on a ridge top.

- (e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

Critical habitat has not been declared for these species.

- (f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

There is no recovery plan for these species.

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

The proposed residential subdivision is likely to result in the operation of, or increase the impact of, the following key threatening processes relevant to the community:

- Clearing of native vegetation.
- Loss of hollow-bearing trees.
- Predation by the feral cat *Felis catus*.
- Removal of dead wood and dead trees.

The proposed subdivision may result in the operation of the above three key threatening processes. However, only a small area of degraded habitat and a small number of potential roosting trees would be removed. Whilst there may be some detrimental impacts to these species, these impacts are unlikely to be significant given the abundance of habitat within the locality and lack of evidence of occupation of the subject site by these species.

Conclusion

The proposal is unlikely to result in a significant effect on these species as:

- Habitat within the study area is degraded and not considered limited within the locality.
- Habitat will be retained within the EMA.

Based on the above assessment, an SIS is not considered necessary.

Appendix 4: Significant Impact Criteria assessments

White-flowered Wax Plant *Cynanchum elegans*

The White-flowered Wax Plant is listed as endangered under the EPBC Act.

Targeted surveys have been undertaken throughout native vegetation within the study area. Seven plants were recorded at two locations within the study area. This is defined as the 'local population'. Habitat is substantially degraded due to a dense cover of Lantana.

The proposed subdivision will not result in the removal of any plants. There is potential for indirect impacts to five plants at one location, including modification of habitat, through the management of vegetation within the outer APZ. No negative impacts to remaining plants will occur.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of a population

No plants will be removed as a result of the proposed subdivision. Retained plants will be managed to minimize and mitigate impacts. Suitable habitat will be managed within the EMA, resulting in the potential for an increase in the size of the population within the site.

reduce the area of occupancy of the species

Some degraded habitat will be removed as a result of the proposed subdivision. However, all occupied habitat will be retained and managed, resulting in beneficial impacts for the species.

fragment an existing population into two or more populations;

No areas of habitat will become isolated or fragmented as a result of the proposed subdivision.

adversely affect habitat critical to the survival of a species;

No habitat critical to the survival of the species has been identified. Habitat within the study area is not likely to be considered critical to the survival of the species.

disrupt the breeding cycle of a population;

The species was recorded within the EMA, at two locations. One location is within the conservation area and will be managed purely for conservation, resulting in beneficial impacts. One location, supporting the majority of plants, is located within the outer APZ.

The management of vegetation within the outer APZ has the potential to result in impacts to the life cycle of this species, resulting in the prevention of suckering by adult plants and preventing the spread of seeds. Provided the measures outlined in Section 5.2 are implemented, including retention of a 20 metre buffer, works undertaken within APZ areas to be completed by a s 132 licenced bush regenerator and fencing of this population, the life cycle of this species will not be adversely affected.

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

No plants will be permanently removed as a result of the proposed subdivision. There is some potential for modification to the habitat for this species within the inner and outer APZs. However, the majority of habitat for this species will be retained within the EMA and managed for conservation purposes. Any works undertaken within APZ areas will be completed by a s 132 licenced bush regenerator.

The habitat to be removed is considered of low importance for the species due to significant ongoing degradation due to horse agistment.

Provided the measures outlined in Section 5.2 are implemented, including protection of 2.7 hectares of habitat within the EMA, and management of retained vegetation in accordance with the VMP there is potential for beneficial impact for this species.

result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

Areas of retained habitat for this species are currently being impacted by significant invasion by weed species. Management of these areas will result in removal of invasive species harmful to this species.

introduce disease that may cause the species to decline, or;

Introduction of diseases are unlikely to result from the proposed subdivision.

interfere with the recovery of the species.

The VMP will incorporate many of the recovery actions identified for this species, including fencing, weed control, and habitat restoration and ecotone maintenance.

Conclusion

The proposal is unlikely to result in a significant impact on the White-flowered Wax Plant as:

- No plants will be removed.
- Although habitat will be removed within the study area, it is already highly degraded.
- Provided the recommendations outlined in Section 5.2 are implemented indirect impacts to retained plants can be effectively managed.
- There is potential for beneficial impacts to this species due to the retention and management of habitat within the EMA.

Based on the above assessment, a referral to the Commonwealth Minister for the Environment is not considered necessary.

Illawarra and south coast lowland forest and woodland ecological community

The Illawarra and south coast lowland forest and woodland ecological community is listed as critically endangered under the EPBC Act.

An action is likely to have a significant impact on critically endangered and endangered ecological community if there is a real chance or possibility that it will:

Reduce the extent of an ecological community

The study area contains 5.76 hectares of CEEC. The project in its current form will result in a reduction of extent of 4.15 hectares of the CEEC to provide for residential subdivision within the study area. This includes the installation of an APZ which will modify 1.09 hectares of the CEEC to be retained. The APZ will impact the CEEC and provide a buffer wider than 30 metres between the development and retained and surrounding vegetation.

The remaining 1.68 hectares of CEEC will be retained and managed under a VMP in perpetuity.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed subdivision occurs within a corridor of vegetation that is orientated north to south and contiguous with the Tongarra – Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al. 2011). The vegetation to be removed as part of the proposed action will reduce the area of the corridor, but will not result in a discrete break in the corridors length. The CEEC to be retained within the east of the study area will retain connectivity to the south. The proposed action will have a minimal impact to the vegetation to the west of the study area which adjoins native vegetation further to the north. This may include the installation of a piped stormwater easement up to 10 metres wide.

Adversely affect habitat critical to the survival of an ecological community

The approved conservation advice considers all Illawarra Lowlands Grassy Woodland that is moderate condition or above as critical to the survival of the community. The proposed subdivision will adversely affect habitat critical to the survival of the CEEC.

Modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological communities survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed subdivision footprint will result in the permanent modification of the habitat within the development area. Trees will be retained within the development footprint in areas where not occurring within dwelling footprints, fence lines, proposed roads or soil cuts. The retained CEEC vegetation to the east and west will be buffered by APZs at a distance of 30 metres or greater. Management of the APZs will contribute to providing a buffer from the development and provide for infiltration of water uphill from the retained CEEC. This will contribute to minimising drying of vadose zone hydrology that may impact the CEEC. The majority of runoff from residential hard surfaces and stormwater flows is proposed to be re-directed through stormwater infrastructure to a rock lined ephemeral gully to the west. This will reduce any increased flows into areas of the CEEC and avoid localised changes in hydrology that will result in a wetter environment.

Causes a substantial change in the species composition of an occurrence of an ecological community, including causing a decline of functionally important species, for example through regular burning or flora or fauna harvesting

The removal of CEEC vegetation will cause a substantial change within the development footprint. Installation of APZs will also result in permanent modification of the CEEC through canopy thinning and slashing of midstorey species and groundcovers on a regular basis.

The CEEC area to be retained within the study area will be managed for conservation under a VMP and include: removal of man-made structures, fencing, control of noxious weeds, and revegetation of low condition groundcover areas. No burning is planned within the VMP management actions.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community including, but not limited to:

Assisting invasive species, that are harmful to the listed ecological community, to become established, or

Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The study area is currently managed for horse agistment with minimum input for weed control. The retained CEEC and its APZs will be managed under a VMP in perpetuity which will result in a reduction of noxious woody weeds and improvement of condition for the retained vegetation. The application of herbicides will be limited to spot application or via manual control methods as per the VMP.

There is potential for garden escapes to become new weed pressures that threaten the CEEC as development occurs within the study area. These threats will be managed through a VMP for the retained vegetation within the EMA..

Broad scale use or application of fertilisers will not be undertaken as part of the proposed development, and sediment fencing will be installed to reduce the potential for downstream impacts into the retained areas via soil erosion.

Interfering with the recovery of an ecological community

A recovery plan for the CEEC has not been prepared. The proposal is contributing to the clearing and fragmentation of the CEEC, which are considered the highest threat to its survival (TSSC 2016).

Conclusion

Based on the SIC guidelines (CoA 2013) and approved conservation advice for the CEEC (TSSC 2016) the proposed action is likely to result in a significant impact on Illawarra Lowlands Grassy Woodland due to the removal and permanent modification of 4.15 hectares of vegetation that is considered critical to the survival of the CEEC.

Based on the above assessment, a referral to the Commonwealth Minister for the Environment is strongly recommended.

Appendix 7: Offset site BAR – RedGum Ridge (Biosis 2016b)



Redgum Ridge Western Precinct (part Lots
815 DP1193843 and 1801 DP1223063)

BioBank Site:

Biodiversity Assessment Report

FINAL REPORT

Prepared for Edenvell Pty Ltd

12 December 2016

Biosis offices

AUSTRALIAN CAPITAL TERRITORY

Canberra

Floor 1, Unit 3, 38 Essington Street
Mitchell ACT 2911

Phone: (02) 6102 1200
Email: canberra@biosis.com.au

NEW SOUTH WALES

Newcastle

Suite 8, 27 Annie Street
Wickham NSW 2293

Phone: (02) 4911 4044
Email: newcastle@biosis.com.au

Sydney

Unit 14 17-27 Power Avenue
Alexandria NSW 2015

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

8 Tate Street
Wollongong NSW 2500

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

QUEENSLAND

Brisbane

Suite 4 First Floor, 72 Wickham Street
Fortitude Valley QLD 4006

Phone: (07) 3831 7400
Email: brisbane@biosis.com.au

VICTORIA

Ballarat

506 Macarthur Street
Ballarat VIC 3350

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne (Head Office)

38 Bertie Street
Port Melbourne VIC 3207

Phone: (03) 8686 4800
Fax: (03) 9646 9242
Email: melbourne@biosis.com.au

Wangaratta

16 Templeton Street
Wangaratta VIC 3677

Phone: (03) 5721 9453
Email: wangaratta@biosis.com.au

Document information

Report to: Edenvell Pty Ltd

Prepared by: Nathan Garvey
Mathew Misdale

Biosis project no.: 20289

File name: 20289.Redgum.Ridge.Biobank.Site.BAR.FIN02.20161219.docx

Citation: Biosis 2016. Redgum Ridge Western Precinct (part Lots 815 DP1193843 and 1801 DP1223063) BioBank Site: Biodiversity Assessment Report. Report for Edenvell Pty Ltd. Authors: N Garvey & M Misdale, Biosis Pty Ltd, Wollongong. Project 20289.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Kylie Reed	18/01/2016
Final version 01	Nathan Garvey	03/03/2016
Final version 02	Nathan Garvey	19/12/2016

Acknowledgements

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

- Edenvell Pty Ltd: Richard Clifford
- MMJ Wollongong: Luke Rollinson
- NSW Office of Environment and Heritage: Chris Page, Daniel Robson, Jedda Lemmon, Ziggy Andersons

Biosis staff involved in this project were:

- Axton Aguiar and Mathew Misdale (assistance in the field)
- Ashleigh Pritchard (mapping)
- Kylie Reed (quality assurance)

© Biosis Pty Ltd

This document is and shall remain the property of Biosis Pty Ltd. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

Stage 1 – Biodiversity Assessment	2
1. Introduction	3
1.1 BioBank site identification	3
1.2 Information sources	4
1.2.1 Publications and databases	4
1.2.2 Spatial data.....	4
2. Landscape.....	8
2.1 Bioregions and landscapes regions	8
2.2 Waterways and wetlands.....	8
2.3 Native vegetation extent.....	8
2.4 Assessment of landscape value	9
2.4.1 Assessment of the current extent of native vegetation cover.....	9
2.4.2 Assessment of connectivity value	9
2.4.3 Assessment of patch size.....	10
3. Native vegetation.....	12
3.1 Background review	12
3.2 Methods.....	12
3.2.1 Site investigation.....	12
3.3 Results.....	15
3.3.1 Vegetation description	15
3.3.2 Plant community types.....	16
3.3.3 Site value scores.....	21
4. Threatened species	25
4.1 Methods.....	25
4.2 Geographic /habitat features.....	25
4.3 Ecosystem credit species	28
4.4 Species credit species.....	31
4.4.1 Flora species	31
4.4.2 Fauna species	35
Stage 3 – Improving biodiversity values.....	40
5. Improving biodiversity values.....	41
5.1 Management zones	41
5.2 Assessment of changes in biodiversity values for management zones within the BioBank site	42
5.2.1 Assessment of changes in landscape attribute values for the BioBank site	42
5.2.2 Averted loss.....	42

5.2.3	Assessment of changes in site value scores for each management zone	42
5.3	Management actions to improve biodiversity values	43
5.3.1	Standard management actions for all vegetation zones	43
5.3.2	Additional management actions	44
5.3.3	Existing Management Obligations	44
6.	Biodiversity credits	46
6.1.1	Ecosystem credits created	46
6.1.2	Species credits created	49
7.	Conclusion	50
	References	51
	Appendices	52
	Appendix 1: Native vegetation data (BioBanking)	53
	Appendix 2: Changes in biodiversity value scores for each management zone	63
	Appendix 3: Management actions template	69
	Appendix 4: Credit profile report	106

List of Figures

Figure 1:	Location map – Redgum Ridge Western Precinct, BioBank Site	6
Figure 2:	Site map – Redgum Ridge Western Precinct, BioBank Site	7
Figure 3:	Vegetation extent within the outer assessment circle	11
Figure 4:	Native vegetation mapping, NPWS (2002)	23
Figure 5:	Native vegetation of the BioBank site, including flora survey effort	24
Figure 6:	Threatened flora surveys and locations of the White-flowered Wax Plant	39
Figure 7:	Management zones and management actions	45

List of Tables

Table 1:	Extent of native vegetation cover before and after development	9
Table 2:	Vegetation zones mapped within the study area	16
Table 3:	Vegetation zones 3 and 4 – Forest Red Gum - Thin-leaved Stringybark grassy woodland	17
Table 4:	Vegetation zones 5, 6, 7 and 8 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest	18
Table 5:	Vegetation zones 9 and 10 – Whalebone Tree - Native Quince dry subtropical rainforest	20
Table 6:	Site value scores for all vegetation zones	22
Table 7:	Assessment of geographic habitat features within the study area	26
Table 8:	Assessment of ecosystem credit species within the BioBank site	29
Table 9:	Species credit species (flora) and status within the BioBank site	32
Table 10:	Species credit species (fauna) and status within the BioBank site	36
Table 11:	BioBanking management zones	41
Table 12:	Summary of ecosystem credits for each management zone	47

Table 13: Summary of species credits.....	49
Table 14: Summary of ecosystem credits	50
Table 15: Flora species recorded from the BioBank site, including cover scores	54
Table 16: Plot and transect field data - Vegetation Zone 3.....	61
Table 17: Plot and transect field data - Vegetation Zone 4.....	61
Table 18: Plot and transect field data - Vegetation Zone 5.....	61
Table 19: Plot and transect field data - Vegetation Zone 6.....	61
Table 20: Plot and transect field data - Vegetation Zone 7.....	61
Table 21: Plot and transect field data - Vegetation Zone 8.....	61
Table 22: Plot and transect field data - Vegetation Zone 9.....	62
Table 23: Plot and transect field data - Vegetation Zone 10	62
Table 24: Changes in biodiversity value scores for Management Zone MZ03	63
Table 25: Changes in biodiversity value scores for Management Zone MZ04	63
Table 26: Changes in biodiversity value scores for Management Zone MZ05	64
Table 27: Changes in biodiversity value scores for Management Zone MZ06	65
Table 28: Changes in biodiversity value scores for Management Zone MZ07	65
Table 29: Changes in biodiversity value scores for Management Zone MZ08	66
Table 30: Changes in biodiversity value scores for Management Zone MZ09	66
Table 31: Changes in biodiversity value scores for Management Zone MZ10	67
Table 32: Changes in biodiversity value scores for Management Zone MZ11	68

List of Plates

Plate 1: Forest Red Gum - Thin-leaved Stringybark grassy woodland (VZ03)	18
Plate 2: Sydney Blue Gum X Bangalay - Lilly Pilly moist forest.....	20
Plate 3: Whalebone Tree - Native Quince dry subtropical rainforest	21

Glossary

APZ	Asset Protection Zone
CBD	Central Business District
DCDB	Digital Cadastral Database
DIWA	Directory of Important Wetlands of Australia
DoE	Department of the Environment
DTDB	Digital Topographic Database
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cmwltth)
GIS	Geographic Information System
IBRA	Interim Biogeographical Rationalisation of Australia
LEP	Local Environment Plan
LGA	Local Government Area
NSW	New South Wales
NV Act	<i>Native Vegetation Act 2003</i> (NSW)
NW Act	<i>Noxious Weed Act 1993</i> (NSW)
OEH	Office of Environment and Heritage (NSW)
PCT	Plant Community Types (as defined by the NSW OEH's Vegetation Information System Classification Database)
PFC	Percentage Foliage Cover
SALIS	Soil and Land Information System
SEPP	State Environmental Planning Policy
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
VIS	Vegetation Information System
WM Act	<i>Water Management Act 2000</i> (NSW)

Stage 1 – Biodiversity Assessment

1. Introduction

1.1 BioBank site identification

The BioBank site includes part of Lots 815 DP 1193843 and 1801 DP 1223063 in Figtree, NSW which is approximately 5 kilometres south-west of the Wollongong Central Business District (CBD) (Figure 1). The site encompasses 47 hectares of private land and is currently zoned E2 Environmental Conservation under the Wollongong Local Environment Plan 2009 (LEP).

The study area is within the:

- Sydney Basin Interim Biogeographical Rationalisation of Australia (IBRA) Region.
- Illawarra IBRA Subregion.
- Dapto – Wollongong Coastal Slopes Mitchell Landscape.
- Lake Illawarra Catchment.
- Wollongong Local Government Area (LGA).

The BioBank site (Figure 2) spans the northern and southern slopes of a centralised ridge plateau that runs from the Woronora plateau, located to the west, towards the coastal plain to the east. The northern slopes of the BioBank site drain toward a fourth order section of Brandy and Water Creek. Two north-draining ephemeral first order streams join Brandy and Water Creek within the BioBank site and one eastwards draining intermittent first order stream meets the creek to the east of the site. The southern slopes drain towards a third order section of American Creek, with two southwards-draining first order ephemeral streams joining the creek within the BioBank site. Brandy and Water Creek and American Creek converge nearby to the east of the BioBank site before joining Allans Creek further to the east.

The study area is located at the western extent of the Illawarra Coastal Plain where the plain begins to rise towards the Woronora plateau. The Gwynneville Soil Landscape is the predominant soil landscape (NSW Soil and Land Information System (SALIS)) which is present in the footloose of the Illawarra Escarpment and isolated rises of the Wollongong Plain between Coledale and Dapto. This soil landscape unit overlies the Illawarra Coal Measures geologic unit. Dominant soils in the upper profile are sandy loams and sandy clay loam with pedal clay in the lower profile (Hazelton and Tille 1990).

The BioBank site supports three plant community types (PCTs) which reflect the underlying soils, landscape position and aspect of the BioBank site. *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion* occurs on the upper margins of the northern and southern slopes, along the centralised ridge plateau. *Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion* occurs in areas of moderate slope, while *Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion* occurs on steeper slopes and shaded gullies.

The BioBank site supports significant biodiversity values, including two endangered ecological communities (EECs) (*Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* and *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion*) and one threatened flora species (White-flowered Wax Plant *Cynanchum elegans*) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Currently, the BioBank site is subject to significant levels of weed infestation. Protection and management of the site for conservation purposes, resulting in an improvement in the condition of vegetation and habitat for

threatened species, has the potential to make a significant contribution to biodiversity conservation in the region, and would also assist in meeting targets set out under the *Illawarra Biodiversity Strategy* (WCC et al. 2011a, 2011b) and Southern Rivers Catchment Management Authority (SRCMA) *Catchment Action Plan* (CAP) 2006 to 2016 as well as the current SRCMA CAP 2013 – 2023 (SRCMA, 2013).

1.2 Information sources

1.2.1 Publications and databases

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

- Department of the Environment (DoE) Protected Matters Search Tool for matters protected by the EPBC Act.
- NSW BioNet - the database for the Atlas of NSW Wildlife, Office of Environment and Heritage (OEH).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2013 (BA).

Other sources of biodiversity information:

- Relevant vegetation mapping, including:
 - Native Vegetation of the Illawarra Escarpment and Coastal Plain (NPWS 2002).
 - OEH Vegetation Information System (VIS) Mapping through the Spatial Information eXchange (SIX) Vegetation Map Viewer.
- NSW Vegetation Information System (VIS): Classification Version 2.1.
- Wollongong LGA Bioregional Assessment (Part I): Native Vegetation of the Illawarra Escarpment and Coastal Plain (NPWS 2002).

The following reports were also used in the preparation of this assessment:

- Redgum Ridge Western Precinct (part Lots 814 and 815 DP1193843) Biodiversity Certification: Biodiversity Conservation Strategy (Biosis 2015a).
- Redgum Ridge Western Precinct (part Lots 814 and 815 DP1193843) Biodiversity Certification: Biodiversity Assessment Report (Biosis 2015b).
- Redgum Ridge Estate BioBanking Assessment (Biosis 2014).
- Illawarra Biodiversity Strategy. Volume 1 Action Plan (WCC et al. 2011a).
- Illawarra Biodiversity Strategy. Volume 2 Background Information (WCC et al. 2011b).
- Catchment Action Plan 2013 – 2023 (SRCMA 2013).

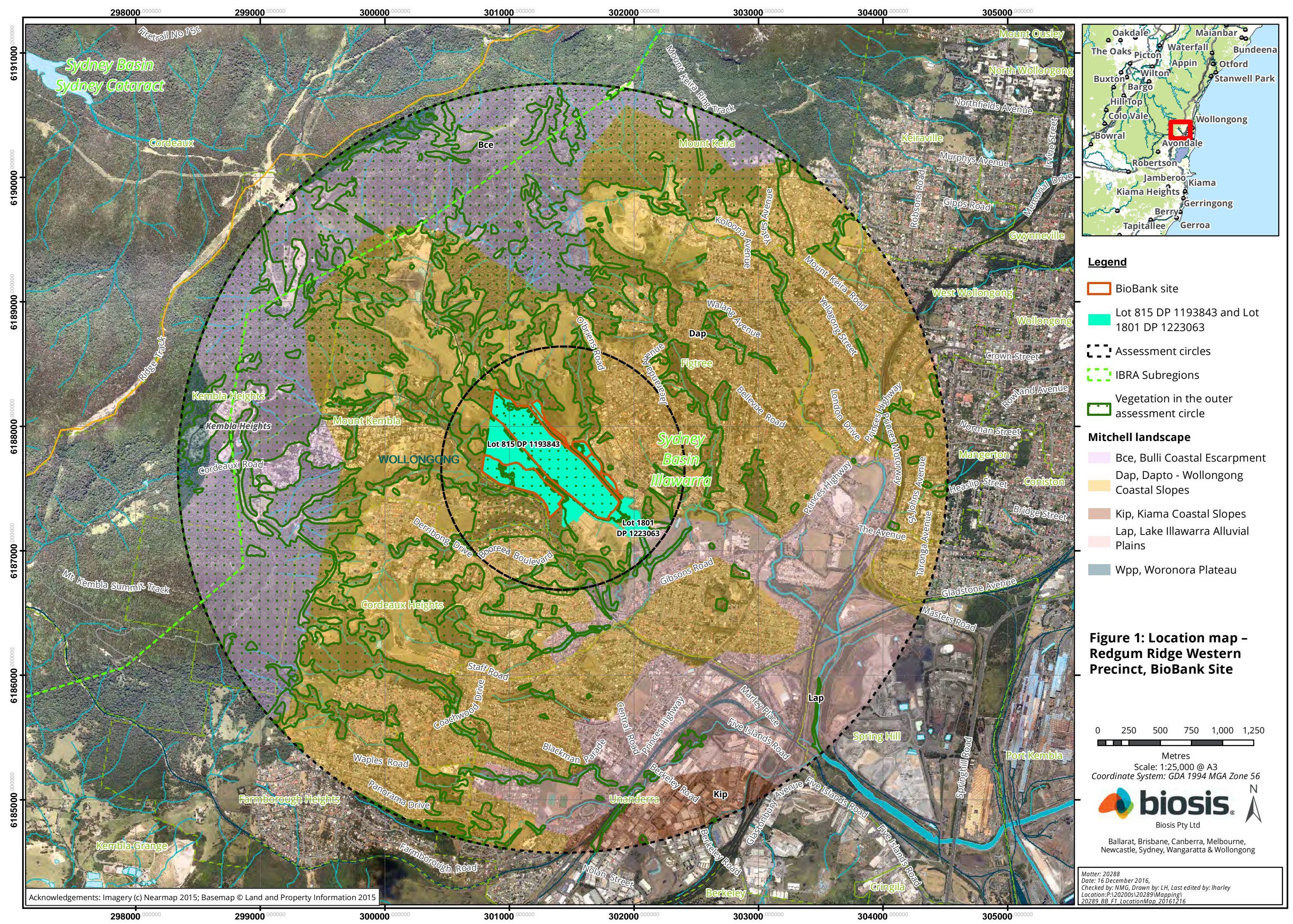
1.2.2 Spatial data

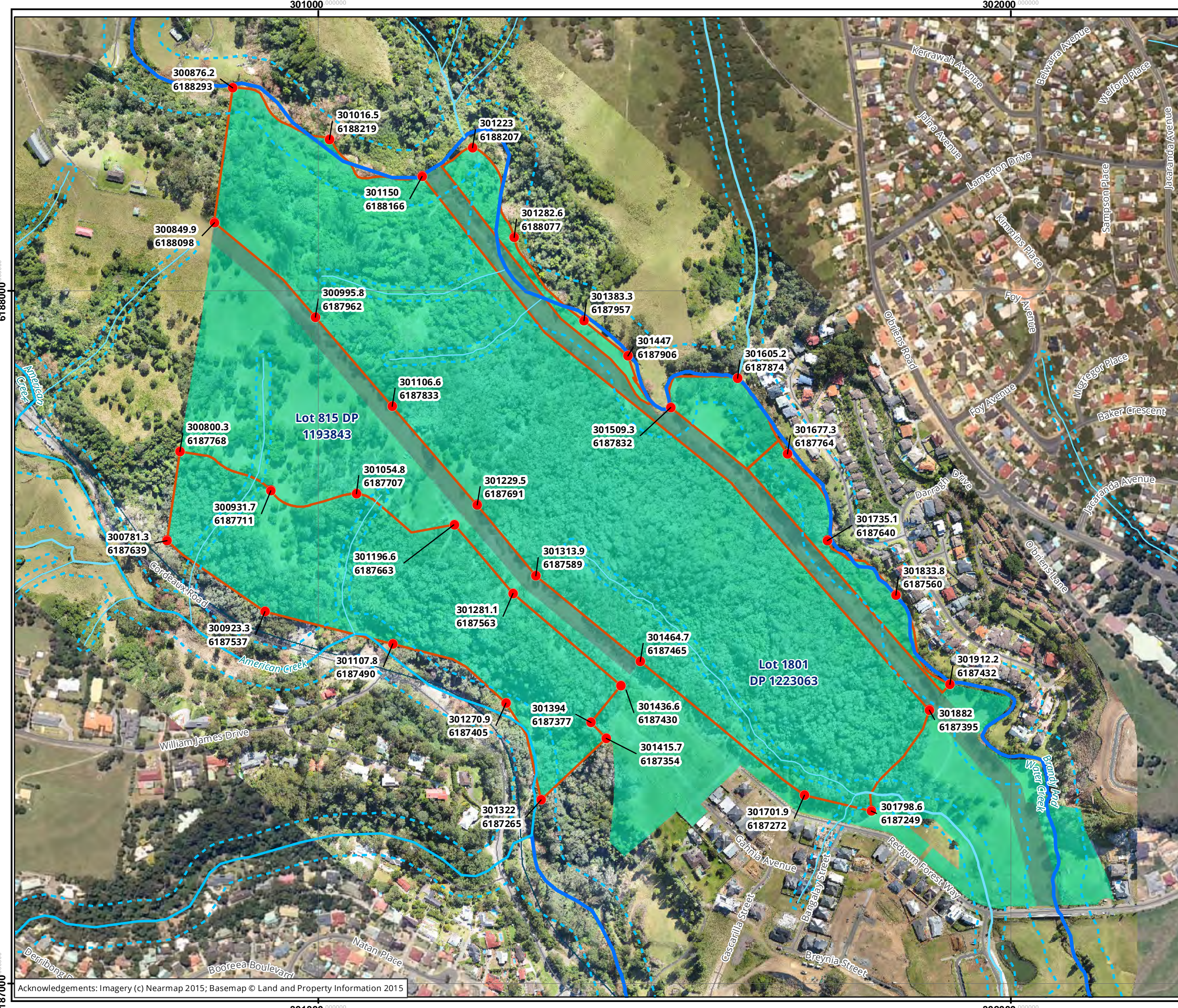
The subdivision layout was supplied by KFW Pty Ltd. Data was converted into shapefile format and imported into ArcGIS.

Basemap data was obtained from NSW Land and Property Information (LPI) 1:25000 digital topographic database (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB). Mapping of stream order was undertaken using a model using the Hydroline layer within the DTDB.

The following spatial datasets were utilised during the development of this report:

- Catchment data was obtained from the Catchment Boundaries of New South Wales dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DIWA).
- State Environmental Planning Policy (SEPP) No. 14 Coastal Wetlands.
- NSW Soil and Land Information System (SALIS).
- Aerial imagery for the BioBank site was obtained from KFW.
- Aerial photography for the assessment circle was obtained from the NSW public imagery database (date: 10 November 2014).





Legend

- BioBank site
- Lot 815 DP 1193843 and Lot 1801 DP 1223063
- Easements
- Stream buffers

Stream order

- 1
- 2
- 3
- 4

Figure 2: Site map – Redgum Ridge Western Precinct, BioBank Site

0 50 100 150 200 250
Metres
Scale: 1:5,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 20289
Date: 16 December 2016,
Checked by: NMG, Drawn by: LH, Last edited by: rgarvey
Location: P:\20200s\20289\Mapping\20289_BB_F2_SiteMap

2. Landscape

2.1 Bioregions and landscapes regions

The BioBank site occurs within the Sydney Basin IBRA bioregion, and the Illawarra IBRA subregion (Figure 2). The Sydney Cataract IBRA subregion is located within the outer assessment circle, to the north-west of the study area (Figure 1).

The BioBank site occurs within the Dapto – Wollongong Coastal Slopes Mitchell Landscape (Figure 2). The Lake Illawarra Alluvial Plains Mitchell Landscape occurs within the inner assessment circle to the south-east of the site. The Bulli Coastal Escarpment and Woronora Plateau Mitchell Landscapes occur within the outer assessment circle to the west of the site, and the Kiama Coastal Slopes Mitchell Landscape occurs within the outer assessment circle to the south-east of the site (Figure 1).

2.2 Waterways and wetlands

The study area is located within the Lake Illawarra catchment area. Waterways within and adjacent to the BioBank site are part of the Allans Creek catchment, with both Brandy and Water Creek and American Creek flowing into Allans Creek approximately 2 kilometres south-west of the site. The Allans Creek catchment is characterised by the Illawarra escarpment which rises to a height to 400 metres to the west above the low coastal plain. Allans Creek enters the Pacific Ocean via Tom Thumbs Lagoon at Port Kembla.

Two first order ephemeral streams flow northwards into a fourth order section of Brandy and Water Creek in the northern section of the BioBank site. A first order intermittent stream is located within the north-eastern section of the BioBank site; this creek flows eastwards converging with both Brandy and Water Creek and American Creek to the east of the site. Two first order ephemeral streams flow south into a third order section of American Creek in the southern section of the BioBank site. American Creek and Brandy and Water Creek converge approximately 450 metres east of the BioBank site to form Allans Creek.

The outer assessment circle intersects a number of creeks and associated tributaries, including:

- Byaralong Creek and a number of unnamed tributaries (located to the north of the BioBank site).
- Allans Creek and a number of unnamed tributaries (located to the south of the BioBank site).

No SEPP No. 14 coastal wetlands or DIWA wetlands are located within the BioBank site or outer assessment circle.

2.3 Native vegetation extent

Mapping of vegetation within the outer assessment circle was undertaken using a combination of NPWS (2002) and aerial photo interpretation to remove areas where development or clearing has occurred.

NPWS (2002) maps 14 native vegetation communities within the outer assessment circle, including:

- Alluvial Swamp Mahogany Forest
- Coachwood Warm Temperate Rainforest
- Coastal Grassy Red Gum Forest
- Escarpment Blackbutt Forest

- Escarpment Edge Silvertop Ash Forest
- Escarpment Moist Blue Gum Forest
- Floodplain Wetland
- Illawarra Escarpment Subtropical Rainforest
- Lowland Dry-Subtropical Rainforest
- Moist Box-Red Gum Foothills Forest
- Moist Coastal White Box Forest
- Moist Gully Gum Forest
- Spotted Gum Open Forest

This vegetation mapping was undertaken prior to 2002. Since this time parts of the outer assessment circle have been developed or cleared for other purposes. For this reason, assessment of the NPWS (2002) was undertaken using aerial photo interpretation with obvious areas of clearing removed and areas that were interpreted to be native vegetation added to the data. This resulted in a total of 1071 hectares of native vegetation being mapped within the inner and outer assessment circles (Figure 3).

2.4 Assessment of landscape value

Landscape value has been calculated using the method for BioBank sites, outlined in Appendix 6 of the BioBanking Assessment Methodology 2014 (OEH 2014).

2.4.1 Assessment of the current extent of native vegetation cover

A 300 hectare inner assessment circle was used to calculate landscape value, as this was the smallest size required to fit the BioBank site. This resulted in a 3000 hectare outer assessment. The assessment circles were centred on the northern section of the BioBank as this was considered to represent the centroid of greatest improvement for the site (Figure 3).

Native vegetation cover within the inner and outer assessment circle was determined using the refined NPWS (2002) dataset (see above under Section 2.3). Table 1 provides a summary of the extent of native vegetation cover within the inner and outer assessments circles, before and after BioBanking based on the outcomes of Stage 3 detailed herein

Table 1: Extent of native vegetation cover before and after development

Assessment Circle	Before BioBanking		After BioBanking	
	Area (ha)	Per cent	Area (ha)	Per cent
Outer assessment circle	1017	34	1021	34
Inner assessment circle	118	39	122	41

2.4.2 Assessment of connectivity value

The BioBank site is located on the southern bank of a fourth order section of Brandy and Water Creek. Therefore, the BioBank site is located within a strategic location, being a 'Riparian buffer on one side of a fourth or fifth order stream or higher'.

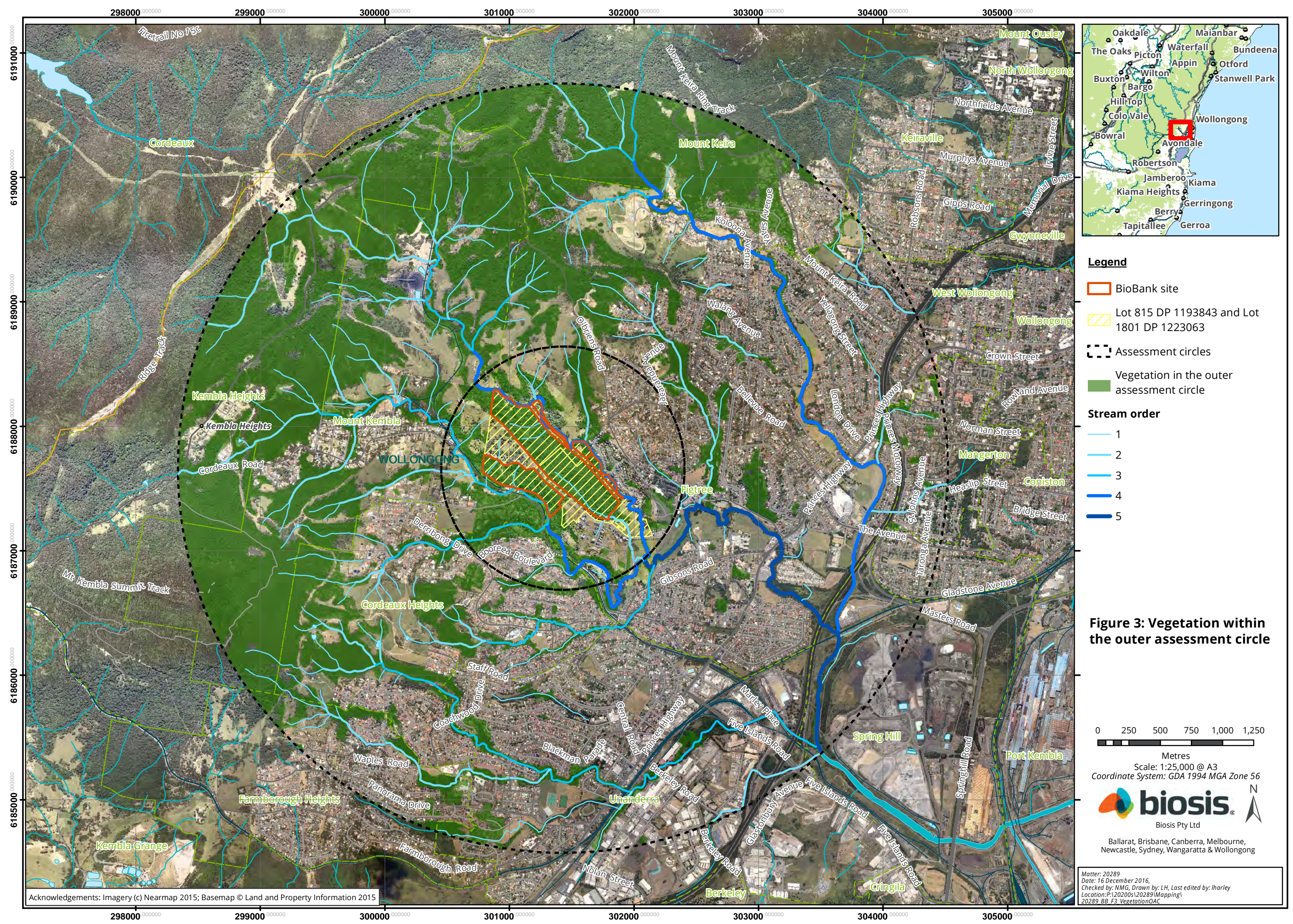
No further assessment of connectivity value is required.

2.4.3 Assessment of patch size

Patch size was assessed using a Geographic Information System (GIS). All vegetation not defined as low condition and separated by a distance of less than 100 metres was mapped sequentially using a selection process in ArcGIS. Using this method, vegetation within the study area forms part of a large patch of vegetation, extending into the Woronora plateau and land managed by Water NSW as a part of Sydney's drinking water catchment. The BioBank site was assessed as having a patch size of > 1000 hectares.

The Dapto – Wollongong Coastal Slopes Mitchell Landscape is estimated to be 71 per cent cleared. A patch size of greater than 100 hectares is deemed to be 'Extra Large' for Mitchell Landscapes with a percent native vegetation cleared of 70 – 90 per cent.

The BioBank site fits into the 'Extra Large' patch size class.



3. Native vegetation

The extent of native vegetation within the study area was determined using Section 5 of the BioBanking Assessment Methodology 2014 (OEH 2014).

3.1 Background review

A review of regional vegetation mapping by NPWS (2002) was undertaken to inform the site investigation.

NPWS (2002) maps four native vegetation communities within the BioBank site (Figure 4). Moist Box-Red Gum Foothills Forest (MU13) is mapped as the predominant vegetation community within the site, occurring across the northern and north-eastern sections. A small patch of Coastal Grassy Redgum Forest (MU23) is mapped in the north-western section of the site. Escarpment Moist Blue Gum Forest (MU8) is mapped along the northern and southern boundaries. Small patches of Lowland Dry-Subtropical Rainforest (MU4) are mapped along the southern boundary of the BioBank site.

Detailed mapping of vegetation within the BioBank site was undertaken for this assessment. Methodology is outlined in Section 3.2 and results presented in Section 3.3.

3.2 Methods

3.2.1 Site investigation

Investigations of the BioBank site have been carried out between September 2011 and December 2015. In summary, investigations included:

- 2011 – A constraints assessment undertaken to document the flora and fauna habitats within the BioBank site and to inform concept plans for a proposed rezoning and residential development. Field work undertaken included initial mapping of the vegetation communities, random meanders for threatened flora species and assessment of fauna habitat features.
- 2013-2014 – A preliminary BioBanking assessment, including consultation with OEH and Local Land Services, to determine the feasibility of BioBanking or Biocertification of the site. Field work undertaken included confirmation of the vegetation types present and alignment with the NSW Biometric Vegetation Types (BVTs), as well as more detailed assessment of fauna habitat features within the BioBank site.
- 2015 – Additional detailed surveys, including refinement of vegetation mapping using Light Detection and Ranging (LiDAR) data to map the tree canopy, ground-truthing to provide detailed mapping of vegetation, vegetation plots/transects in accordance with the NSW BioBanking Assessment Methodology (OEH 2014) and targeted surveys for threatened flora species within the BioBank site.

The following provides the details of survey methods undertaken to inform this assessment.

Constraints assessment (Biosis Research 2011)

Flora and fauna field assessments were undertaken on 14 September 2011. The flora and fauna surveys were preliminary in nature and designed to inform key elements of concept planning for a rezoning and lot layout of the site.

Flora surveys focused on ground truthing the existing NPWS (2002) vegetation mapping and defining vegetation formations for consideration in bushfire hazard assessment and planning. Redefining the boundaries of plant communities and alignment into vegetation types (Keith 2004) was based on sampling and observations of vegetation, structure, floristic composition and physiographic features such as soils and aspect. Flora surveys were undertaken using a combination of 20 x 20 metre quadrats, spot locations and random meanders to sample each stratification unit for the purpose of identifying the community type. Flora surveys were carried out in the following landscape stratification units:

- Closed forest
- Woodland
- Open woodland
- Closed scrub
- Cleared and disturbed areas.

Flora habitat assessments focused on the potential for threatened flora species and populations to occur on within the BioBank site, and the presence or absence of threatened ecological communities (TECs). The general condition of the vegetation was assessed based on disturbance history, the degree of infestation by exotic species, structure and overall resilience. Threatened flora species previously recorded in the locality and with potential to occur on the site were targeted in surveys. An inventory of the native and exotic flora species recorded for each plant community was compiled.

Brief diurnal fauna surveys were conducted over the BioBank site to determine the values of the site for fauna. These were determined, primarily, on the basis of the types and qualities of habitat(s) present on the site. The presence of the following habitat features was noted:

- Structure and floristics of vegetation communities.
- Ground cover vegetation, leaf litter and presence of coarse woody debris.
- Size, range and abundance of hollow-bearing trees.
- Rocky outcrops, overhangs or crevices.
- Presence of specific feed trees or host plants.
- Presence of foraging, roosting or nesting resources.
- Size, number and vegetation cover of waterbodies present.
- Connectivity to off-site habitat.
- Disturbance, including weed invasion, clearing, rubbish, fire and urban development.

All species of fauna observed during the assessment were recorded and active searching for fauna was undertaken. This included direct observation during diurnal surveys, searching under rocks and logs, examination of tracks and scats and identifying calls. Particular attention was given to searching for significant species and their habitats. Fauna species were recorded with a view to characterising the values of the site and were not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

Preliminary BioBanking assessment (Biosis 2014)

Diurnal flora and fauna surveys were carried out over the BioBank site on 1 August 2013 to confirm vegetation types and map condition in accordance with the previous version of the BioBanking Assessment

Methodology (DECC 2008). This was followed by a general flora and fauna assessment incorporated as part of the more formal BBAM surveys on 16 October 2013. Flora surveys included:

- Random meanders over the BioBank 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:
 - Eastern Flame Pea *Chorizema parviflorum* (threatened population)
 - White-flowered Wax Plant *Cynanchum elegans*
 - Illawarra Socketwood *Daphnandra johnsonii*
 - Rainforest Cassia *Senna acclinis*
 - *Solanum celatum*.
- Searches to locate and confirm the continued presence of threatened flora species recorded in previous surveys by UBM Consultants (2005).
- Assessment to confirm the extent of the of the TSC Act listed TECs *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion* and *Illawarra subtropical rainforest in the Sydney Basin Bioregion* as previously mapped by NPWS (2002) or amended and mapped by Biosis Research (2011).

Plot and transect surveys were undertaken in accordance with DECC (2008). Plot and transect surveys included:

- A 20 metre x 50 metre quadrat and 50 m transect for assessment of site attributes.
- A 20 metre x 20 metre quadrat, nested within the quadrat outlined above, for full floristic survey to determine native plant species richness.

Additional survey and assessment

Additional surveys and assessment of the BioBank site have been undertaken during the development of this Biodiversity Assessment Report to align previous surveys with the current NSW BioBanking Assessment Methodology (OEH 2014). This additional survey and assessment has focused on refining the mapping of vegetation types within the BioBank site, mapping of vegetation condition and weeds and targeted surveys for threatened species.

Mapping of the tree canopy was obtained using LiDAR data, sourced from the NSW LPI. Small gaps in the LiDAR data were manually filled to obtain a defined boundary for the tree canopy layer across the BioBank site. Data obtained using this method provides an accurate representation of the tree canopy, but does not define if this is native vegetation, and does not provide information on areas with a native understorey but no overstorey. This tree canopy layer was used to inform further surveys.

Flora surveys undertaken for this assessment included the refinement of previous vegetation mapping (Biosis Research 2011, Biosis 2014). Vegetation mapping was conducted using hand-held (uncorrected) tablet units using the ArcGIS Collector application, the tree canopy layer and aerial photo interpretation, with the boundaries of vegetation types determined by ground-truthing. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration. Mapping has been produced using a GIS.

Delineation of PCT boundaries was undertaken using the vegetation community definitions of NPWS (2002), definitions for the relevant vegetation types obtained from the NSW Vegetation Information System (VIS): Classification Version 2.1, along with the final determination for the Illawarra Subtropical Rainforest EEC (NSW Scientific Committee 2002) and Illawarra Lowlands Grassy Woodland EEC (NSW Scientific Committee 2011).

General classification of native vegetation in NSW used in this report is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. The grouping referred to in this report is vegetation type (or PCT). PCTs were identified using the VIS Classification Version 2.1.

PCTs were stratified into vegetation zones based on condition (low or moderate/good) and ancillary code (where relevant). Areas that do not currently support extensive native communities, but will be rehabilitated to provide buffers to other communities or to enhance the BioBank site, are mapped as PCTs in low condition.

Following stratification of vegetation zones, the site value was assessed using plot and transect survey data, as per the methodology outlined in Section 5 of the NSW BioBanking Assessment Methodology (OEH 2014). Plot and transect surveys included:

- A 20 metre x 50 metre quadrat and 50 m transect for assessment of site attributes.
- A 20 metre x 20 metre quadrat, nested within the quadrat outlined above, for full floristic survey to determine native plant species richness.

The minimum number of plots/transects per vegetation zone was determined using Table 3 of OEH (2014b). A total of 19 plots/transects were completed within the BioBank site (Figure 5).

Additional targeted flora surveys were undertaken between September and December 2015 with the entire BioBank site traversed on foot using the random meander method (Cropper 1993). These targeted surveys focused on identifying the following threatened species:

- Eastern Flame Pea (threatened population)
- Illawarra Greenhood *Pterostylis gibbosa*
- Illawarra Socketwood
- Illawarra Zieria *Zieria granulata*,
- Rainforest Cassia
- *Solanum celatum*.
- Spiked Rice-flower *Pimelea spicata*
- White-flowered Wax Plant.

A list of flora species was compiled for each vegetation type. Records of all flora species will be submitted to OEH for incorporation into the Atlas of NSW Wildlife.

3.3 Results

3.3.1 Vegetation description

The BioBank site supports 43.05 hectares of native vegetation as well as 3.76 hectares of vegetation that will be rehabilitated as outlined above (Figure 5).

The site supports open forest communities. Weed cover in these areas was generally low, with the exception of a moderate weed cover within Megarritys Creek and associated tributaries, where moisture and nutrient levels are elevated.

3.3.2 Plant community types

Site investigations, including determination of vegetation communities using the methodology outlined in Section 3.2.1, confirmed the presence of three vegetation communities within the BioBank site.

The condition of vegetation within the BioBank site was assessed in accordance with the NSW BioBanking Assessment Methodology (OEH 2014). Forest Red Gum - Thin-leaved Stringybark grassy woodland was assessed as being in moderate / good condition, but with a section of derived native grassland. Areas of Sydney Blue Gum X Bangalay - Lilly Pilly moist forest included areas in Moderate / good condition, but varying levels of weed infestation (ancillary code poor) and a derived native grassland area. Some sections of this community are currently in a degraded form and will be rehabilitated; these areas were considered to be in low condition using the NSW BioBanking Assessment Methodology (OEH 2014). Areas of Whalebone Tree - Native Quince dry subtropical rainforest were mostly in moderate / good condition with some areas subject to significant weed invasion, that will be rehabilitated, considered to be in low condition using the NSW BioBanking Assessment Methodology (OEH 2014)

As a result, eight vegetation zones have been mapped within the BioBank site. Vegetation zones identified within the BioBank site, including the PCT, the vegetation formation and vegetation class (Keith 2004) and the area of each vegetation zone is described in Table 2.

Table 2: Vegetation zones mapped within the study area

Vegetation zone ¹	Plant community type	Vegetation formation	Vegetation class	Condition	Ancillary code	Area (ha)
03	SR545 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	Grassy woodlands	Moderate / good	–	8.98
04				Moderate / good	Derived grassland	0.32
05	SR652 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Southern Escarpment Wet Sclerophyll Forests	Wet sclerophyll forests (shrubby sub-formation)	Moderate / good	–	20.59
06				Moderate / good	Derived grassland	0.27
07				Moderate / good	Poor	1.86

¹ Numbering of vegetation zones continues from the Biodiversity certification agreement developed for the development site (Biosis 2015a, 2015b). As such, Vegetation Zones 01 and 02 are not referred to herein.

Vegetation zone ¹	Plant community type	Vegetation formation	Vegetation class	Condition	Ancillary code	Area (ha)
08				Low	–	4.15
09	SR662 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Rainforests	Dry rainforests	Moderate / good	–	9.61
10				Low	–	1.04

A detailed description of each vegetation zone is provided in Table 3 (Vegetation Zones 3 and 4) and Table 4 (Vegetation Zones 5 and 6).

Table 3: Vegetation zones 3 and 4 – Forest Red Gum - Thin-leaved Stringybark grassy woodland

Vegetation zones 3 and 4 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Plant community type ID	838
Biometric vegetation type ID	SR545
Common name	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion
Condition	Moderate / good (Vegetation Zone 3) Moderate / good – Derived grassland (Vegetation Zone 4)
Extent within study area	8.98 hectares of moderate/good condition Forest Red Gum - Thin-leaved Stringybark grassy woodland was mapped within the BioBank site in Vegetation Zone 3, with a further 0.32 hectares of derived grassland in Vegetation Zone 4.
Description	<p>This PCT spans the central ridge and upper slopes of the BioBank site (Figure 5).</p> <p>The canopy is dominated by remnant and regrowth Forest Red Gum <i>Eucalyptus tereticornis</i> ranging in height from 15 to 25 metres. There is a midstorey that includes Maiden's Wattle <i>Acacia maidenii</i>, Red Ash <i>Alphitonia excelsa</i>, Grey Myrtle <i>Backhousia myrtifolia</i>, Willow Bottlebrush <i>Callistemon salignus</i>, regrowth <i>Eucalyptus tereticornis</i> and patches of Prickly-leaved Tea Tree <i>Melaleuca styphelioides</i>. The understorey varies from sparse to scattered occurrences of native shrubs such as Orange Thorn <i>Pittosporum multiflorum</i> and Veined Mock-olive <i>Notelaea venosa</i>. Lantana <i>Lantana camara</i> is present throughout as scattered occurrences under a well-developed canopy to dense thickets in places. The groundcover stratum is generally in good condition and dominated by native species such as <i>Carex longibrachiata</i>, Kidney Weed <i>Dichondra repens</i>, Pennywort <i>Hydrocotyle peduncularis</i>, Weeping Grass <i>Microlaena stipoides</i> var. <i>stipoides</i>, Whiteroot <i>Pratia purpurascens</i> and Bearded Tylophora <i>Tylophora barbata</i>.</p>

Vegetation zones 3 and 4 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion


Survey effort	Four plots/transects were undertaken in the Vegetation Zone 3 and one plot/transect undertaken in Vegetation Zone 4 (Figure 5).
Disturbance	This PCT is generally in good condition, with disturbance limited to a 30 to 50% cover of Lantana in the northern section of the BioBank site and grazing by deer. Areas of derived grassland have been subject to past clearing and are devoid of a canopy and midstorey layer but maintain a predominantly native grassy groundcover.
Species relied upon for identification of vegetation type and relative abundance	The presence and dominance of Forest Redgum in the overstorey, with only scattered occurrence of other species, and the predominantly grassy groundcover were used to identify the extent of this vegetation type within the BioBank site.
EEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: <i>Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion</i> endangered ecological community
Estimate of percent cleared value of PCT	85%
Plate 1: Forest Red Gum - Thin-leaved Stringybark grassy woodland (VZ03)	

Table 4: Vegetation zones 5, 6, 7 and 8 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest

Vegetation zones 5, 6, 7 and 8 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

Plant community type ID	1245
Biometric vegetation type ID	SR652 (HN597 in the Hawkesbury Nepean CMA and ME044 in the Metropolitan CMA)
Common name	<i>Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</i>
Condition	Moderate / good (Vegetation Zone 5)

Vegetation zones 5, 6, 7 and 8 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

	<p>Moderate / good – Derived grassland (Vegetation Zone 6)</p> <p>Moderate / good – Poor (Vegetation Zone 7)</p> <p>Low (Vegetation Zone 8)</p>
Extent within study area	<p>20.59 hectares of moderate/good condition Sydney Blue Gum X Bangalay - Lilly Pilly moist forest was mapped within the BioBank site, with another 0.27 hectares of derived grassland and 1.86 considered to be in poor condition. 4.15 hectares in low condition will be rehabilitated.</p>
Description	<p>Sydney Blue Gum X Bangalay - Lilly Pilly Moist Forest is the predominant PCT within the BioBank site, occurring across the northern slope and in the south-west corner of the site.</p> <p>The canopy is dominated by Forest Red Gum with occasional White-topped Box <i>Eucalyptus quadrangulata</i> in the higher areas whilst <i>Eucalyptus saligna</i> X <i>botryoides</i> is dominant in the lower stands with Forest Red Gum occasional. The midstorey and understory is absent in the higher ridge areas that are being slashed. The midstorey is variable in per cent cover but is dominated by Grey Myrtle, Red Olive-berry <i>Cassine australis</i> var. <i>australis</i>, and <i>Dodonaea viscosa</i> ssp. <i>angustifolia</i> on the higher slopes with occasional Willow Bottlebrush. The midstorey of the lower slope area of this community includes Two-veined Hickory <i>Acacia binervata</i>, Grey Myrtle, White Cedar <i>Melia azedarach</i> and Brush Cherry <i>Syzygium australe</i>. Similarly, understorey vegetation cover and floristics are variable however Lantana, Cockspur Thorn <i>Maclura cochinchinensis</i> and Orange Thorn are present throughout, along with a dense cover of the weed Mysore Thorn <i>Caesalpinia decapetala</i> in some areas. The groundcover in the slashed areas is a mix of native and exotic grasses and forbs. Native species include Kidney Weed, Weeping Grass and <i>Oplismenus aemulus</i>, whilst exotic species are Narrow-leafed Carpet Grass <i>Axonopus fissifolius</i>, Cobbler's Pegs <i>Bidens pilosa</i>, Spear Thistle <i>Cirsium vulgare</i>, Panic Veldtgrass <i>Ehrharta erecta</i> and Black Medic <i>Medicago lupulina</i>. The groundcover stratum is sparse under areas of intact or advanced regrowth in the upper strata and includes native grasses, ferns and scramblers such as Giant Maidenhair <i>Adiantum formosum</i>, Old Man's Beard <i>Clematis aristata</i>, Prickly Rasp Fern <i>Doodia aspera</i>, Scrambling Lily <i>Geitonoplesium cymosum</i>, Sickle Fern <i>Pellaea falcata</i> and Pastel Flower <i>Pseuderanthemum variabile</i>.</p>
Survey Effort	<p>Five plots/transects were undertaken in the Vegetation Zone 5, one in Vegetation Zone 6, one in Vegetation 7 and two in Vegetation Zone 8 (Figure 5).</p>
Disturbance	<p>This PCT has low to high levels of disturbance, with dense infestations of Lantana and Mysore Thorn of greater than 50% cover in some areas, rubbish dumping and .</p>
Species relied upon for identification of vegetation type and relative abundance	<p>The presence of White-topped Box and <i>Eucalyptus saligna</i> X <i>botryoides</i> in the overstorey were used to identify the extent of this vegetation type within the BioBank site.</p>

Vegetation zones 5, 6, 7 and 8 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion



EEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Not Listed
Estimate of percent cleared value of PCT	45%
Plate 2: Sydney Blue Gum X Bangalay - Lilly Pilly moist forest	

Table 5: Vegetation zones 9 and 10 – Whalebone Tree - Native Quince dry subtropical rainforest

Vegetation zones 9 and 10 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion

Plant community type ID	1300
Biometric vegetation type ID	SR662 (HN608 in the Hawkesbury Nepean CMA)
Common name	<i>Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion</i>
Condition	Moderate / good (Vegetation Zone 9) Low (Vegetation Zone 10)
Extent within study area	9.61 hectares of moderate/good condition Whalebone Tree - Native Quince dry subtropical rainforest was mapped within the BioBank site and another 1.04 hectares in low condition will be rehabilitated.
Description	<p>Whalebone Tree - Native Quince dry subtropical rainforest occurs on steeper slopes and gullies.</p> <p>The canopy is dominated by native trees species including Red Ash, Grey Myrtle, Red Olive-berry with occasional Willow Bottlebrush, Prickly-leaved Tea Tree and Whalebone Tree <i>Streblus brunonianus</i> on the higher slopes. Remnant and</p>

Vegetation zones 9 and 10 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion

	regrowth Forest Red Gum is present as an occasional emergent. The understorey is very sparse and common species are Cockspur Thorn, Orange Thorn and regenerating Red Olive-berry. Lantana is also common as scattered individuals under dense canopy or moderate patches in more open areas. The groundcover stratum is also sparse under intact canopy and includes native ferns, grasses and forbs. Common species are Giant Maidenhair, Necklace Fern <i>Asplenium flabellifolium</i> , Kidney Weed, Prickly Rasp Fern, Scrambling Lily, <i>Oplismenus aemulus</i> and <i>Stellaria flaccida</i> . Exotic species in the groundcover stratum include Cape Ivy <i>Delairea odorata</i> in open areas and Madeira Winter Cherry <i>Solanum pseudocapsicum</i> in shadier locations.
Survey Effort	Three plots/transects were undertaken in the Vegetation Zone 9 and two plots/transects undertaken in Vegetation Zone 10 (Figure 5).
Disturbance	Some areas within this PCT are subject to dense weed infestations, particularly Lantana and moderate levels of impact from grazing by deer.
Species relied upon for identification of vegetation type and relative abundance	The presence of this PCT was indicated by a dense cover (>70%) of mesic overstorey species such as Red Ash, Grey Myrtle, Red Olive-berry and Whalebone Tree,
EEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: <i>Illawarra Subtropical Rainforest in the Sydney Basin Bioregion</i> endangered ecological community
Estimate of percent cleared value of PCT	90%
Plate 3: Whalebone Tree - Native Quince dry subtropical rainforest	

3.3.3 Site value scores

Plots and transect survey data was inputted into the BioBanking credit calculator to determine site value scores. All site attributes for vegetation zones 4 and 6 were scored as zero given that vegetation is currently

cleared. Plot and transect survey data is presented in Appendix 1. Current site value scores for each Vegetation Zone are outlined in Table 6.

Table 6: Site value scores for all vegetation zones

Vegetation zone	PCT	Site value score	Area
03	SR545 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	72.40	8.98
04		10.94	0.32
05	SR652 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	72.40	20.59
06		31.25	0.27
07		46.35	1.86
08		33.85	4.15
09	SR662 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	75.52	9.61
10		33.33	1.04



Legend

- BioBank site
- Lot 815 DP1193843
- Lot 1801 DP1223063

Native vegetation (NPWS 2002)

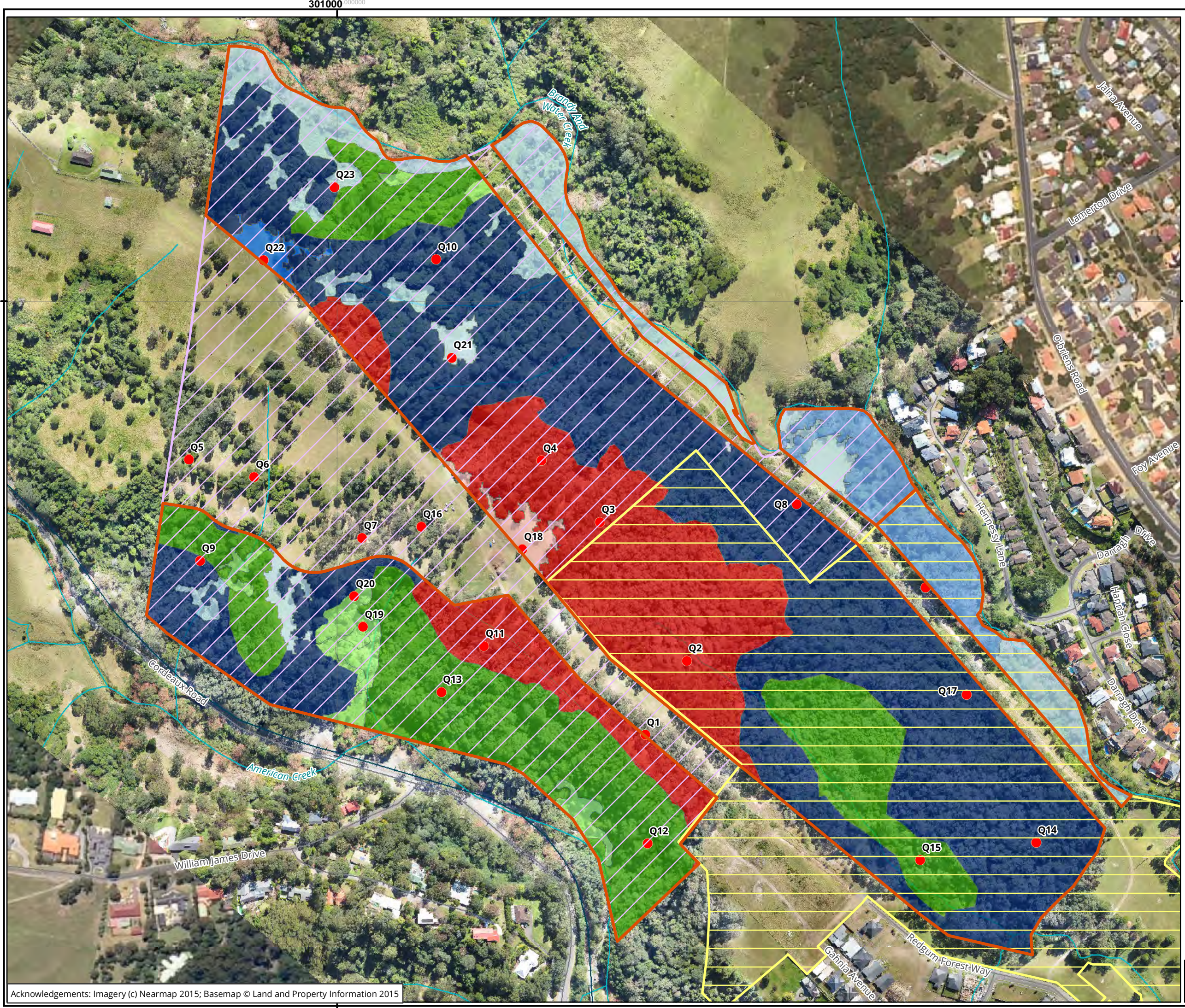
- Lowland Dry-Subtropical Rainforest (MU4)
- Escarpment Moist Blue Gum Forest (MU8)
- Moist Box-Red Gum Foothills Forest (MU13)
- Coastal Grassy Red Gum Forest (MU23)

Figure 4: Native vegetation mapping, NPWS (2002)

0 40 80 120 160 200
Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 20289
Date: 16 December 2016,
Checked by: NMG, Drawn by: LH, Last edited by: lharley
Location: P:\20200s\20289\Mapping\20289_BB_F4_VegetationNPWS



- Legend**
- BioBank site
 - Lot 815 DP1193843
 - Lot 1801 DP1223063
 - Flora survey effort (Biosis 2015)
- Native vegetation (Biosis 2015)**
- VZ03: Forest Red Gum - Thin-leaved Stringybark grassy woodland - Moderate/Good
 - VZ04: Forest Red Gum - Thin-leaved Stringybark grassy woodland - Moderate/Good (Derived grassland)
 - VZ05: Sydney Blue Gum x Bangalay Lilly Pilly moist forest - Moderate/Good
 - VZ06: Sydney Blue Gum x Bangalay Lilly Pilly moist forest - Moderate/Good (Derived grassland)
 - VZ07: Sydney Blue Gum x Bangalay Lilly Pilly moist forest - Moderate/Good (Poor)
 - VZ08: Sydney Blue Gum x Bangalay Lilly Pilly moist forest - Low
 - VZ09: Whalebone Tree - Native Quince dry subtropical rainforest - Moderate/Good
 - VZ10: Whalebone Tree - Native Quince dry subtropical rainforest - Low

Figure 5: Native vegetation of the BioBank site, including flora survey effort

0 40 80 120 160 200
Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 20289
Date: 16 December 2016,
Checked by: NMG, Drawn by: LH, Last edited by: lharley
Location: P:\20200s\20289\Mapping\20289_BB_F5_VegetationBiosis

4. Threatened species

4.1 Methods

Flora and fauna assessments of the BioBank site have been undertaken between September 2011 and December 2015. Section 3.2.1 provides an overview of threatened species surveys undertaken within the BioBank site.

4.2 Geographic /habitat features

An assessment of the occurrence of geographic habitat features within the BioBank site, in accordance with Section 6.3 of the NSW BioBanking Assessment Methodology (OEH 2014). The species generated by the calculator associated with the NSW BioBanking Assessment Methodology (OEH 2014), along with the results of this assessment are outlined in Table 7.

Table 7: Assessment of geographic habitat features within the study area

Scientific name	Common name	Managed at site?	Feature	Justification
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	No	Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels.	Suitable roosting habitat for this species was not recorded within the BioBank site.
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	No	Land within 40 metres of heath, woodland or forest.	Suitable habitat for the species, in the form of ephemeral streams with suitable breeding pools, is not present.
<i>Mixophyes balbus</i>	Stuttering Frog	No	Rainforest or tall open wet forest with understorey and/or leaf litter and within 100 m of streams.	Suitable habitat for this species is so degraded as to warrant the species unlikely to occur.
<i>Petroica rodinogaster</i>	Pink Robin	No	Land within 40 metres of gullies in eucalypt forests.	The BioBank site is outside the known range of this species.
<i>Pseudophryne australis</i>	Red-crowned Toadlet	No	Heath or eucalypt forest on sandstone with a build-up of litter or other debris and containing, or within 40 metres of, ephemeral or intermittent drainage lines.	The Red-crowned Toadlet is restricted to Triassic sandstones. Suitable habitat not present.
<i>Chorizema parviflorum</i>	<i>Chorizema parviflorum</i> Benth. (a shrub) population, Wollongong and Shellharbour local government areas	No	Land within Shellharbour and Wollongong LGAs in Illawarra CMA subregion.	Whilst there is a record of this species approximately 5 kilometres south of the BioBank site, the species was not recorded during targeted surveys.

Scientific name	Common name	Managed at site?	Feature	Justification
<i>Lespedeza juncea</i> subsp. <i>sericea</i>	<i>Lespedeza juncea</i> subsp. <i>sericea</i> population, Wollongong Local Government Area	No	Land within Wollongong LGA in Illawarra CMA subregion.	The endangered population occurs south of Dapto, and is known from just one location. The BioBank site is outside of this area.
<i>Solanum celatum</i>	<i>Solanum celatum</i>		Land within Shoalhaven River Valley in Ettrema CMA subregion.	The BioBank site is not located in the correct CMA subregion, however suitable habitat is present within the BioBank site. The species was not recorded during targeted surveys.

4.3 Ecosystem credit species

A list of ecosystem credit species predicted to occur within the study area, based on the PCTs present and generated by the calculator associated with the NSW BioBanking Assessment Methodology (OEH 2014), along with an assessment of whether they occur within the study area and the Vegetation Zone they are predicted to occur in is provided in Table 8. The potential for a species to occur within the study area was assessed in accordance with Section 6.3 of the NSW BioBanking Assessment Methodology (OEH 2014).

Table 8: Assessment of ecosystem credit species within the BioBank site

Scientific name	Common name	TS offset multiplier	Habitat on site	Vegetation zone
<i>Burhinus grallarius</i>	Bush Stone-curlew	2.6	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	2	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652) Vegetation Zones 9 and 10 (SR662)
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	1.8	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652)
<i>Circus assimilis</i>	Spotted Harrier	1.4	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Daphoenositta chrysoptera</i>	Varied Sittella	1.3	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652)
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	2.6	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	2.2	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6 and 7 (SR652)
<i>Glossopsitta pusilla</i>	Little Lorikeet	1.8	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Hieraaetus morphnoides</i>	Little Eagle	1.4	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Kerivoula papuensis</i>	Golden-tipped Bat	1.3	Yes	Vegetation Zones 5, 6 and 7 (SR652) Vegetation Zone 9 (SR662)
<i>Lathamus discolor</i>	Swift Parrot	1.3	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Lophoictinia isura</i>	Square-tailed Kite	1.4	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652)
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	2.2	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652)

Scientific name	Common name	TS offset multiplier	Habitat on site	Vegetation zone
<i>Neophema pulchella</i>	Turquoise Parrot	1.8	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Ninox connivens</i>	Barking Owl	3	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Ninox strenua</i>	Powerful Owl	3	Yes	Vegetation Zones 5, 6, 7 and 8 (SR652) Vegetation Zones 9 and 10 (SR662)
<i>Petroica boodang</i>	Scarlet Robin	1.3	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Petroica phoenicea</i>	Flame Robin	1.3	Yes	Vegetation Zones 3 and 4 (SR545)
<i>Potorous tridactylus</i>	Long-nosed Potoroo	1.3	Yes	Vegetation Zone 9 (SR662)
<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove	1.3	Yes	Vegetation Zones 9 and 10 (SR662)
<i>Ptilinopus superbus</i>	Superb Fruit-dove	1.3	Yes	Vegetation Zones 9 and 10 (SR662)
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	2.2	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652) Vegetation Zones 9 and 10 (SR662)
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	2.2	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652) Vegetation Zones 9 and 10 (SR662)
<i>Tyto novaehollandiae</i>	Masked Owl	3	Yes	Vegetation Zones 3 and 4 (SR545) Vegetation Zones 5, 6, 7 and 8 (SR652) Vegetation Zones 9 and 10 (SR662)
<i>Tyto tenebricosa</i>	Sooty Owl	3	Yes	Vegetation Zones 5, 6 and 7 (SR652) Vegetation Zone 9 (SR662)

The presence of most species could not be discounted using the methodology outlined in Section 6.3 of the NSW BioBanking Assessment Methodology (OEH 2014). It was therefore assumed that most species occurred within the BioBank site.

Tg values represent how well as species will respond to management at a BioBank site, and, therefore, how the removal of habitat features will impact on the species in a local area. If a species is reliant on habitat features that take a long time to develop (e.g. hollows), or management actions are ineffective at addressing a species decline, or the species has poor fecundity or dispersal capability this will generate a higher Tg value.

For all vegetation zones the forest owls have a Tg value of 0.325 and a resultant threatened species offset multiplier of 3.0. These species include:

- Barking Owl (Vegetation Zones 3 and 4).
- Powerful Owl (Vegetation Zones 5, 6, 7, 8, 19 and 10).
- Masked Owl (All vegetation zones).
- Sooty Owl (Vegetation Zones 5, 6, 7 and 9).

Vegetation Zones 3 and 4 align with the Illawarra Lowlands Grassy Woodland EEC, while Vegetation Zones 9 and 10 align with the Illawarra Subtropical Rainforest EEC. As these vegetation zones are EECs they will generate a threatened species multiplier of 3.0 and this multiplier will be used to determine the number of ecosystem credits created.

4.4 Species credit species

4.4.1 Flora species

A list of species credit species (flora) predicted to occur within the BioBank site, based on the PCTs present, along with an assessment of whether the BioBank site provides suitable habitat is provided in Table 9. The potential for a species to occur within the BioBank site was assessed in accordance with Section 6.5 of the NSW BioBanking Assessment Methodology (OEH 2014).

Table 9: Species credit species (flora) and status within the BioBank site

Scientific name	Common name	Habitat present in the BioBank site	Justification	Recorded during targeted surveys
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Yes	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include Forest Redgum open forest and woodland, which is present within the BioBank site. There are numerous records of this species in proximity to the BioBank site, and the species was known to occur within the site based off records from previous assessments (Biosis Research 2011, Biosis 2014). Targeted surveys were undertaken.	Yes
<i>Chorizema parviflorum</i>	Eastern Flame Pea	Yes	The species inhabits heath and sclerophyll woodland and forest on heavy soils, particularly woodlands or forest dominated by Forest Red Gum and/or Woollybutt <i>Eucalyptus longifolia</i> . Areas of Forest Red Gum - Thin-leaved Stringybark grassy woodland were considered potential habitat. Targeted surveys were undertaken.	No
<i>Daphnandra johnsonii</i>	Illawarra Socketwood	Yes	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. There are a number of records of this species approximately 5 kilometres south of the BioBank site. A precautionary approach was undertaken and it was considered there is potential for this species to occur in Sydney Blue Gum X Bangalay - Lilly Pilly moist forest and Whalebone Tree - Native Quince dry subtropical rainforest. Targeted surveys were undertaken.	No
<i>Irenepharsus trypherus</i>	Illawarra Irene	No	Occurs on coast and escarpment between Wollongong and the Shoalhaven River, typically inhabiting steep rocky slopes near cliff lines and ridge tops with the species being recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment. Habitat associations include moist sclerophyll forest, Ironwood <i>Backhousia myrtifolia</i> thicket, and rainforest. There are a number of records of this species within the Illawarra IBRA subregion, but none in proximity to the BioBank site. For this reason the species was considered unlikely to occur within the BioBank site.	No

Scientific name	Common name	Habitat present in the BioBank site	Justification	Recorded during targeted surveys
<i>Pimelea curviflora</i> subsp. <i>curviflora</i>	<i>Pimelea curviflora</i> subsp. <i>curviflora</i>	Yes	Confined to the coastal area of the Sydney and Illawarra regions, with a new population discovered at Croom Reserve near Albion Park in Shellharbour LGA in August 2011. Whilst previously recorded on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands the species was recorded in association with Illawarra Lowland Grassy Woodland (SR545) habitat at Croom reserve. A precautionary approach was undertaken and the BioBank site was considered to have potential to support the species in areas of Forest Red Gum - Thin-leaved Stringybark grassy woodland. Targeted surveys were undertaken.	No
<i>Pimelea spicata</i>	Spiked Rice-flower	Yes	The Spiked Rice-flower occurs in two disjunct areas, the Cumberland Plain and the Illawarra. In the Illawarra region the species is found in open woodland and also in coastal grassland communities with emergent shrubs. There are a number of records of this species in the Illawarra IBRA subregion, with most restricted to coastal areas and Blackbutt Reserve in Shellharbour. Areas of Forest Red Gum - Thin-leaved Stringybark grassy woodland were considered potential habitat for this species and targeted surveys were undertaken.	No
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	Yes	Known from a small number of populations in the Hunter region, the Illawarra region and the Shoalhaven region, with all populations recorded from open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Redgum, Woollybutt and <i>Melaleuca decora</i> . There are a number of records from the Illawarra subregion and areas of Forest Red Gum - Thin-leaved Stringybark grassy woodland were considered potential habitat for this species. Targeted surveys were undertaken.	No

Scientific name	Common name	Habitat present in the BioBank site	Justification	Recorded during targeted surveys
<i>Senna acclinis</i>	Rainforest Cassia	Yes	Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland. Preferred habitat is in or on the edges of subtropical and dry rainforest, often as a gap phase shrub. There is a single record of this species from the Illawarra IBRA subregion which is a planted specimen. A precautionary approach was undertaken and the species was considered a potential inhabitant of Sydney Blue Gum X Bangalay - Lilly Pilly moist forest on the margins of Whalebone Tree - Native Quince dry subtropical rainforest and targeted surveys were undertaken.	No
<i>Solanum celatum</i>	<i>Solanum celatum</i>	Yes	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 forests. Areas of Sydney Blue Gum X Bangalay - Lilly Pilly moist forest and Whalebone Tree - Native Quince dry subtropical rainforest were considered potential habitat for this species. Targeted surveys were undertaken.	No
<i>Zieria granulata</i>	Illawarra Zieria	Yes	Occurs in the Kiama district where it grows on dry rocky ridges in sclerophyll forest to rainforest margins (Harden 2002). 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 <i>Melaleuca armillaris</i> scrub, Forest Red Gum woodland and rainforest margins, although the species has been recorded from a number of other vegetation types (DEC 2005v).	No

A number of flora species were identified as candidate species for further assessment, in accordance with Section 6.5 of the NSW BioBanking Assessment Methodology (OEH 2014). Targeted surveys for these species were undertaken as per the methodology outlined in Section 3.2.1. Survey effort is shown in Figure 6.

These targeted surveys recorded the White-flowered Wax Plant within the BioBank site, often with multiple stems at each location. However, as the White-flowered Wax Plant is known to be capable of suckering from rootstock in response to disturbance only groups of stem were counted. A total of 89 individual plants were observed within the BioBank site (Figure 6).

4.4.2 Fauna species

A list of species credit species (fauna) predicted to occur within the BioBank site, based on the PCTs present, along with an assessment of whether the BioBank site provides suitable habitat is provided in Table 10. The potential for a species to occur within the BioBank site was assessed in accordance with Section 6.5 of the NSW BioBanking Assessment Methodology (OEH 2014).

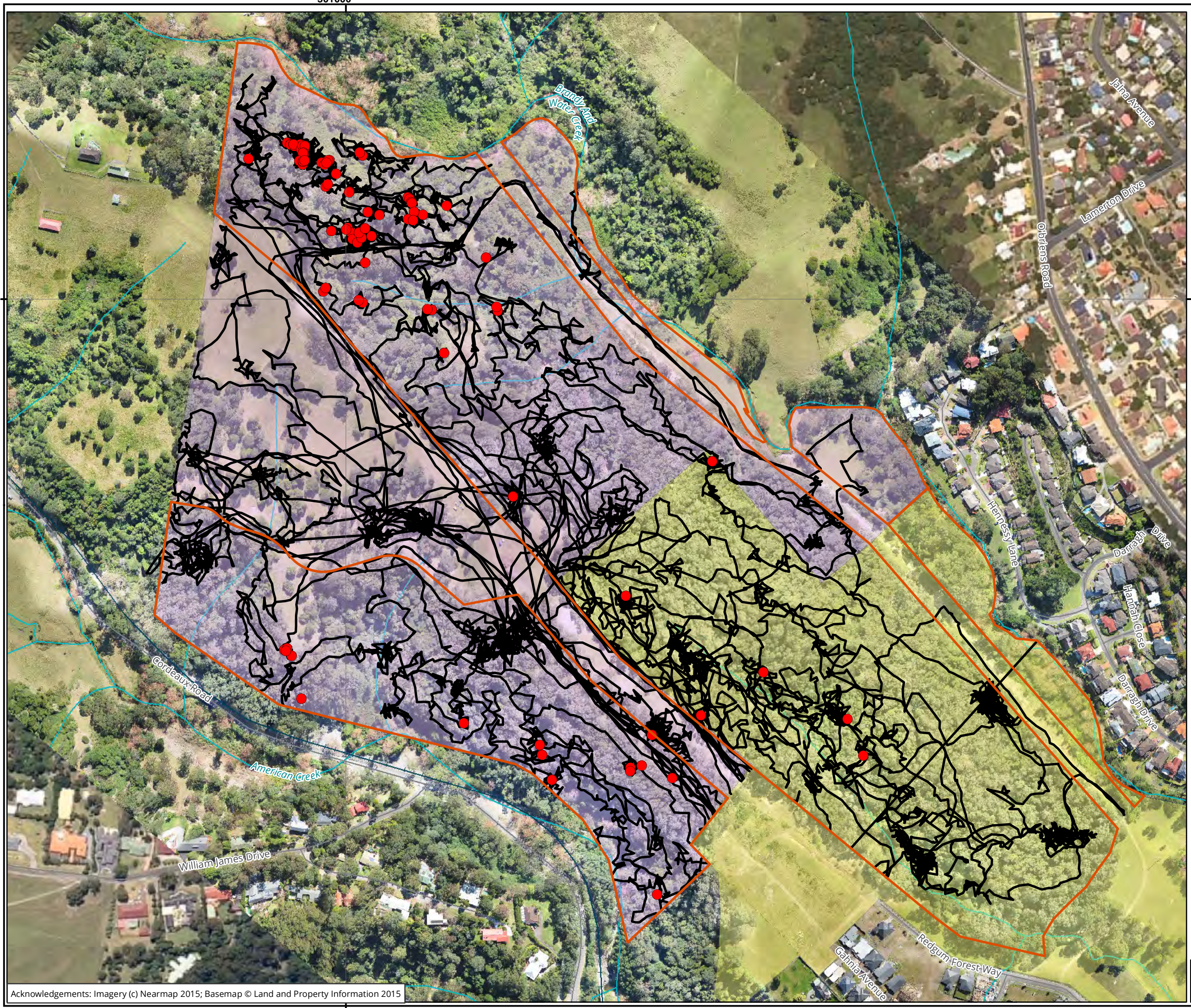
Table 10: Species credit species (fauna) and status within the BioBank site

Scientific name	Common name	Habitat present in the BioBank site	Justification
<i>Anthochaera phrygia</i>	Regent Honeyeater	No	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. There are only three known key breeding regions remaining, including the Capertee Valley and the Bundarra-Barraba region in NSW. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilizes a variety of other Eucalypt species. There are five records of this species within the Illawarra CMA subregion. The BioBank site is not part of a breeding region, and does not support key eucalypt feed species. Although the species may forage within the BioBank site on occasion, it is considered a vagrant species, in accordance with Part 3.3.2 of OEH (2015).
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	No	The species occurs in a broad range of habitat types, with heaths and woodlands preferred. There are 11 records of this species within the Illawarra CMA subregion; however, these records are located in areas more associated with sandstone heaths. Habitat within the BioBank site is degraded and lacks a number of habitat features, including dense complex habitat, nectar producing species and hollows that the Eastern Pygmy Possum is reliant upon.
<i>Petaurus norfolcensis</i>	Squirrel Glider	No	In coastal areas the Squirrel Glider inhabits Blackbutt-Bloodwood forest with heath understory, often with mixed stands of Acacia species. Require abundant tree hollows for refuge and nest sites. There are two records within the Illawarra CMA subregion; however, these records are located at Jervis Bay and Kangaroo Valley where more suitable habitat occurs. No records exist in relation to the BioBank site, and the habitat is considered poor quality due to the absence of suitable forest types and suitable feed species.

Scientific name	Common name	Habitat present in the BioBank site	Justification
<i>Phascolarctos cinereus</i>	Koala	Yes	The Koala inhabits a number of forest and woodland vegetation types, with the presence of Koala feed trees an important indicator. In the Southern Rivers CMA Forest Redgum is considered a primary feed tree. There are 18 records of the Koala within the Illawarra CMA subregion; however the majority of these are aged, with only five records within the past 10 years with the majority coming from community surveys. The Koala is rare in the Illawarra. Although the BioBank site provides suitable habitat the species has not been observed within the site, and given the scarcity of the species it is considered unlikely to generate significant numbers of species credits.
<i>Pteropus poliocephalus</i> (Breeding Habitat)	Grey-headed Flying-fox (Breeding habitat)	No	The BioBank site does not support a camp of the Grey-headed Flying-fox.
<i>Sminthopsis leucopus</i>	White-footed Dunnart	No	The White-footed Dunnart occurs in a wide range of vegetation types, including forest and woodland communities, generally with an open understory structure. There is one record of this species within the Illawarra CMA subregion, at the furthest southern reach of the subregion. There are no records in close proximity to the BioBank site. Habitat within the BioBank site is considered of only moderate quality, and the lack of records in close proximity decreases the likelihood that the species is present.

Only one fauna species, the Koala, was identified as a candidate species for further assessment, in accordance with Section 6.5 of the NSW BioBanking Assessment Methodology (OEH 2014).


No targeted fauna surveys for threatened species were undertaken as a part of this assessment. No threatened fauna species credits will be created.



- Legend**
- BioBank site
 - Lot 815 DP1193843
 - Lot 1801 DP1223063
 - Threatened flora survey (Biosis 2015)
 - Biosis Threatened Flora**
 - White-flowered Wax Plant

Figure 6: Threatened flora surveys and locations of the White-flowered Wax Plant

0 40 80 120 160 200
Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

**biosis**
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 20289
Date: 16 December 2016,
Checked by: NMG, Drawn by: LH, Last edited by: lharley
Location: P:\20200s\20289\Mapping\20289_BB_F6_ThrFlora_WFWP

Stage 3 – Improving biodiversity values

5. Improving biodiversity values

This section details the improvement in biodiversity values that will occur by undertaking management of native vegetation within the BioBank site. It details the proposed management zones, the management actions to be undertaken within each management zone and the expected change in landscape value, averted loss and site value score that is predicted following their implementation.

5.1 Management zones

Nine management zones have been delineated (Table 11) based on the vegetation zones present within the BioBank site and future management. Vegetation Zone 3 was split into two management zones as a 1.05 hectare section of the vegetation zone will be managed as an asset protection zone (APZ).

Table 11: BioBanking management zones

Vegetation Zone	Plant Community Type	Condition	Ancillary code	Management Zone ²	Area
03	SR545 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Moderate / good	–	MZ03	7.93
		Moderate / good	–	MZ04	1.05
04		Moderate / good	Derived grassland	MZ05	0.32
05	SR652 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Moderate / good	–	MZ06	20.59
06		Moderate / good	Derived grassland	MZ07	0.27
07		Moderate / good	Poor	MZ08	1.86
08		Low	–	MZ09	4.15

² Numbering of management zones continues from continues from the Biodiversity certification agreement developed for the development site (Biosis 2015a, 2015b)

Vegetation Zone	Plant Community Type	Condition	Ancillary code	Management Zone ²	Area
09	SR662 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Moderate / good	–	MZ10	9.61
03	SR545 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Low	–	MZ11	1.04

Vegetation will be retained within all management zones; the default management actions are detailed in Section 1 of Appendix 2 and summarized in Section 5.3.1.

5.2 Assessment of changes in biodiversity values for management zones within the BioBank site

5.2.1 Assessment of changes in landscape attribute values for the BioBank site

BioBanking the site will result in a small increase in the value of the landscape attributes at the site due to the following:

- Percent native vegetation cover within an inner assessment circle will increase from 39% to 41% following BioBanking due to rehabilitation of areas in low condition.

5.2.2 Averted loss

The native vegetation within the BioBank site has been assessed as having a low risk of decline over a 20 year period as it is currently zoned E2 Environmental Conservation under the Wollongong Local Environment Plan 2009 (LEP).

Therefore, averted loss is not included within biodiversity attribute assessment.

5.2.3 Assessment of changes in site value scores for each management zone

Changes in biodiversity value scores for each management zone are outlined in Table 24 to Table 32 in Appendix 2.

For all management zones, except management zone MZ04, default increases were used to determine increases in biodiversity value scores. For management zone MZ04, which is currently being managed for reduced fuel loads, it was assumed there would be no increase in site value, other than a reduction in exotic plant cover due to weed management in this area.

5.3 Management actions to improve biodiversity values

The management actions required for the management of biodiversity within the BioBank site have been developed in accordance with the template for management actions (version 1.3 – August 2011) and Section 12 of the NSW BioBanking Assessment Methodology (OEH 2014).

A list of management actions to improve biodiversity is attached at Appendix 3.

5.3.1 Standard management actions for all vegetation zones

Appendix 3 provides the BioBanking management action template for the BioBank site. In summary, the following are compulsory actions for any BioBank site and will be undertaken where applicable in all management zones:

- Management of grazing for conservation.
 - Stock will not be permitted to graze in any area of the BioBank site.
- Weed control.
 - Declared noxious weeds are to be managed according to requirements under the *Noxious Weeds Act 1993*.
 - Other weeds should be removed following the guidelines of the Weed Management Plan set out in Appendix 3.
- Application of ecological fire management.
 - The compulsory Fire Management Plan has been set out in Appendix 3.
 - Given the proximity to residential development and presence of Whalebone Tree - Native Quince dry subtropical rainforest and the White-flowered Wax Plant, it is recommended that fires are suppressed within the Biobank site.
- Management of human disturbance.
 - All waste (Figure 7) will be removed from the BioBank site.
 - The BioBank site is to be fenced off to deter residents and members of the public from entering the area. Fencing requirements are set out in Appendix 2 and shown in Figure 7.
 - Access to the BioBank site for ongoing management will be via two access roads Figure 7. Access gates will be installed at all access points into the BioBank site Figure 7.
 - Signage will be installed at the boundaries of the BioBank site, in line with the requirements set out in Appendix 3 and shown in Figure 7.
- Retention of regrowth and remnant native vegetation.
 - Promote the regrowth of native vegetation by suppressing the growth of weeds.
- Replanting or supplementary planting.
 - Replanting requirements are set out in Appendix 3. Supplementary planting will be undertaken in management zones MZ06, MZ08, MZ10 and MZ11 to aid in rehabilitation of areas currently subject to dense weed infestations.
- Retention of dead timber.
 - Dead timber will not be removed from the BioBank site.

- Retention of rocks.
 - Rocks will not be removed from the BioBank site.

5.3.2 Additional management actions

Additional management actions are outlined in the credit report (Appendix 4) for creating ecosystem credits. Additional management actions outlined in the credit report include:

- Exclude commercial apiaries
- Exclude miscellaneous feral species
- Feral and/or over abundant native herbivore control
- Fox control
- Slashing

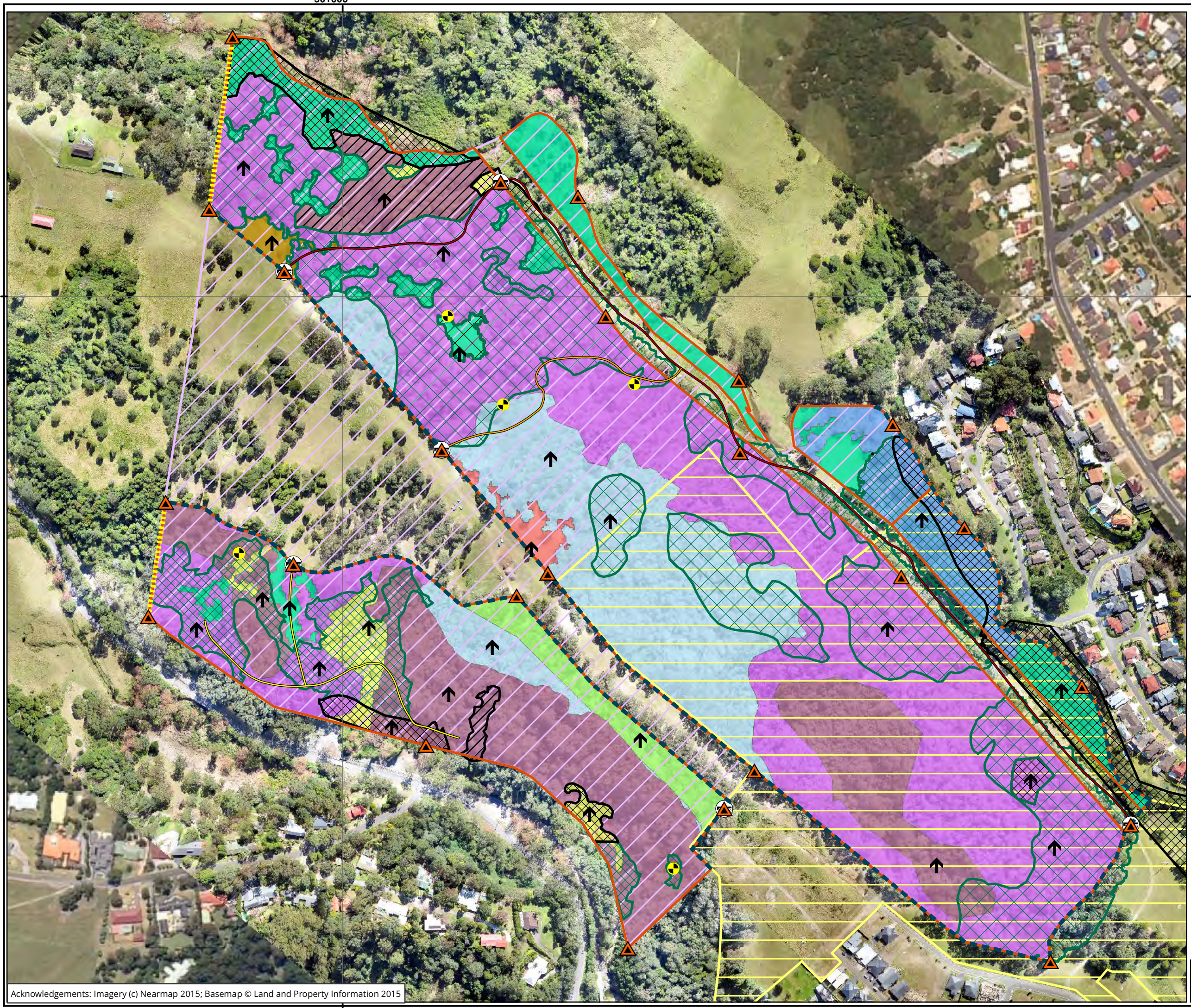
It is considered that control of feral and/or overabundant herbivores is not required at the BioBank site. Relevant management actions are set out in Appendix 3.

5.3.3 Existing Management Obligations

The study area does not have any existing conservation obligations such as:

- A restriction on use or public positive covenant under Part 4A of the *Crown Lands Act 1989*.
- A conservation agreement entered into under the *National Parks and Wildlife Act 1974* (NPW Act).
- A trust agreement entered into under the *Nature Conservation Trust Act 2001* (NCT Act).
- Any agreement entered into with a public authority under which the owner of the land received funding for biodiversity conservation purposes (other than BioBanking agreements).
- The study area is not publically owned land.

Therefore, the study area does not have any existing conservation obligations that would reduce the number of ecosystem or species credits.



Legend

- BioBank site
- Lot 815 DP1193843
- Lot 1801 DP1223063
- Photopoints
- Waste (to be removed)
- Signage

Fencing

- Three wire farm fence
- Wire and bollard
- Access gate
- Access track - upgrade existing (permanent)
- Access track - upgrade existing (temporary)
- Access track - new track (temporary)

Weeds (to be managed)

- >50% weed cover (mostly Lantana)
- >50% weed cover (Mostly Mysore Thorn)
- >30% and <50% weed cover (Mostly Lantana)
- >30% and <50% weed cover (Other weeds)
- Lantana along Rainforest edge and canopy gaps

Management zones

- MZ03
- MZ04
- MZ05
- MZ06
- MZ07
- MZ08
- MZ09
- MZ10
- MZ11

Figure 7: Management zones and management actions

0 40 80 120 160 200

Metres

Scale: 1:3,949 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 20289
Date: 16 December 2016,
Checked by: NMG, Drawn by: LH, Last edited by: lharley
Location: P:\20200s\20289\Mapping\20289_BB_F7_Management_20160919

6. Biodiversity credits

6.1.1 Ecosystem credits created

This section provides an assessment of the ecosystem credits created by the development of a BioBanking agreement over the BioBank site. A summary of ecosystem credits created for each management zone are detailed below in Table 12. The full credit profile is provided in Appendix 4.

Table 12: Summary of ecosystem credits for each management zone

PCT code	PCT name	Management zone	Management zone area (ha)	Landscape Value score	Current site value	Future site value	Gain in site value	Averted loss in site value	Number of ecosystem credits created
SR545	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	3	7.93	24.6	72.4	94.79	22.39	6.64	106
SR545	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	4	1.05	24.6	72.4	75.52	3.12	6.64	9
SR545	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	5	0.32	24.6	10.94	24.65	13.71	0.52	3
SR652	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	6	20.59	24.6	72.4	84.64	12.24	4.69	214
SR652	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	7	0.27	24.6	31.25	52.78	21.53	2.86	3
SR652	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	8	1.86	24.6	46.35	54.43	8.08	2.34	16
SR652	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	9	4.15	24.6	33.85	52.78	18.93	2.69	48

PCT code	PCT name	Management zone	Management zone area (ha)	Landscape Value score	Current site value	Future site value	Gain in site value	Averted loss in site value	Number of ecosystem credits created
SR662	Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	10	9.61	24.6	75.52	87.5	11.98	7.16	105
SR662	Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	11	1.04	24.6	33.33	47.14	13.81	1.22	10

6.1.2 Species credits created

This section provides an assessment of the species credits created by BioBanking the study area. A summary of ecosystem credits created is provided in Table 13. The full credit profile is provided in Appendix 4.

Table 13: Summary of species credits

Scientific name	Common name	Number of species credits created
<i>Cynanchum elegans</i>	White-flowered Wax Plant	632

Based on the outcomes of Section 4.4, no credits for threatened fauna species are able to be created by the development of a BioBanking agreement over the site.

7. Conclusion

The development of a BioBanking agreement over the BioBank site, including the conservation and management of native vegetation and species habitat will result in the creation of 514 credits across three PCTs, as outlined in Table 14.

Table 14: Summary of ecosystem credits

PCT code	Plant community type name	Ecosystem credits created
SR545	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	118
SR652	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	281
SR662	Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	115

In addition, 632 White flowered Wax Plant credits will be created.

Management actions required to generate these credits are summarized in Section 5.3 and detailed in the list of management actions required at the BioBank site (Appendix 3).

A complete credit report is provided in Appendix 4.

References

- Biosis Research 2011. Redgum Ridge Rezoning Investigations: Terrestrial Flora and Fauna Constraints Analysis. Report for Clifford Developments. Authors: B Morrissey & K Reed, Biosis Pty Ltd, Wollongong. Project no. 13619.
- Biosis 2014. Redgum Ridge Estate BioBanking Assessment. Report for Clifford Developments. Authors: B Morrissey & N Garvey, Biosis Pty Ltd, Wollongong. Project no. 16921
- Biosis 2015a. Redgum Ridge Western Precinct (part Lots 814 and 815 DP1193843) Biodiversity Certification: Biodiversity Conservation Strategy. Report for Edenvell Pty Ltd. Author: N Garvey, Biosis Pty Ltd, Wollongong. Project 20288.
- Biosis 2015b. Redgum Ridge Western Precinct (part Lots 814 and 815 DP1193843) Biodiversity Certification: Biodiversity Assessment Report. Report for Edenvell Pty Ltd. Authors: N Garvey & M Misdale, Biosis Pty Ltd, Wollongong. Project 20288.
- DECC 2008. BioBanking Assessment Methodology and Credit Calculator Operational Manual. NSW Department of Environment and Climate Change, Hurstville, NSW.
- Cropper SC. 1993. Management of Endangered Plants. CSIRO, Melbourne.
- Hazelton PA and Tille PJ 1990. Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet map and report. Soil Conservation Service of NSW, Sydney.
- Keith DA 2004. Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. Department of Environment and Conservation, Hurstville.
- NPWS 2002. Native Vegetation of the Illawarra Escarpment and Coastal Plain. NSW National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee 2002. Illawarra subtropical rainforest in the Sydney Basin Bioregion - endangered ecological community listing: NSW Scientific Committee - final determination. NSW Scientific Committee, Sydney, NSW.
- NSW Scientific Committee 2011. Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. NSW Scientific Committee, Sydney, NSW.
- OEH 2014. BioBanking Assessment Methodology 2014. Office of Environment and Heritage, Sydney.
- SRCMA 2013. Catchment Action Plan 2013 – 2023. Southern Rivers Catchment Management Authority, Wollongong, NSW.
- UBM 2015. Vegetation Management Plan for Red Gum Ridge, Figtree. Report prepared for Edenvell Pty Ltd by Urban Bushland Management Consultants Pty Ltd, Castle Hill, NSW
- WCC et al. 2011a. Illawarra Biodiversity Strategy. Volume 1 Action Plan. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong, NSW.
- WCC et al. 2011b. Illawarra Biodiversity Strategy. Volume 2 Background Information. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong, NSW.

Appendices

Appendix 1: Native vegetation data (BioBanking)

Appendix 1.1 Flora species lists

As some plots / transect were undertaken prior to the revision of the NSW BioBanking Assessment Methodology in 2014, some data has been collected using the modified Brauin/Blanquet scores below.

Modified Braun Blanquet cover:

- 1: <5% - 3 or less individuals
- 2: <5% - more than 3 sparsely scattered
- 3: <5% - common throughout plot
- 4: 5% - 25%
- 5: 25% - 50%
- 6: 50% - 75%
- 7: 75% - 100%

All quadrats except quadrats Q18 to Q24 have used this modified Braun Blanquet cover scoring system. Quadrats Q18 to Q24 have used scores from 1 to 5 per cent and then to nearest five per cent.

Table 15: Flora species recorded from the BioBank site, including cover scores

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Acacia maidenii</i>	Maiden's Wattle	1	2	1	1	3	4	4	2	2	2	2				5	1	25	15	10
<i>Acacia mearnsii</i>	Black Wattle																			
<i>Acronychia oblongifolia</i>	White Aspen						1			1										
<i>Adiantum formosum</i>	Giant Maidenhair														1	2				
<i>Adiantum hispidulum</i>	Rough Maidenhair																			
<i>Ageratina adenophora</i>	Crofton Weed						2	3							5	2	10			
<i>Agrostis avenacea</i>	Blown Grass										1	2								
<i>Alchornea ilicifolia</i>	Native Holly																			
<i>Alectryon subcinereus</i>	Wild Quince					1				1	2									
<i>Alphitonia excelsa</i>	Red Ash					1		3												10
<i>Anagallis arvensis</i>	Scarlet Pimpernel				1					2	2			1				1		
<i>Aneilema biflorum</i>	0																			
<i>Aphanopetalum resinosum</i>	Gum Vine																			
<i>Araujia sericifera</i>	Moth Vine						1	3									1	1	1	1
<i>Asparagus asparagoides</i>	Bridal Creeper																			2
<i>Asplenium aethiopicum</i>	Shredded Spleenwort	1								1										
<i>Asplenium flabellifolium</i>	Necklace Fern									2					1	1				
<i>Asteraceae spp.</i>	#N/A									4	2	4								
<i>Axonopus compressus</i>	Broad-leaved Carpet Grass													60						
<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass				1					2	2	2						1		
<i>Backhousia myrtifolia</i>	Grey Myrtle						3				2									
<i>Bidens pilosa</i>	Cobbler's Pegs									2	2			1			1	1	1	1
<i>Brachychiton acerifolius</i>	Illawarra Flame Tree																			
<i>Breynia oblongifolia</i>	Coffee Bush		1					1		2										
<i>Briza maxima</i>	Quaking Grass																			
<i>Briza minor</i>	Shivery Grass													1						
<i>Brunoniella australis</i>	Blue Trumpet																			
<i>Callistemon salignus</i>	Willow Bottlebrush	1	1						4		4	5								
<i>Calochlaena dubia</i>	Rainbow Fern			1							2	2				1				
<i>Caesalpinia decapetala</i>	Thorny Poinciana																			2

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Carex appressa</i>	Tall Sedge															1				
<i>Carex longebrachiata</i>	0	1	3		3	3	3	5	3					5		2	40	5	2	5
<i>Carlina vulgaris</i>	#N/A				1															
<i>Cassine australis</i>	Red Olive Plum	1				2	1		2	2									5	
<i>Cayratia clematidea</i>	Native Grape									2	3	3								
<i>Celtis sinensis</i>	Japanese Hackberry									2	2									
<i>Centaurium erythraea</i>	Common Centaury									2	3									
<i>Centella asiatica</i>	Indian Pennywort			1	3	2		2		2	2			1			1			
<i>Cestrum parqui</i>	Green Cestrum														1	1				
<i>Cheilanthes sieberi</i>	Rock Fern	1																		
<i>Chloris gayana</i>	Rhodes Grass																	1		
<i>Citriobatus pauciflorus</i>	Orange Thorn								3											
<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum					3	1	1	1	1	2					5				
Climber sp. 1	#N/A										5									
Climber sp. 2	#N/A																			
Climber sp. 3	#N/A									5										
Climber sp. 4	#N/A									2	2									
<i>Commelina cyanea</i>	Native Wandering Jew													1	1					
<i>Conyza bonariensis</i>	Fleabane									3	3	2								
<i>Conyza spp.</i>	A Fleabane									2									1	
<i>Coprosma quadrifida</i>	Prickly Currant Bush					1	2	1		3		2				4			1	3
<i>Croton verreauxii</i>	Green Native Cascarilla						5	3	2							70				
<i>Cryptocarya glaucescens</i>	Jackwood								2	1										
<i>Cyathea cooperi</i>	Straw Treefern														1					
<i>Cymbopogon refractus</i>	Barbed Wire Grass													1			1			
<i>Cynanchum elegans</i>	White-flowered Wax Plant																		1	
<i>Cynodon dactylon</i>	Common Couch			1	7						1			15			20	25		
<i>Cyperus gracilis</i>	Slender Flat-sedge									1	2									
<i>Cyperus spp.</i>														1						
<i>Cyperus tetraphyllus</i>				1																

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Delairea odorata</i>	Cape Ivy					3		2		4	3	3			2	2			1	2
<i>Dendrocnide excelsa</i>	Giant Stinging Tree															2			1	
<i>Desmodium</i> spp.	Tick-trefoil		3								1									
<i>Desmodium varians</i>	Slender Tick-trefoil									4				1				1		
<i>Dianella longifolia</i>	Blueberry Lily	1	1								1									
<i>Dichelachne crinita</i>	Longhair Plumegrass													3						
<i>Dichelachne</i> spp.	A Plumegrass																	1		
<i>Dichanthium</i> spp.																	3			
<i>Dichondra repens</i>	Kidney Weed	1	3	1	2	3	3	3	3		2	5						3	1	2
<i>Digitaria violascens</i>										2	1									
<i>Diospyros australis</i>	Black Plum							1		1										
<i>Doodia aspera</i>	Prickly Rasp Fern	1																		
<i>Duchesnea</i> spp.								1												
<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass	1								1				1				5		
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass			1				1			2	4								
<i>Ehrharta erecta</i>	Panic Veldtgrass								2											
<i>Ehretia acuminata</i>															1					
<i>Elaeodendron australe</i>										3	3	3								
<i>Entolasia marginata</i>	Bordered Panic	1		1	2	1				2									1	1
<i>Entolasia stricta</i>	Wiry Panic								3											
<i>Eucalyptus botryoides</i> x <i>saligna</i>							4													40
<i>Eucalyptus quadrangulata</i>	White-topped Box				1		1			1										
<i>Eucalyptus tereticornis</i>	Forest Red Gum	1	5		3	5	4		5											30
<i>Eupomatia laurina</i>	Bolwarra														1					
<i>Eustrephus latifolius</i>	Wombat Berry	1				2	1	2	2							1	1	1		1
<i>Ficus coronata</i>	Creek Sandpaper Fig															1				
<i>Ficus</i> spp.							1			2	3	3								
<i>Gahnia aspera</i>	Rough Saw-sedge	1								3	3	4								
<i>Galium gaudichaudii</i>	Rough Bedstraw		2								2									
<i>Geitonoplesium cymosum</i>	Scrambling Lily	1	2			2			2	3	3	3						1	1	1

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Geitonoplesium</i> sp.								2		1										
<i>Geranium homeanum</i>								2		3	3						1			
<i>Glochidion ferdinandii</i>								1			1									5
<i>Glycine clandestina</i>	Twining glycine		2							2		2								
<i>Glycine tabacina</i>	Variable Glycine	1						2												
<i>Gomphocarpus</i> spp.				1							2						10	3		
<i>Guioa semiglauca</i>						1														3
<i>Gymnostachys anceps</i>	Settler's Twine			1			2			3	3									1
<i>Hardenbergia violacea</i>	False Sarsaparilla			1						2	1									
<i>Hibbertia scandens</i>	Climbing Guinea Flower	1			2					3	3	2					7	1		1
<i>Hibiscus</i> spp.							1		1		2									
<i>Holcus lanatus</i>	Yorkshire Fog													1						
<i>Hydrocotyle peduncularis</i>	A Pennywort																			
<i>Hypericum gramineum</i>	Small St John's Wort													5						
<i>Hypochoeris radicata</i>	Catsear				1					2	3	2		5						
<i>Imperata cylindrica</i>	Blady Grass			1	2						1						50			
<i>Juncus usitatus</i>								2				2		3		1	1			
<i>Lantana camara</i>	Lantana	1	1				5	3	3			2			95	30	5	1	40	50
<i>Ligustrum sinense</i>	Small-leaved Privet																			1
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	1																		
<i>Maclura cochinchinensis</i>	Cockspur Thorn											2							1	1
<i>Marsdenia rostrata</i>	Milk Vine		1						2			2						1		1
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	1					1													
<i>Melia azedarach</i>	White Cedar					1		1											5	2
<i>Melicope micrococca</i>	Hairy-leaved Doughwood										1					1				1
<i>Melicope</i> spp.							1	1	1											
<i>Microlaena stipoides</i>	Weeping Grass	1	4		4	3		3	3			2		5		1	3	30		
<i>Mimosa pudica</i>	Common Sensitive Plant																			
<i>Modiola caroliniana</i>	Red-flowered Mallow																			
<i>Morinda jasminoides</i>	Sweet Morinda											2								

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Myrsine</i> spp.							1		1											
<i>Myrsine variabilis</i>		1	2																	
<i>Nandina domestica</i>	Japanese Sacred Bamboo			1																
Native tree sp.												2								
<i>Notelaea longifolia</i>	Large Mock-olive					1	1	4	1			2								
<i>Notelaea ovata</i>		1														10				
<i>Notelaea venosa</i>	Veined Mock-olive											2								
<i>Onopordum acanthium</i>																		1		
<i>Oplismenus aemulus</i>		1			3		4		4					1	1		2	2	1	5
<i>Oplismenus imbecillis</i>		1	3					3								5				
<i>Oplismenus</i> spp.				1																
<i>Oxalis perennans</i>														1				1		
<i>Oxalis</i> spp.									2											
<i>Pandorea pandorana</i>	Wonga Wonga Vine	1	2		2	2	2	3	1							5	1		5	5
<i>Panicum pygmaeum</i>	Pygmy Panic																			
<i>Parsonsia straminea</i>	Common Silkpod																			
<i>Paspalidium criniforme</i>																				
<i>Paspalum dilatatum</i>	Paspalum		1		1															
<i>Paspalum</i> spp.														1			1	1		
<i>Passiflora edulis</i>	Common Passionfruit															1				1
<i>Passiflora subpeltata</i>	White Passionflower						1	1												
<i>Pellaea falcata</i>	Sickle Fern					3		3	3						1	2	2		1	5
<i>Pennisetum clandestinum</i>	Kikuyu Grass				1									1						
<i>Pittosporum multiflorum</i>	Orange Thorn	1	2																	
<i>Pittosporum undulatum</i>	Sweet Pittosporum					1		1												2
<i>Plantago lanceolata</i>	Lamb's Tongues													3				1		
<i>Poa labillardieri</i>								3	2							1	10	30		
<i>Poa sieberiana</i>	Snowgrass	1	3		2															
<i>Poa</i> spp.																				
<i>Pomaderris</i> spp.																1				

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Pouteria australis</i>	Black Apple			1																
<i>Pratia purpurascens</i>	Whiteroot	1			2															
<i>Prunella vulgaris</i>	Self-heal													1						
<i>Pseuderanthemum variabile</i>	Pastel Flower	1	2				3		3							1			1	1
<i>Pteridium esculentum</i>	Bracken														1					
<i>Rapanea variabilis</i>	Muttonwood															1		1		
<i>Romulea rosea</i>																				
<i>Rubus parvifolius</i>	Native Raspberry	1					1	1	1								1			
<i>Rubus rosifolius</i>	Rose-leaf Bramble														1	2				
<i>Sarcopetalum harveyanum</i>	Pearl Vine																			
<i>Scolopia braunii</i>	Flintwood																			
<i>Scutellinia</i> spp.						1														
<i>Senecio hispidulus</i>	Hill Fireweed																			
<i>Senecio longifolia</i>																				
<i>Senecio madagascariensis</i>	Fireweed				1			3						1			1	1		1
<i>Senna pendula</i>																				1
<i>Senna pendula</i> var. <i>glabrata</i>							2													
<i>Senna septemtrionalis</i>	Arsenic Bush			1																
<i>Setaria incrassata</i>	Purple Pigeon Grass							1												
<i>Setaria parviflora</i>																				
<i>Setaria</i> spp.														1			1			
<i>Sida rhombifolia</i>	Paddy's Lucerne	1	1											1			1		1	1
<i>Sigesbeckia orientalis</i> subsp. <i>Orientalis</i>	Indian Weed			1																
<i>Sisymbrium officinale</i>	Hedge Mustard			1																
<i>Smilax australis</i>	Lawyer Vine			1																
<i>Solanum mauritianum</i>	Wild Tobacco Bush			1				1												
<i>Solanum prinophyllum</i>	Forest Nightshade			1																
<i>Solanum pseudocapsicum</i>	Madeira Winter Cherry		1	1		3		3	3						2	2		3	5	3
<i>Solanum pungetium</i>	Eastern Nightshade					1	1													
<i>Sonchus oleraceus</i>	Common Sowthistle																			

Scientific name	Common name	Q2	Q3	Q4	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<i>Sporobolus africanus</i>	Parramatta Grass													1						
<i>Stellaria flaccida</i>							2									1				
<i>Stellaria media</i>	Common Chickweed																			
<i>Stephania japonica</i>	Snake vine		2			3			1						1	2		1	1	2
<i>Stephania</i> spp.							1													
<i>Streblus brunonianus</i>	Whalebone Tree						1	1								1				1
<i>Syzygium smithii</i>							1													
<i>Taraxacum officinale</i>	Dandelion				1															
<i>Themeda australis</i>	Kangaroo Grass	1																		
<i>Toona ciliata</i>	Red Cedar																			
<i>Toxicodendron succedaneum</i>	Rhus Tree														1				3	
<i>Trifolium repens</i>	White Clover							2												
<i>Tylophora barbata</i>	Bearded Tylophora	1							3											
<i>Urtica incisa</i>	Stinging Nettle					3									2	1			1	
<i>Verbena bonariensis</i>	Purpletop																1	1		
<i>Verbena rigida</i>	Veined Verbena																			
<i>Veronica plebeia</i>	Trailing Speedwell					1										1	1	1	1	
<i>Wilkiea huegeliana</i>	Veiny Wilkiea															1				

Appendix 1.2 Plot and transect field data

Table 16: Plot and transect field data - Vegetation Zone 3

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q11	29	10	44	24	8	72	4	1	1	76	301169	6187604	56
Q2	31	36	24	50	8	24	8	0	1	16	301402	6187587	56
Q3	20	29	7.6	40	2	22	30	0	1	31	301302	6187746	56
Q4	17	30.5	17	42	4	34	15	1	1	29	301235	6187817	56

Table 17: Plot and transect field data - Vegetation Zone 4

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q18	14	0.5	0	40	0	4	56	0	0	0	301213	6187715	56

Table 18: Plot and transect field data - Vegetation Zone 5

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q10	28	65	13	50	0	12	30	0	1	0	301114	6188048	56
Q14	41	41	13.5	52	26	54	30	2	1	84	301803	6187378	56
Q17	41	27	33.5	60	14	36	18	4	1	37	301723	6187548	56

Table 19: Plot and transect field data - Vegetation Zone 6

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q22	18	11	0	76	0	0	32	0	1	0	300916	6188047	56

Table 20: Plot and transect field data - Vegetation Zone 7

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q24	25	25.5	25.5	8	2	48	54	0	0	28	301676	6187671	56

Table 21: Plot and transect field data - Vegetation Zone 8

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q21	18	0.5	0	74	0	4	30	0	1	0	301132	6187935	56
Q23	18	9	4.5	4	0	8	88	0	0.33	0	300997	6188131	56

Table 22: Plot and transect field data - Vegetation Zone 9

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q12	30	69	7.5	0	8	8	0	1	1	66	301357	6187377	56
Q13	22	63	19	0	4	14	0	0	1	65	301120	6187551	56
Q15	28	56	29.5	50	28	48	12	0	1	41	301670	6187358	56

Table 23: Plot and transect field data - Vegetation Zone 10

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
Q19	12	7.5	0.5	8	0	0	92	0	0	0	301030	6187626	56
Q20	30	9	5	0	0	22	78	0	0.5	7	301020	6187661	56

Appendix 2: Changes in biodiversity value scores for each management zone

Table 24: Changes in biodiversity value scores for Management Zone MZ03

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	2	3	Default increase. No additional management required.
Native over-storey cover:	3	3	Cannot increase.
Native mid-storey cover:	2	3	Default increase. No additional management required.
Native ground cover (grasses):	3	3	Cannot increase.
Native ground cover (shrubs):	2	3	Default increase. No additional management required.
Native ground cover (other):	1	2	Default increase. No additional management required.
Exotic plant cover:	2	3	Default increase. No additional management required.
Number of trees with hollows:	2	2.5	Default increase. No additional management required.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	3	3	Cannot increase.

Table 25: Changes in biodiversity value scores for Management Zone MZ04

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	2	2	No increase due to ongoing slashing for fuel reduction.
Native over-storey cover:	3	3	Cannot increase.
Native mid-storey cover:	2	2	No increase due to ongoing slashing for fuel reduction.
Native ground cover (grasses):	3	3	Cannot increase.
Native ground cover	2	2	No increase due to ongoing slashing for

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
(shrubs):			fuel reduction.
Native ground cover (other):	1	1	No increase due to ongoing slashing for fuel reduction.
Exotic plant cover:	2	3	Default increase. Weed management to be undertaken.
Number of trees with hollows:	2	2	No increase due to ongoing slashing for fuel reduction.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	3	3	Cannot increase.

Table 26: Changes in biodiversity value scores for Management Zone MZ05

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	1	1.25	Default increase. No additional management required.
Native over-storey cover:	0	1	Default increase. No additional management required.
Native mid-storey cover:	0	1	Default increase. No additional management required.
Native ground cover (grasses):	3	3	Cannot increase.
Native ground cover (shrubs):	3	3	Cannot increase.
Native ground cover (other):	1	2	Default increase. No additional management required.
Exotic plant cover:	1	1.5	Default increase. No additional management required.
Number of trees with hollows:	0	0	No increase.
Overstorey regeneration:	0	0.5	Default increase. No additional management required.
Total length of fallen logs:	0	0	No increase.

Table 27: Changes in biodiversity value scores for Management Zone MZ06

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	3	3	Cannot increase.
Native over-storey cover:	3	3	Cannot increase.
Native mid-storey cover:	3	3	Cannot increase.
Native ground cover (grasses):	0	1	Default increase. No additional management required.
Native ground cover (shrubs):	1	2	Default increase. No additional management required.
Native ground cover (other):	3	3	Cannot increase.
Exotic plant cover:	2	3	Default increase. No additional management required.
Number of trees with hollows:	2	2.5	Default increase. No additional management required.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	1	1.5	Default increase. No additional management required.

Table 28: Changes in biodiversity value scores for Management Zone MZ07

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	2	3	Default increase. No additional management required.
Native over-storey cover:	1	2	Default increase. No additional management required.
Native mid-storey cover:	0	1	Default increase. No additional management required.
Native ground cover (grasses):	0	1	Default increase. No additional management required.
Native ground cover (shrubs):	3	3	Cannot increase.
Native ground cover (other):	0	1	Default increase. No additional management required.
Exotic plant cover:	2	3	Default increase. No additional management required.

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Number of trees with hollows:	0	0	No increase.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	0	0	No increase.

Table 29: Changes in biodiversity value scores for Management Zone MZ08

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	3	3	Cannot increase.
Native over-storey cover:	2	3	Default increase. No additional management required.
Native mid-storey cover:	3	3	Cannot increase.
Native ground cover (grasses):	3	3	Cannot increase.
Native ground cover (shrubs):	3	3	Cannot increase.
Native ground cover (other):	3	3	Cannot increase.
Exotic plant cover:	1	1.5	Default increase. No additional management required.
Number of trees with hollows:	0	0	No increase.
Overstorey regeneration:	0	0.5	Default increase. No additional management required.
Total length of fallen logs:	1	1.5	Default increase. No additional management required.

Table 30: Changes in biodiversity value scores for Management Zone MZ09

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	2	3	Default increase. No additional management required.
Native over-storey cover:	1	2	Default increase. No additional management required.

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native mid-storey cover:	1	2	Default increase. No additional management required.
Native ground cover (grasses):	0	1	Default increase. No additional management required.
Native ground cover (shrubs):	3	3	Cannot increase.
Native ground cover (other):	3	3	Cannot increase.
Exotic plant cover:	1	1.5	Default increase. No additional management required.
Number of trees with hollows:	0	0	No increase.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	0	0	No increase.

Table 31: Changes in biodiversity value scores for Management Zone MZ10

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	3	3	Cannot increase.
Native over-storey cover:	2	3	Default increase. No additional management required.
Native mid-storey cover:	3	3	Cannot increase.
Native ground cover (grasses):	1	2	Default increase. No additional management required.
Native ground cover (shrubs):	2	3	Default increase. No additional management required.
Native ground cover (other):	3	3	Cannot increase.
Exotic plant cover:	3	3	Cannot increase.
Number of trees with hollows:	1	1.5	Default increase. No additional management required.
Overstorey regeneration:	3	3	Cannot increase.
Total length of fallen logs:	3	3	Cannot increase.

Table 32: Changes in biodiversity value scores for Management Zone MZ11

Site attribute	Current score (0-3)	Score with management (0-3)	Justification
Native plant species:	3	3	Cannot increase.
Native over-storey cover:	2	3	Default increase. No additional management required.
Native mid-storey cover:	2	3	Default increase. No additional management required.
Native ground cover (grasses):	3	3	Cannot increase.
Native ground cover (shrubs):	0	1	Default increase. No additional management required.
Native ground cover (other):	3	3	Cannot increase.
Exotic plant cover:	0	0.5	Default increase. No additional management required.
Number of trees with hollows:	0	0	No increase.
Overstorey regeneration:	0	0.5	Default increase. No additional management required.
Total length of fallen logs:	1	1.5	Default increase. No additional management required.

Appendix 3: Management actions template

Instructions for completing the template for management actions

This template for management actions should be filled in by the landowner and submitted to OEH with an application to establish a biobank site. These standard words and format must be used for the management actions (refer to the *Guide to establishing a biobank site* for guidance).

OEH will review the management actions and plans and make any necessary amendments after consultation with the landowner. These management actions will be incorporated into the biobanking agreement as Annexure C.

There are four sections to this template:

1. standard management actions – mandatory
2. additional management actions – only if indicated by the assessment
3. standard management plans (weeds and fire for conservation) – mandatory
4. additional management plans (feral and overabundant herbivores and vertebrate pests) – only if indicated by the assessment.

An additional short section is also included in this template that requires the details of photo points for monitoring purposes. This information will be incorporated into the agreement as Annexure D.

Green boxes like this one provide instructions and examples and will be deleted by OEH before the biobanking agreement is processed.

Yellow highlighted fields need to be customised by the landowner. Usually the landowner needs to provide the information required; sometimes the landowner will need to delete or retain provided options. It is important to ensure that, especially where fields are customised, that the management actions are certain, clear and specific so that it is clear what the requirements of the actions are.

The format and wording of standard and additional management actions must not be changed. Enter site specific information into the yellow highlighted fields as required.

Management actions are divided into passive and active actions. Passive actions have little or no cost and include refraining from doing something, such as not removing fallen logs or bush rock. Passive management actions must be commenced as soon as the biobanking agreement is signed.

If a management action is active, you have to undertake specific activities to improve the site's biodiversity. Active management actions only need to be commenced when 80% of the Total Fund Deposit is met (ie from 'first payment date').

In the table below, the timing column indicates:

- passive actions by the term 'Ongoing from commencement date'
- active actions by a reference to 'Ongoing from first payment date'.

Managing grazing for conservation can be passive or active depending on the biobank site. For example, managing grazing for conservation is a passive management action if the biobank site is already suitably fenced, and it is an active management action if the biobank site needs to be fenced. Both options appear in the timing column and are highlighted yellow. Delete whichever option is not applicable.

Section 1: Standard management actions

Standard management actions		
Item 1	Management of grazing for conservation	Timing
1.1	<p>Stock must not be permitted to graze in any area of the biobank site.</p> <p>If no grazing is to be allowed, replace the above item with: 'Stock must not be permitted to graze in any area of the biobank site.'</p> <p>Then delete the words in item 1.2 and 1.3 (but keep the numbering) and replace with: 'This item is not applicable'. The wording in the adjacent Timing column can also be deleted.</p>	Ongoing from commencement date.
1.2	<p>This item is not applicable.</p> <p>Insert any requirements specific to the site to accommodate local conditions and allow for flexibility in a framework of reasonable certainty.</p> <p>Delete 'Specific requirements:' if it is not relevant.</p> <p>The landowner can prevent stock from grazing or require stock to graze in specific areas by erecting and maintaining stockproof fencing. Fencing may be permanent or temporary (including electric fences). Indicate the specific type and length of fence to be erected and by when.</p> <p>Soil disturbance may be required (and is permitted) to encourage regeneration of native vegetation in conjunction with management of grazing for conservation.</p>	N/A
1.3	This item is not applicable.	N/A
1.4	If, at any time, the landowner observes stock in any area of the biobank site, other than an area on the biobank site where grazing is permitted, the landowner must take necessary measures to remove the stock from the area immediately.	Ongoing from commencement date.
Item 2	Weed control	Timing
2.1	<p>The landowner must implement and, at all relevant times, comply with, the integrated weed management plan included in Section 3 ('the weed management plan') (or such updated integrated weed management plan as has been approved by the Director General under item 2.2 below).</p> <p>To allow for adaptive management, minor alterations can be made to the implementation of the weed management plan. Any alterations must be recorded in writing in accordance with Section 3 of this Annexure.</p>	Ongoing from first payment date.

2.2	<p>The weed management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review.</p> <p>Where the Director General determines from the review that an update of the plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must be prepared by an appropriately qualified person and must cover the matters outlined below and any additional matters specified by the Director General in writing:</p> <ul style="list-style-type: none"> • a description of the target weed/s at the biobank site and their location/s, linked to each management zone where weeds are present • the method/s of weed control in each zone • the frequency of weed control activities at the site, taking into account management practices where weeds are providing habitat for native species • the timing of any planting of native plant species required in each management zone to provide alternative habitat for native species affected by weed control activities • methods for monitoring the success of weed control activities • a timetable/measures for inspections to identify new weed species or exotic plant species (including noxious weeds under the <i>Noxious Weeds Act 1993</i>) • additional weed control activities to destroy or remove any new weed species that are found on the site • measures for assessing and reporting monitoring results • a diary for recording actions taken in accordance with the weed management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary. 	Ongoing from first payment date.
-----	---	----------------------------------

Item 3	Management of fire for conservation	Timing
3.1	<p>The landowner must implement, and at all relevant times, comply with the fire management plan included in Section 3 (or such updated fire management plan as has been approved by the Director General under item 3.2 below) (‘the fire management plan’). To allow for adaptive management and weather conditions, minor alterations can be made to the implementation of the fire management plan, and must be recorded in writing in accordance with Section 3 of this Annexure.</p>	Ongoing from first payment date.
3.2	<p>The fire management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review.</p> <p>Where the Director General determines from the review that an update of the fire management plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must be prepared by an appropriately qualified person and cover the matters outlined below and any additional matters specified by the Director General in writing:</p> <ul style="list-style-type: none"> • the year the last fire went through, the type of fire and the extent of the fire and location, where known • frequency of natural fires in the area of the biobank site, where known • a description of locations and management zones where ecological burns will be conducted and areas that will not be burnt • the methods that will be used for ecological burns • the fire frequency intervals recommended for the vegetation types and threatened species present, including any required adjustment to the schedule in the event of a wildfire or activities undertaken under the <i>Rural Fires Act 1997</i> to ensure minimum frequency between ecological burns • the fire intensity for the recommended vegetation types • the time of year suitable for ecological burns • the diary for recording actions taken in accordance with the fire management plan and minor alterations to fire management plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary. 	Ongoing from first payment date.
3.3	<p>Fires must not be lit on the biobank site other than for the purpose of ecological burning in accordance with the fire management plan or as permitted as a permissible human activity on the biobank site under item 4 of this Annexure or</p>	Ongoing from commencement date.

	clause 3.6 of this agreement.	
Item 4	Management of human disturbance	Timing
4.1	Except as permitted under clause 3 of this agreement or item 4.2 (below), human activities that adversely affect biodiversity values on the biobank site, including repeated disturbance of native animals, must not be carried out, or caused or permitted to be carried out, on the biobank site.	Ongoing from commencement date.
4.2	Human activities that may have a negative impact on biodiversity values on the biobank site are permitted if they are listed as permissible activities under clause 3.6 of this agreement or if they are undertaken as part of the management actions or management plans.	Ongoing from commencement date.
4.3	All waste shown on the map entitled Figure 7: Management zones and management actions dated 24/02/2016 must be removed from the biobank site in an appropriate manner. If there is no waste on the biobank site delete the words of this item (but retain the numbering) and replace with: 'This item is not applicable.'	Commencing from first payment date.
4.4	The landowner must not store, dispose of, or cause or permit to be disposed of, any waste on the biobank site. Note: The storage or disposal of waste on the biobank site may require an approval under the <i>Protection of the Environment Operations Act 1997</i> .	Ongoing from commencement date.
4.5	The landowner must take all reasonable steps to remove waste deposited by others on the biobank site, or which is otherwise present on the biobank site.	Ongoing from first payment date.
4.6	Fencing and signage must be installed and maintained to deter human disturbance including waste dumping. Signage must be the BioBanking signs available from the OEH. Specific requirements: <ul style="list-style-type: none"> • Installation of approximately 876 metres of wire and bollard fencing at the interface between residential development and the southern section of the Biobank site. • Installation of approximately 1515 metres of wire and bollard fencing at the interface between residential development and the northern section of the Biobank site, and along the eastern boundary of the northern section of the BioBank site. • Installation of approximately 582 metres of wire and bollard fencing at the interface between residential areas to the north and the BioBank site. Signs, identify a Biobank site, will be installed along the fence. • Installation of approximately 327 metres of standard three-wire fencing along the western boundary of the BioBank site. Signs, identify a Biobank site, will be installed along the fence. • Wire and bollard fencing must be visually amenable and fit in with the adjacent residential development. This fencing is designed to indicate the presence of the BioBank site, but not prevent access to this area. • Creation of an access track into the southern section of the Biobank site to enable management activities. This 	Ongoing from first payment date.

	<p>access track will require minimal vegetation trimming to allow access for a small mechanical plant with rubberised tracks to undertake weed removal works. This access track will be temporary in nature for a maximum period of 5 years.</p> <ul style="list-style-type: none"> • Upgrading of an existing access track in the northern section of the Biobank site to enable management activities. This track has not been used for a number of years and is now largely regenerated. This access track will require minimal vegetation trimming to allow access for a small mechanical plant with rubberised tracks to undertake weed removal works. This access track will be temporary in nature for a maximum period of 5 years. • Upgrading of an existing access tracks in the northern section of the Biobank site to enable management activities. This access track will be established on a permanent basis. • Installation of four access gates along access tracks at the interface with the BioBank site. Signs, identifying a BioBank site, will be installed on all access gates. • Installation of an access gate to allow access to management zone MZ04 for slashing associated with APZ management. A sign, identifying a BioBank site, will be installed on all access gates. • In addition to the signs identified above, five signs will be installed along the northern boundary of the BioBank site. <p>Fencing, signage and access management is shown on the map entitled Figure 7: Management zones and management actions dated 24/02/2016.</p> <p>Signage should be located at points of access and other practical locations interfacing with adjoining properties. For biobank sites that are located fully within a larger private landholding, there should be at least one BioBanking sign to be placed at the main access gate to the site.</p> <p>It is recommended that required signage be installed within 3 months of first payment date.</p>	
--	--	--

Item 5	Retention of regrowth and remnant native vegetation Note: An approval under the <i>Native Vegetation Act 2003</i> may be required to carry out thinning or any other removal or damage to native vegetation under this item.	Timing
5.1	Native vegetation (whether remnant native vegetation or regrowth) on the biobank site must not be cut down, felled, thinned, logged, killed, destroyed, poisoned, ringbarked, uprooted, burnt or otherwise removed, except in accordance with item 5.2 below, or if it is required as part of the management actions or it is essential for the carrying out of permissible development under clause 3.5 of this agreement. Note: Native vegetation on the biobank site may be managed to improve biodiversity values by thinning to benchmark stem densities over no more than 80% of each management zone. Benchmark stem densities has the same meaning as defined in the Vegetation Benchmark Database as published by OEH and updated from time to time. An approval under the <i>Native Vegetation Act 2003</i> may be required to carry out thinning or any other removal or damage to native vegetation under this item.	Ongoing from commencement date.
5.2	Native vegetation on the biobank site must not be burnt except in accordance with the fire management plan prepared pursuant to item 3 above.	Ongoing from commencement date.
Item 6	Replanting or supplementary planting where natural regeneration will not be sufficient	Timing
6.1	The landowner must undertake planting or seeding of the native groundcover/shrub/tree species indicated in the planting schedule for the biobank site as set out in item 6.6 below (‘the planting schedule’) in the areas of planting and within the timeframe indicated in the planting schedule. If the landowner cannot complete the planting within the timeframe indicated in the planting schedule due to local weather conditions, the landowner must complete the planting as soon as possible after that date and must make a record of and retain the reasons why the planting was not completed by the required time. Appropriate site treatment (e.g. weed control) of each area of planting or seeding identified in the planting schedule must be undertaken prior to such planting. Specific requirements: <ul style="list-style-type: none"> • Replanting will be undertaken by a licensed bush regenerator. The requirements outlined below provide a guide only, with replanting to be guided by the bush regenerator dependent on site specific conditions. • Intensive weed control works must be undertaken prior to any supplementary planting. • Site preparation works, including weed control prior to planting that will be undertaken to assist in establishment of plants. • Replanting will utilise species and planting densities outlined in the planting schedule (Section 6.6). • Supplementary planting will be undertaken in areas of low condition vegetation where there is currently a dense infestation of Mysore Thorn <i>Caesalpinia decapetala</i>. 	Commencing from first payment date .

	<p>These area will include, management zones MZ06, MZ10 and MZ11 along the southern boundary and management zones MZ08, MZ09 and MZ11 along Brandy and Water Creek.</p> <ul style="list-style-type: none"> • The planting will be part of an integrated regeneration strategy that will stage weed removal and focus on planting pioneer species to assist staged removal by providing fast shade cover to provide light competition. Areas of Brandy and Water creek will also include limited shrub under planting to be consistent with flood planning requirements.. • Other supplementary planting will be undertaken in management zones MZ08 and MZ09 where mechanical treatment and follow up treatment are less access restricted. • Supplementary planting may be required in other areas of moderate / good condition vegetation where there is a dense infestation of weeds, if natural regeneration is not successful. • If following initial weed control erosion becomes an issue jute mesh may be required to assist in stabilising soils. <p>Include details regarding site treatment that must be undertaken before planting each area under the 'Specific requirements'.</p> <p>Planting or seeding is only required where natural regeneration is not sufficient to bring back native vegetation.</p> <p>Where no replanting is required, delete the words in every point of this item (but retain the numbering) and replace with: 'This item is not applicable.'</p>	
6.2	<p>Areas of planting or seeding as set out in the planting schedule must be protected from grazing for the first 3 years after planting or seeding or until the plants exceed 300 cm in height to ensure that the plants are established to such an extent that biodiversity values will be improved by such grazing and the plants will not be adversely impacted by grazing.</p> <p>Once that date or height has been met, grazing in the areas of planting or seeding must be managed in accordance with items 1.1, 1.2 and 1.4 of this Section 1.</p> <p>The landowner must make a record of the date when the date or height requirement under this item is reached and the particular area of replanting in which it has been reached, and maintain that record in accordance with the record keeping requirements.</p> <p>Specific requirements:</p> <ul style="list-style-type: none"> • During initial establishment of pioneer species wire caging will be provided to prevent impacts from deer and other herbivores. <p>If required, different years or heights for specific types of plants can be listed under 'Specific requirements'.</p>	Ongoing from the completion of planting in each area of replanting.
6.3	<p>The landowner must survey each area of planting or seeding established under item 6.1 above and document them to determine whether the planted plants or seeds have established and survived, and retain the findings in accordance with the record keeping requirements.</p> <p>If, after the first survey or subsequent surveys, the establishment</p>	Conduct the first survey 24 months after the completion of planting or seeding in each area of planting or seeding, and then

	and survival rate of plants in an area of planting or seeding are below those usual for the species and region, the landowner must supplement the planting in the adversely affected areas within a reasonable timeframe (usually within 12 months, though this can be varied and recorded in a diary with reasons for variation, if the weather is unsatisfactory for the establishment and survival of plants or seeds).	every 12 months thereafter.
6.4	Areas of planting and seeding must be managed as required to assist the establishment and survival of native plant species. Management includes watering, slashing, scalping, spraying of weeds, plant replacement and strategic grazing by stock (in accordance with item 6.2 above) at strategic times of the year to control weeds to improve biodiversity values. The dates of planting must be recorded in accordance with the record keeping requirements set out in Annexure D.	As required, from the date that planting or seeding areas are established.
6.5	Seeds and plants used for planting and seeding must be obtained from locally collected provenances, unless there are reasons to do otherwise (e.g. to ensure genetic variability or for adaptation to climate change).	As required (from commencement date if relevant to prepare for future planting).

The planting schedule should be filled in including:

- **number of plants per area** – for tubestock, the number of plants should be rounded to the nearest 100 if there are more than 1,000 plants or to the nearest 10 if there are 1,000 plants or less; if direct seeding is used leave this field blank
- **planting method** – specify whether plants are to be tubestock, direct seeding or another method
- **timing** – describe as the number of months (or Year if relevant (ie Year 1, Year 2, etc)) for completion of planting from the first payment date.

6.6 Planting schedule at the biobank site

Species' common name	Species' scientific name	Management zone/s of planting	Number of plants per area	Planting method	Timing (months or Year)
In areas of Mysore Thorn control					
Maidens Wattle	<i>Acacia maidenii</i>	MZ06, MZ08, MZ09, MZ10, MZ11	1 per 100m ²	Tubestock	Within 3 months following initial control.
Coast White Box	<i>Eucalyptus quadrangulata</i>				
Wollongong Woollybutt	<i>Eucalyptus saligna</i> x <i>botryoides</i>				
Morton Bay Fig	<i>Ficus microphylla</i>				
Native Rosella	<i>Hibiscus heterophyllus</i>				
White Cedar	<i>Melia azedarach</i>				
	<i>Melicope micrococca</i>				

Red Cedar	<i>Toona ciliata</i>				
General supplementary planting					
Weeping Grass	<i>Microlaena stipoides</i> var. <i>stipoides</i>	All zones	10 per m2	Broadcast seed collected from site	During extended rainfall in spring, summer and autumn
	<i>Carex longebrachiata</i>	MZ08 and MZ09 (Brandy & Water Creek – eastern end)	1 per m2	Tubestock or hiko cell	Year 2, spring and autumn
Tussock Grass	<i>Poa labillardiere</i>				
Kangaroo Grass	<i>Themeda triandra</i>				
Spiny-headed Mat-rush	<i>Lomandra longifolia</i>				
Many-flowered Mat-rush	<i>Lomandra multiflora</i>				
	<i>Juncus usitatus</i>				
Knobby Club-rush	<i>Ficinia (Isolepsis) nodosus</i>				
Blue Flax-lily	<i>Dianella caerulea</i>				
Scented Rosewood	<i>Synoum glandulosum</i>				
Orange Thorn	<i>Pittosporum multiflorum</i>				
Native Bleeding Heart	<i>Homalanthus populifolius</i>				

Item 7	Retention of dead timber	Timing
7.1	<p>Dead timber (whether standing or fallen and including branches and leaf litter) must not be removed from or moved within the biobank site except for the personal (non-commercial) use by the landowner for firewood for one dwelling only or for repair of fencing (not for construction of fencing).</p> <p>Dead timber used for fencing repair must be documented by the landowner in writing and records must be kept in accordance with the record keeping requirements. The landowner must record the approximate amount of dead timber collected from the biobank site for use in fencing, the location that that dead timber was collected from and the date it was collected (month, year).</p>	Ongoing from commencement date.
7.2	<p>Timber from outside the biobank site may be introduced to and placed on the biobank site to improve biodiversity values. Once the timber has been brought onto the site, it is subject to the requirements of item 7.1 above.</p> <p>Timber brought from outside the biobank site must be documented by the landowner in writing and records must be kept in accordance with the record keeping requirements. The landowner must record the approximate amount of timber brought from outside the biobank site, the location where the timber was placed on the biobank site and the date on which it was placed (month, year).</p>	When required but not required before the first payment date.
Item 8	Erosion control	Timing
8.1	<p>All reasonable steps must be undertaken to prevent, control and remedy erosion on the biobank site.</p> <p>Soil management for preventing and controlling erosion is to be undertaken using best practice management, such as that developed by the Soil Conservation Service, applied as relevant for the biobank site.</p>	Commencing from first payment date.
	If there is no existing erosion, delete the last paragraph.	

Item 9	Retention of rocks	Timing
9.1	The landowner must not remove, or cause or permit to be removed, rocks from the biobank site or move, or cause or permit to be moved, rocks within the biobank site.	Ongoing from commencement date.
9.2	Rocks from outside the site may be placed on the biobank site to improve habitat for threatened species. Rocks, once placed on the biobank site, are subject to item 9.1 above. The landowner must make and retain records of the location of the rocks placed on the site and the date the rocks were brought onto the site in accordance with the record keeping requirements.	When required but not required before the first payment date.

Section 2: Additional management actions

Additional management actions should only be completed when they are required for creating ecosystem credits or species credits. This will be stated on the Biobanking Agreement Credit Report.

Complete the required fields for any additional management actions required for your site. Leave all other additional management actions and OEH will delete them before including this section in your draft biobanking agreement.

Additional management actions		
Item 10	Control of feral and overabundant native herbivores	Timing
10.1	<p>The landowner must implement, and at all relevant times, comply with the management plan to control feral and overabundant native herbivores included in Section 4 (or such updated management plan as has been approved by the Director General under item 10.2 below) (‘the feral and overabundant native herbivores management plan’). To allow for adaptive management, minor alterations can be made to the implementation of the feral and overabundant native herbivores management plan, which must be recorded in writing in accordance with Section 3 of this Annexure.</p> <p>Note: A licence under Section 121 of the <i>National Parks and Wildlife Act 1974</i> may be required to control overabundant native herbivores.</p>	Ongoing from first payment date.
10.2	<p>The feral and overabundant native herbivores management plan must be reviewed at intervals of no less than 4 years and no more than 6 years. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review.</p> <p>Where the Director General determines from the review that an update of the feral and overabundant native herbivores management plan is required, the Director General will notify the landowner in writing that an update of the plan is required and the landowner must update the plan and submit the amended plan to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must cover the matters outlined below and any additional matters specified by the Director General in writing:</p> <ul style="list-style-type: none"> • a description of the feral or overabundant native herbivore/s • consideration of relevant current OEH and other pest management programs and methods • the method/s for feral and overabundant native herbivore control in each management zone, determined in accordance with best 	Ongoing from first payment date.

	<p>practice management</p> <ul style="list-style-type: none"> the frequency and timing of the control actions in each management zone methods for monitoring the success of the pest control actions a timetable and measures for inspections to identify new feral or overabundant native herbivores that may adversely affect biodiversity values on the biobank site additional control actions to destroy or remove any new feral and overabundant native herbivore pest species that occur on site measures for assessing and reporting monitoring results a diary for recording actions taken in accordance with the feral and overabundant native herbivores management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary. 	
Item 11	Vertebrate pest management – Rusa Deer and Red Fox	Timing
11.1	<p>The landowner must implement, and at all relevant times, comply with the vertebrate pest management plan included in Section 4 (or such updated vertebrate pest management plan as has been approved by the Director General under item 11.2 below) (the vertebrate pest management plan). To allow for adaptive management, minor alterations can be made to the implementation of the vertebrate pest management plan, but these must be recorded in writing in accordance with Section 3 of this Annexure.</p>	Ongoing from first payment date.
11.2	<p>The vertebrate pest management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the review commencement must be provided to the Director General in writing within 14 days of the commencement. The findings of the review must be submitted to the Director General within 3 months of commencing the review.</p> <p>Where the Director General determines from the review that an update of the plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must cover the matters outlined below and any additional matters specified by the Director General in writing:</p> <ul style="list-style-type: none"> a description of the target fauna species e.g. pigs, foxes or other species such as feral dogs or goats consideration of relevant current OEH and other pest management programs the method/s of vertebrate pest control in each management zone determined in accordance with best management practice the frequency and timing of vertebrate pest control actions in each management zone 	Ongoing from first payment date.

	<ul style="list-style-type: none"> • methods for monitoring the success of vertebrate pest control actions • a timetable and measures for inspections to identify new vertebrate pest species that may negatively impact on threatened species on the biobank site • additional vertebrate pest control actions to destroy or remove any new vertebrate pest species that occur on-site • measures for assessing and reporting monitoring results • a diary for recording actions taken in accordance with the vertebrate pest management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative actions) and reasons for the minor alterations must be recorded in the diary. 	
Item 12	Nutrient control	Timing
12.1	Fertilisers, pesticides and herbicides must not be applied on the biobank site, except where required to undertake the management actions. Use of fertilisers for establishing native vegetation through planting or seeding, use of herbicides for controlling weeds or use of pesticides for controlling vertebrate pests or feral herbivores can be undertaken in accordance with best practice management when required to undertake the management actions.	Ongoing from commencement date.
Item 13	Control of exotic fish species	Timing
13.1	<p>Appropriate management actions must be conducted to suppress or control non-native fish species specify which non-native fish in waterways and water bodies specify which waterways and water bodies on the biobank site in accordance with best practice management.</p> <p>Specific requirements:</p> <p>_____x</p>	Ongoing from first payment date.
Item 14	Maintenance or reintroduction of natural flow regimes	Timing
14.1	<p>All artificial structures on waterways or waterbodies on the biobank site identified in the map entitled insert exact name of any existing structures map or other relevant map dated dd/mm/yyyy as requiring filling or removal in order to restore the natural flows must be removed or filled.</p> <p>All management actions associated with this item must be conducted in accordance with best practice management practice at the time.</p> <p>Specific requirements:</p> <p>_____x</p>	Commencing from first payment date.
14.2	All necessary rehabilitation resulting from the removal of artificial	Within xx months of the

	<p>structure/s referred to in item 14.1 must be undertaken.</p> <p>All management actions associated with this item must be conducted in accordance with best practice management.</p> <p>Specific requirements:</p> <p> x</p>	<p>date an artificial structure is removed.</p>
14.3	<p>Artificial structures such as dams or levee banks that impede the natural flow regimes on the biobank site must not be constructed unless approved by the Director General in writing for the purpose of restoring natural flows.</p>	<p>Ongoing from commencement date.</p>

Section 3: Standard management plans

Completing the compulsory weed management plan

A table is provided below for the integrated weed management plan. Add additional sections to the table if required.

The plan must include, but is not limited to:

- a description of the target weed/s at the biobank site and their location/s, linked to each management zone where weeds are present
- the method/s of weed control in each management zone
- the frequency of weed control activities at the site, taking into account management practices where weeds are providing habitat for native species
- the timing of any planting of native plant species required in each management zone to provide alternative habitat for native species affected by weed control activities
- methods for monitoring weed control activities
- reporting and assessing the results from monitoring
- a timetable/measures for inspections to identify new weed species or exotic plant species (including noxious weeds under the *Noxious Weeds Act 1993*)
- a diary for recording actions taken in accordance with the integrated weed management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.

When the management plan is reviewed (see item 2.2), weed control activities may be amended, deleted or added to take into account the weed species on the site at that time.

Weed management plan

The weed types, description and location (management zone/s) of weed infestations existing at the commencement date are listed in the weed management plan. The methods of weed control (management actions), monitoring and inspections are also listed.

The landowner must perform the methods of weed control and other weed management activities and monitoring in the weed management plan by the methods described (and in accordance with item 2 of this Annexure) for all weeds. The methods of control will apply to the weeds listed in the table below as well as any other weeds that may be present on the site from time to time.

The template for reporting of monitoring activities and the diary template for weed control management must be filled in to record observations during the implementation of the weed management plan, including any minor variations.

Weed types				
Weed	Common name of target weed	Scientific name of target weed	Description of infestation (eg intensity (% cover) & location within zone)	Management zone/s
	Turkey Rhubarb	<i>Acetosa sagittata</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >5% cover along American Creek in south-east of the BioBank site. 	All MZ10, MZ11
	Crofton Weed	<i>Ageratina adenophora</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >5% cover along American Creek in south-east of the BioBank site. 	All MZ10, MZ11
	Mistflower	<i>Ageratina riparia</i>	<5% cover at spot locations in all management zones.	All
	Madeira Vine	<i>Anredera cordifolia</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >5% cover in MZ10 and MZ11 in southeast, and also MZ09 in north east of BioBank site. 	All MZ08, MZ09, MZ10, MZ11
C	Moth Vine	<i>Araujia sericifera</i>	<5% cover at spot locations in all management zones.	All
	Ground Asparagus	<i>Asparagus aethiopicus</i>	<5% cover at spot locations in all management zones.	All
	Mysore Thorn	<i>Caesalpinia decapetala</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >10% cover in MZ10 and MZ11 in southeast of BioBank site. >50% cover in MZ06, MZ10 and MZ11 along banks of American Creek in southeast of BioBank site. >50% cover in MZ08 and MZ09 along banks of Brandy and Water Creek in northern section of the BioBank site. >50% cover in MZ06 in northeastern section of the BioBank site. 	All MZ06, MZ08, MZ09, MZ10, MZ11
	Hackberry	<i>Celtis occidentalis</i>	<5% cover at spot locations in all management zones. Target large established trees in MZ06 to reduce weed recruitment following weed	All MZ06

			control.	
	Green Cestrum	<i>Cestrum parqui</i>	<5% cover at spot locations in all management zones. Targeted through the northern edge of MZ06.	All MZ06
A	Cape Ivy	<i>Delairea odorata</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >5% cover in MZ10 and MZ11 in southeast of BioBank site. 	All MZ10, MZ11
	Coral Tree	<i>Erythrina x sykesii</i>	<5% cover along American Creek in south-east of the BioBank site. Particular infestation in: <ul style="list-style-type: none"> >50% canopy cover in MZ08 and MZ09 along Brandy & Water Creek 	Creeklines
	Narrow-leaved Cotton Bush	<i>Gomphocarpus fruticosus</i>	<5% cover at spot locations in all management zones.	All
	Lantana	<i>Lantana camara</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >50% cover in MZ06, MZ09, MZ10 and MZ11 in southern section of the BioBank site. >50% cover in MZ06 in the northern section of the BioBank site. 30-50% cover in MZ03, MZ05, MZ06, MZ07, MZ09, MZ10 and MZ11 in the northern section of the BioBank site. Minor cover along the edge of MZ10 in northern section of the BioBank site. 	All MZ03, MZ05, MZ06, MZ07, MZ09, MZ10, MZ11
	Large-leaved Privet	<i>Ligustrum lucidum</i>	<5% cover at spot locations in all management zones. Particular infestation of mature trees in MZ06 south of access track, within moist gullies.	All
	Small-leaved Privet	<i>Ligustrum sinense</i>	>5% cover along American Creek in south-east of the BioBank site.	
D	Red-flowered Marrow	<i>Modiola caroliniana</i>	<5% cover at spot locations in all management zones.	All
	African Olive	<i>Olea europaea subsp. cuspidata</i>	<5% cover at spot locations in all management zones. Spot location large mature bush near rubbish in MZ03.	All

E		<i>Senna pendula</i> var. <i>glabrata</i>	<5% cover at spot locations in all management zones.	All
	Arsenic Bush	<i>Senna septemtrionalis</i>	<5% cover at spot locations in all management zones.	All
	Wild Tobacco Bush	<i>Solanum mauritianum</i>	<5% cover at spot locations in all management zones.	All
B	Madeira Winter	<i>Solanum pseudocapsicum</i>	<5% cover at spot locations in all management zones.	All
	Wandering Jew	<i>Tradescantia fluminensis</i>	<5% cover at spot locations in all management zones. Particular infestation in: <ul style="list-style-type: none"> >5% cover in MZ10 and MZ11 in southeast of BioBank site. 	All MZ10, MZ11
Methods of weed control				
Management zone/s	Weed/s	Method of weed control		Frequency (months or Year)
All	All	Staged weed removal works undertaken by a qualified bush regenerator over a 4 – 5 year period (20% reduction in cover per year). This will include weed removal and replanting focusing on areas with heavy weed infestations, including areas with a greater than 30% cover of Lantana.		Years 1 to 5
MZ09, MZ10 and MZ11	Mysore Thorn	Specific control activities will include establishing weed free corridors at 10 m spacings (corridor width ~4m) using manual or mechanical control dependent on accessibility.. Revegetation will be undertaken using pioneer species listed within Section 6.6 at 1 per 100 m ² to integrate passive control measures (shade competition). Weed control will include spot spraying of corridor edges and natural assisted regeneration corridor groundcover. Spot spray and mechanical control not allowed within 10 m of White-wax Flower <i>Cynanchum elegans</i> .		Years 1 to 5
All	All	Tri-annual maintenance inspections by a qualified bush regenerator.		Year 6 onwards
All		<u>Control of Woody Weeds</u> Mechanical or manual control in steep areas undertaken by a qualified bush regenerator (mechanical plant to have rubberised tracks). Spot spray using appropriate herbicide by suitably qualified contractor outside of riparian buffers as per herbicide directions. Manual control within riparian zone.		During maintenance inspections outlined above.

		Spot spray and mechanical control not allowed within 10 m of White-wax Flower <i>Cynanchum elegans</i> .	
All	All	<p><u>Control of Perennials/ Scrambling Weeds</u></p> <p>Individual plants/ small numbers: Manual removal of any fruits or propagules present on plants prior to manual removal or spraying. Manual removal of woody rhizomes for herbaceous perennials for each plant. This can be done using a knife for small plants or a mattock for large specimens. Rhizomes and fruit must be removed and disposed of appropriately. Water tubers are not propagules and do not require removal.</p> <p>Larger infestations: Spot spraying by a suitable qualified bush regenerator with an appropriate herbicide outside of riparian buffers as per herbicide directions.</p> <p>Spot spray and mechanical control not allowed within 10 m of White-wax Flower <i>Cynanchum elegans</i>.</p>	During maintenance inspections outlined above.
All	All	<p><u>Control of Annual and Grass Weeds</u></p> <p>Small areas or numbers: Manual removal of any seed heads present on plants, with seed heads taken offsite and disposed of appropriately. Plants can be manually removed by hand or cutting roots below crown.</p> <p>Large areas or numbers: Spot spraying of plants with diluted Glyphosate based herbicide outside of riparian buffers as per herbicide directions.</p> <p>Spot spray and mechanical control not allowed within 10 m of White-wax Flower <i>Cynanchum elegans</i>.</p>	During maintenance inspections outlined above.
All	All	<p><u>Control of Vines</u></p> <p>Manual control of vines without aerial tubers:</p> <p>Cut stump and herbicide application or hand pull vines, leave in canopy to break down to avoid disruption of nesting or canopy damage. Scrape and paint with herbicide for vines with suckering rootstocks. Follow-up control to inspect area for successful control of large plants and assess for suckering rootstocks and re-treatment.</p> <p>Manual control of vines with aerial tubers: Remove plants parts, as far as practicable, do not spread across BioBank site. Dispose of this material to a registered waste disposal facility. Follow-up control: Manual removal of tubers with small mattock or trowel. Spot spray – Qualified contractors can spray with diluted Glyphosate or appropriate selective herbicide (Starane) outside of riparian buffers as per herbicide directions.</p> <p>Repeated follow up treatment will be required to eradicate infestation vines with aerial tubers present within the soil.</p> <p>Spot spray and mechanical control not allowed within 10 m of White-wax Flower <i>Cynanchum elegans</i>.</p>	During maintenance inspections outlined above.
Native planting required to provide habitat for native species affected by weed control activities			

Management zone	Description of planting required (reference planting schedule at item 6.6)	Timing	
Areas with a dense infestation of Mysore Thorn in MZ10 and MZ11	Revegetation of areas with a dense weed infestation of Mysore Thorn in management zones MZ09, MZ10 and MZ11. Supplementary planting with a mixture of rainforest species such as Red Cedar <i>Toona ciliata</i> , Maiden's Wattle <i>Acacia maidenii</i> , <i>Melicope micrococca</i> , Giant Stinging Tree <i>Dendrocnide excelsa</i> , Small-leaved Fig <i>Ficus obliqua</i> and White Cedar <i>Melia azedarach</i> .	At completion of initial weed control.	
Areas with a dense infestation of Mysore Thorn in MZ08 and MZ09	Revegetation of riparian areas with a dense weed infestation of Lantana & Mysore Thorn in management zones MZ08 and MZ09. Supplementary planting with a mixture of suitable species such as listed above. Undertaken if natural regeneration is not successful.		
Monitoring and inspections of existing and new weeds			
Management zone/s	Weed/s	Method of monitoring	Date/s required
All	All	Maintenance inspections by a qualified bush regenerator. Maintenance inspections must document the following: <ul style="list-style-type: none">The results of inspections, including any new weeds recorded, the results of previous weed control works and any rubbish of pedestrian access issues.Describe works undertaken to implement weed control works or address other identified issues.	As per schedule outlined above.
All	All	Annual review of the BioBank site by a qualified ecologist. During annual inspections the following information will be collected: <ul style="list-style-type: none">A review of weed control undertaken, and an assessment of the projective foliage cover of weeds using the BioBanking Assessment Methodology (OEH 2014).A description of the presence, type and abundance of weeds and comparison against weed cover outlined in this management plan and previous annual inspections.A description of any regenerating vegetation, including overstorey, midstorey and groundcover species.Any issues that need to be addressed during future weed control works. This information is to be included within the annual report.	Annually from the first payment date
Other weed management activities (where required)			
All White-flowered Wax Plants <i>Cynanchum elegans</i> will be relocated, verified and flagged /			

--

[illegible][illegible]

Completing the compulsory fire for conservation management plan

A table is provided below for the fire conservation management plan. Add additional sections to the table if required. The plan must include, but is not limited to:

- a map of the vegetation on the biobank site (with date) and any infrastructure and built assets on the biobank site (the map to be included in the biobanking agreement)
- the year the last fire went through, the type of fire and the extent of the fire and location, where known
- frequency of natural fires in the area of the biobank site, where known
- a description of locations and management zones where ecological burns will be conducted and areas that will not be burnt
- the methods that will be used for ecological burns
- the fire frequency intervals recommended for the vegetation types and threatened species present, including any required adjustment to the schedule in the event of a wildfire or activities undertaken under the *Rural Fires Act 1997* to ensure minimum frequency between ecological burns
- the fire intensity for the recommended vegetation types
- the time of year suitable for ecological burns
- methods for monitoring the outcomes of ecological burns
- reporting and assessing the results from monitoring
- the diary for recording actions taken in accordance with the fire management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary in accordance with the record keeping requirements.

Fire for conservation management plan

The plan includes information on all known previous fire events in the 'Fire history' table to demonstrate local fire conditions including intensity and frequency.

The ecological fire requirements for each vegetation type or threatened species on the biobank site are listed in the 'Fire requirements for vegetation types and threatened species' table. These are the fire frequency intervals recommended for the vegetation types and threatened species present on the biobank site. They include any requirement adjustments to the schedule in the event of a wildfire or activities undertaken under the *Rural Fires Act (RFA) 1997* to ensure the minimum frequencies between ecological burns.

The landowner must carry out ecological burns for each management zone according to the method and frequency described (as informed by the history and requirements sections and in accordance with Section 3 of this annexure). These actions are set out in the 'Ecological burning actions table'. Monitoring and inspections (set out in the 'Fire management monitoring' table) as described must also be implemented. The landowner must also carry out the actions listed in the 'Other fire management activities' table.

The table titled 'Template of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of monitoring activities. The landowner must also complete the table titled 'Diary template for fire management activities' to record the management actions undertaken or observations made, including any minor variations.

Fire history for previous 20 years (or longer if known)				
Year of fire	Hazard reduction, wildfire or ecological burn and extent of fire			Management zone/s
	No fire history in past 20 years			
Fire requirements for vegetation types and threatened species				
Vegetation type and/or threatened species	Fire frequency required ¹	Time of year for burning	Fire intensity required	Adjustment required due to wildfires or RFA activities
SR545 – Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	5 – 40 years, with some intervals greater than 15 years	All year, ensuring a mosaic of seasonal burning	Low to moderate, ensuring a mosaic of fire intensity	Not applicable
SR652 – Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	25 – 60 years, with crown fires avoided at the lower end of the fire interval	All year, ensuring a mosaic of seasonal burning	Low to moderate, ensuring a mosaic of fire intensity	Not applicable
SR662 – Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Fire to be avoided	Not applicable	Not applicable	Not applicable
White-flowered Wax Plant <i>Cynanchum elegans</i>	Fire to be avoided	Not applicable	Not applicable	Not applicable
Ecological burning actions				
Management zone/s	Actions	Supervision & extinguishing techniques	Time of year for burning	Frequency (years)
All	Given the proximity to residential development and presence of Whalebone Tree - Native Quince dry subtropical rainforest and the White-flowered Wax Plant it is recommended that fires are suppressed within the Biobank site.	Not applicable	Not applicable	Not applicable

¹ NPWS 2004. Guidelines for ecologically sustainable fire management. NSW biodiversity strategy. NSW National Parks and Wildlife Service, Hurstville.

[illegible]

--	--	--	--

Section 4: Additional management plans

If required, complete this control of feral and overabundant native herbivores management plan

A table is provided below for the management plan to control feral and overabundant native herbivores. Add additional sections to the table if required. The plan must include, but is not limited to:

- a description of the feral or overabundant native herbivore/s
- consideration of relevant current OEH and other pest management programs and methods
- the method/s for feral and overabundant native herbivore control in each management zone, determined in accordance with best practice management
- the frequency and timing of the control actions in each management zone
- methods for monitoring the success of the pest control actions
- reporting and assessing the results from monitoring
- a timetable and measures for inspections to identify new feral or overabundant native herbivores that may adversely affect biodiversity values on the biobank site
- a diary for recording actions taken in accordance with the management plan to control feral and overabundant native herbivores and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.

When the management plan is reviewed (see item 10.2 in Section 1), control activities may be amended, deleted or added to take into account the feral and overabundant native herbivore on the site at the time.

Management plan to control feral and overabundant native herbivores

The management plan for feral and overabundant native herbivores includes information on the management requirements for the feral and overabundant native herbivores at the biobank site listed in the 'Feral and overabundant native herbivores' table. The possible methods of control for each species, used by OEH and other pest management programs, are listed and the suitability of each method is described in the 'Methods considered' table.

The landowner must carry out the methods for control for feral and overabundant native herbivores for each management zone according to the method and frequency as described in the 'Methods for control' table. The methods of control applied to the feral or overabundant native herbivores listed in the 'Feral or overabundant native herbivores' table as well as any other feral or overabundant herbivores that may be present on the site from time to time.

Monitoring and inspections of existing and new feral and overabundant herbivores at the biobank site as described in the 'Monitoring and inspections' table must be implemented.

The table titled 'Template for reporting of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of the monitoring activities. The landowners must complete the table titled 'Diary template for feral and overabundant herbivore management' to record the management actions undertaken including any minor variations or observations made.

Feral and overabundant native herbivores			
Feral type	Name of feral/overabundant native herbivore	Description of extent	Management zone/s
A			
B			
C			
D			
E			

Methods considered		
Feral type	Name and description of program or method	Describe suitability

Methods of control			
Management zone/s	Feral type	Method of control	Frequency and timing

Monitoring and inspections			
Management zone/s	Feral type/s	Method of monitoring	Date/s required

Template for reporting of monitoring activities

[illegible]

Date of activity	Management zone/s	Description and type of activity undertaken This column must include details of the feral and overabundant herbivores targeted, control techniques applied and numbers controlled.	Minor variations (details and reasons)
------------------	-------------------	---	---

[illegible]

If required, complete this vertebrate pest management plan

A table is provided below for the vertebrate pest management plan. Add additional sections to the table if required. The plan must include, but is not limited to:

- a description of the target fauna species e.g. pigs, foxes or other species such as feral dogs or goats
- consideration of relevant current OEH and other pest management programs
- the method/s of vertebrate pest control in each management zone determined in accordance with best management practice
- the frequency and timing of vertebrate pest control actions in each management zone
- methods for monitoring the success of vertebrate pest control actions
- reporting and assessing the results from monitoring
- a timetable and measures for inspections to identify new vertebrate pest species that may negatively impact on threatened species on the biobank site
- a diary for recording actions taken in accordance with the vertebrate pest management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative actions) and reasons for the minor alterations must be recorded in the diary in accordance with the requirements.

All pest species identified as requiring management on a biobank site must be included in the vertebrate pest management plan.

Separate management plans can be developed for each pest species.

When the management plan is reviewed (see item 11.2 in Section 1), control activities may be amended, deleted or added to take into account vertebrate pest species found on the site at that time.

Vertebrate pest management plan

The management plan for vertebrate pests includes information on the vertebrate pests and their extent existing at the time of the agreement as listed in the 'Vertebrate pests' table. The possible methods of control for each species, used by OEH and other pest management programs are listed and the suitability of each method to the biobank site is described in the 'Methods considered' table.

The landowner must carry out the methods for vertebrate pest control for each management zone according to the method and frequency described in the 'Methods of control' table. The methods of control will apply to the vertebrate pests listed in the 'Vertebrate pests' table as well as any other vertebrate pests that may be present on the site from time to time.

Monitoring and inspections of existing and new vertebrate pests on the biobank site, as described in the 'Monitoring and inspections' table, must be implemented.

The table titled 'Template for reporting of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of monitoring activities. The landowner must also complete the 'Diary template for vertebrate pest management' to record the management actions undertaken, including any minor variations, and observations made.

Vertebrate pests

Pest	Name of vertebrate pest (e.g. pig, fox, goat, dog)	Description of extent	Management zone/s
A	Rusa Deer <i>Rusa timorensis</i>	Deer are abundant within the BioBank site, causing extensive damage to vegetation.	All
B	Red Fox <i>Vulpes vulpes</i>	None recorded – assumed.	All
Methods considered			
Pest type	Name and description of program or method ²³	Describe suitability	
A	Ground-based shooting	<p>High.</p> <p>Ground-based shooting is considered the cost-effective method for deer control for the site, particularly if undertaken as a part of a coordinated program across the local area. This will allow control of deer within and moving into the BioBank site.</p> <p>The site is currently part of the Northern Illawarra Deer Management Program, managed by Local Land Services (LLS). This control method will require an ongoing contribution to the Northern Illawarra Deer Management Program.</p>	
A	Fencing	<p>Low.</p> <p>Fencing required to prevent deer accessing the site must be a minimum of 2 metres in height and dug into the ground to prevent deer pushing under the fence. Over 2.7 kilometres of deer fencing would need to be constructed to minimise access for deer.</p> <p>The installation of deer proof fencing sufficient to prevent access by deer would be extremely costly. Furthermore, fencing of the BioBank site to prevent deer entering the site will also prevent other ground-dwelling fauna species moving through and impact on connectivity values of the site.</p>	
A	Trapping and relocation	<p>Low.</p> <p>This method may be used in conjunction with other methods, but the success is unknown and is likely to be quite costly. In addition, prior to any trapping a deer farm willing to accept any deer would need to be identified.</p> <p>This method should be used in conjunction with other methods, such as fencing, when deer number increase.</p>	
A	Trapping and culling	<p>Undetermined.</p> <p>This method is being investigated by Council and the CLHPA. At this stage, it is not considered feasible for the BioBank site for the reason outlined above under shooting.</p>	
B	Shooting	<p>Low.</p> <p>Given the proximity of the BioBank site to residential development</p>	

² DPI 2014. Biology, ecology and management of vertebrate pests in NSW. State of New South Wales through Department of Trade and Investment, Regional Infrastructure and Services 2014

³ WCC 2013. Pest Management Plan 2013-2014 – Deer. Wollongong City Council.

		this method of control is deemed undesirable, particularly given other available techniques.	
B	Baiting using 1080 poison	Moderate. Most effective method for control. However, there is a risk to humans and domestic pets due to proximity to residential areas. In addition, this is not deemed required due to low density populations. Should monitoring identify an increase in fox density this method may be implemented in consultation with LLS.	
B	Trapping (using cage traps and leg-hold traps)	Low. Whilst this method can be effective it is time consuming and costly. Given the low density populations that may be present trapping is not required.	
B	Monitoring	High. Given Foxes were not recorded within the BioBank site this is deemed the most effective method.	
Methods of control			
Management zone/s	Pest type	Method of control	Frequency and timing
All	A	Ground-based shooting will be undertaken as a part of the Northern Illawarra Deer Management Program.	Annual
All	B	Monitoring – see below.	Annual
Monitoring and inspections of existing and new vertebrate pests			
Management zone/s	Pest type/s	Method of monitoring	Date/s required
All	A	Annual inspections of the BioBank site to determine the extent of damage by deer. The results of these inspections must be included in annual reports.	Annually
All	B	Monitoring of Fox abundance will be undertaken using unbaited remote cameras. Twenty (20) cameras will be placed out across the BioBank site for 14 nights during late summer, when independent young are expected to dispersing and adults will be active (DPI 2014). The results of monitoring will be included within the annual report. Should monitoring identify the presence of Foxes within the BioBank site additional controls will be implemented in consultation with LLS.	Annually from first payment date
Other management activities (where required)			
Nil.			

[illegible][illegible]

Photo points

This section of the management actions template is not part of *Annexure C: Management actions* but is required for *Annexure D* of the biobanking agreement which requires information relating to the placement of photo points for monitoring purposes. Fill in the table below so that this information can be included in the appropriate format in the final agreement. A map of the photo point locations is also required to be submitted.

Photo points should be positioned in areas that are likely to show change over time. Some plot locations can be used as photo points but many plot locations (especially in vegetated areas already in very good condition) may not show any change over time. Locate photo points where there will be changes because of management actions such as areas currently in low to moderate condition, targeted for revegetation and/or intensive weed control.

Photos are required to be taken every 12 months at the same location, direction, height and time of day.

Annexure D: Monitoring, reporting and record keeping requirements

1 Monitoring requirements

- 1.1 The landowner must ensure that photographs are taken at photo-points at each of the locations and in the direction identified in the table below titled 'Locations of plots and photo points' within 12 months of the commencement date and then at least every 12 months thereafter.
- 1.2 The photo points are identified on the map entitled insert **Figure 7: Management zones and management actions** dated 24/02/2016 in Annexure A of this agreement. The purpose of the photographs is to show changes over time. Photographs should be taken at approximately the same direction, location, height and time of day (during daylight hours) in each reporting period (as defined in item 2.2 of this Annexure D) and retained for the life of this agreement. All photographs must be dated, stating the direction in which they were taken and identified with their locations.

Locations of photo points			
Projected coordinate system: GDA94 Zone 56			
Photo point reference	Easting	Northing	Direction of photo (magnetic degrees)
PP01	301335.8	6187499	135 and 315
PP02	301169	6187604	90 and 270
PP03	301120	6187551	90 and 270
PP04	301030	6187626	90 and 270
PP05	300973.9	6187580	90 and 270
PP06	300909.8	6187658	0 and 180
PP07	300835.7	6187624	90 and 270
PP08	301114	6188048	135 and 315

PP09	301047.3	6188109	90 and 270
PP10	301235	6187817	135 and 315
PP11	300888.6	6188145	90 and 270
PP12	301302	6187746	45 and 225
PP13	301614.9	6187625	135 and 315
PP14	301670	6187358	90 and 270
PP15	301803	6187378	45 and 225
PP16	301213	6187715	135 and 315
PP17	301653.6	6187747	135 and 315
PP18	301811	6187556	135 and 315
PP19	300940.5	6187648	0 and 180
PP20	301132	6187935	0 and 180
PP21	300920.7	6188061	135 and 315
PP22	301278.6	6187416	135 and 315
PP23	300983.3	6188205	90 and 270
PP24	301776.2	6187453	135 and 315
PP25	301055.7	6187514	90 and 270

Appendix 4: Credit profile report

BioBanking credit report



Office of
Environment
& Heritage

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 3/03/2016

Time: 9:26:12AM

Calculator version: v4.0

Biobank details

Proposal ID: 0103/2015/2276B

Proposal name: Lots 814 & 815, Redgum Ridge BioBank Site

Proposal address: Redgum Forest Way, Figtree NSW 2525 Figtree NSW 2525

Proponent name: Edenvell Pty Ltd

Proponent address: 30 Kenny Street Wollongong NSW 2500

Proponent phone: 02 4229 8799

Assessor name: Nathan Garvey

Assessor address: 8 Tate Street WOLLONGONG NSW 2500

Assessor phone: 4229 5222

Assessor accreditation: 0103

Additional information required for approval:

- ☐ Use of local benchmark
- ☐ Expert report...
- ☐ Request for additional gain in site value

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	9.30	118.00
Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	26.87	281.00
Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	10.65	115.00
Total	46.82	514

Credit profiles

1. Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion, (SR662)

Number of ecosystem credits created	105
IBRA sub-region	Illawarra

2. Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion, (SR662)

Number of ecosystem credits created	10
IBRA sub-region	Illawarra

3. Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion, (SR652)

Number of ecosystem credits created	233
IBRA sub-region	Illawarra

4. Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion, (SR652)

Number of ecosystem credits created	48
IBRA sub-region	Illawarra

5. Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion, (SR545)

Number of ecosystem credits created	118
IBRA sub-region	Illawarra

Species credits summary

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
White-flowered Wax Plant	Cynanchum elegans	89.00	632

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Exclude commercial apiaries
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Exclude miscellaneous feral species
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Fox control
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Slashing
Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Exclude miscellaneous feral species
Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	Fox control
Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Exclude miscellaneous feral species
Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Fox control

Appendix 8: Referral



Australian Government

Department of the Environment and Energy

Referral of proposed action

Proposed action title: Lot 101 DP 785139 Crest Road, Albion Park

Prepared by: Biosis Pty Ltd.

On behalf of: MMJ Real Estate on behalf of Spinitu Pty Ltd

1 Summary of proposed action

1.1 Short description

Spinutu Pty Ltd propose to develop a residential subdivision at Lot 101 DP 785139 Crest Road, Albion Park (the 'study area'; Figure 1). The proposed development is for 71 residential lots, one environmental lot dwelling provision, associated public reserves, access roads, other public infrastructure and asset protection zones (APZ) and hereafter is referred to as the 'subject site' (Figure 1).

The study area covers a total area of 9.65 hectares. The site is located approximately 20 kilometres south-west of the Wollongong Central Business District, at the southern end of Crest Road, Albion Park, within the Shellharbour Local Government Area (LGA).

Of the 9.65 hectares of study area, residential development will impact on 7.75 ha of land, of which 4.15 hectares (total 5.75 hectares) is identified as having vegetation comprising, *Illawarra and south coast lowland forest and woodland ecological community* (Illawarra Lowlands Grassy Woodland), listed as a Critically Endangered Ecological Community (CEEC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Residual land within the study area includes an additional 1.60 ha of EPBC listed Illawarra Lowlands Grassy Woodland. See Figure 2 and Figure 6 for these boundaries. The CEEC vegetation within the study area is grazed by horses on an unrestricted basis and steep areas fenced from grazing in the east are not managed. These steep areas are mostly dominated by woody weeds.

Five White-flowered Wax Plant *Cynanchum elegans* (Endangered) will be retained within the environmental lot and managed under a site specific vegetation management plan (VMP). Four of the plants are located within the APZ and will be managed by fencing and specific controls within a 20 metre buffer.

The environmental lot (including the APZ) have the potential for Illawarra Zieria *Zieira granulata* (Endangered) to recruit from stored soil seedbanks following weed control and soil disturbance. Contingencies for managing this scenario have been provided within the VMP.

It is intended that the land that is not fully developed for residential purposes will be conserved within an environmental lot zoned as E3 – Environmental Management Zone under the *Shellharbour Local Environmental Plan 2013* (Shellharbour LEP) (Figure 3) to manage residual CEEC, threatened flora, and APZ managed CEEC in perpetuity.

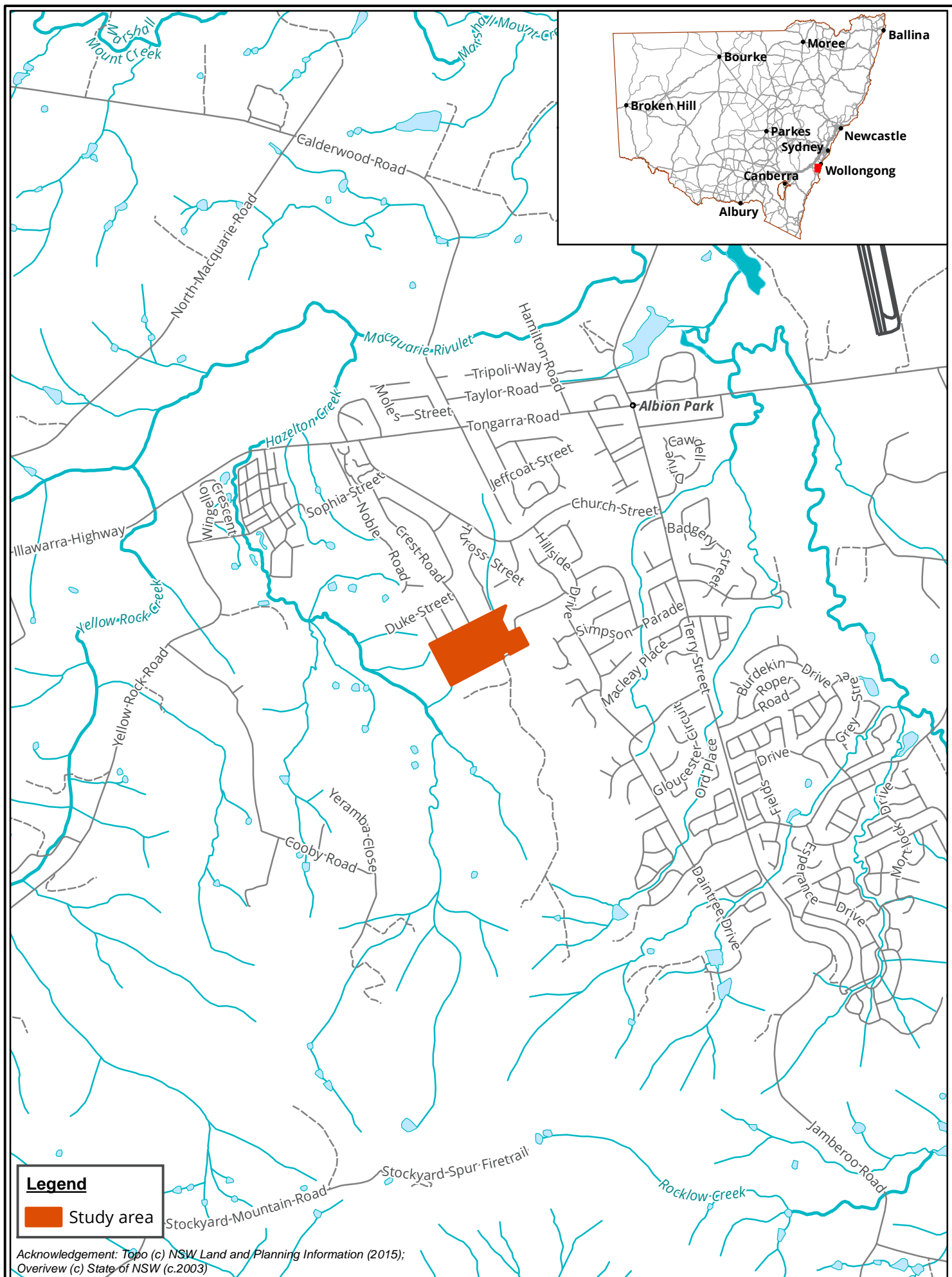
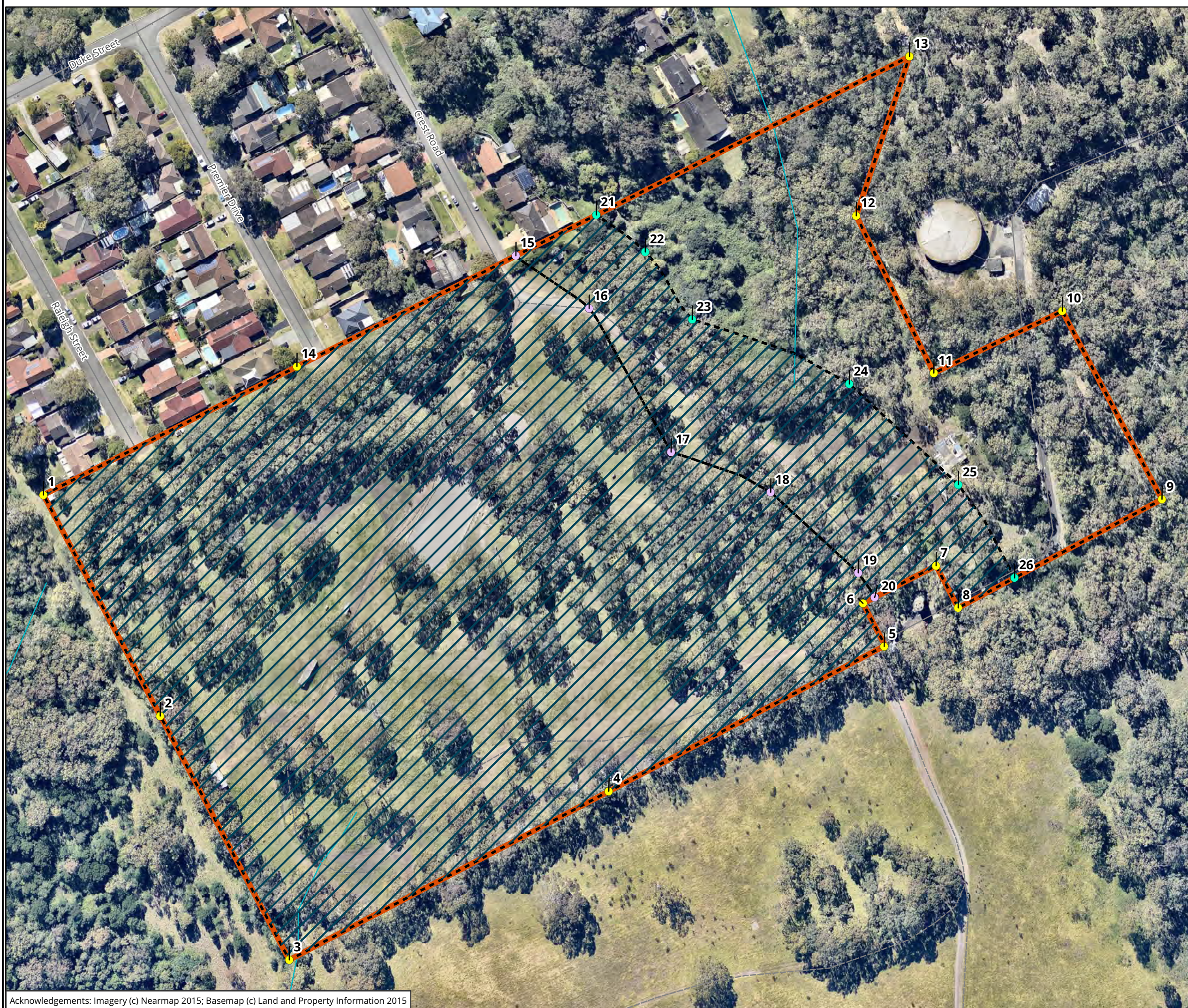


Figure 1: Location of the study area, Albion Park, NSW



Legend

- Study area
- Proposed layout
- Subject site

Coordinate vertices

- External boundary
- Internal boundary 1
- Internal boundary 2

Figure 2: Boundary points for the proposed development and subject site

0 10 20 30 40 50
Metres

Scale: 1:1,600 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 21 August 2017,
Checked by: LH, Drawn by: NMG
Location: \\bio-data-01\matters\25300s\25345\Mapping\25345_F2_PropDevSubjectSite

Latitude and longitude

Refer to Figure 2 or locations of these data points in the Table below.

	Decimal degree		Degrees, Minutes, Seconds	
	Latitude	Longitude	Latitude	Longitude
External property boundary				
1	-34.581572	150.763363	34° 34' 53.661" S	150° 45' 48.107" E
2	-34.582483	150.763914	34° 34' 56.937" S	150° 45' 50.089" E
3	-34.583487	150.764522	34° 35' 0.553" S	150° 45' 52.279" E
4	-34.582829	150.766112	34° 34' 58.186" S	150° 45' 58.004" E
5	-34.582265	150.767482	34° 34' 56.154" S	150° 46' 2.937" E
6	-34.582088	150.767383	34° 34' 55.516" S	150° 46' 2.577" E
7	-34.581941	150.767746	34° 34' 54.988" S	150° 46' 3.886" E
8	-34.582114	150.767851	34° 34' 55.612" S	150° 46' 4.262" E
9	-34.581691	150.768865	34° 34' 54.088" S	150° 46' 7.913" E
10	-34.580916	150.768395	34° 34' 51.298" S	150° 46' 6.222" E
11	-34.581157	150.767756	34° 34' 52.165" S	150° 46' 3.923" E
12	-34.58051	150.767392	34° 34' 49.837" S	150° 46' 2.612" E
13	-34.579866	150.767671	34° 34' 47.518" S	150° 46' 3.615" E
14	-34.581073	150.764624	34° 34' 51.863" S	150° 45' 52.647" E
Internal Boundary 1				
15	-34.580642	150.765713	34° 34' 50.310" S	150° 45' 56.567" E
16	-34.580863	150.766067	34° 34' 51.108" S	150° 45' 57.843" E
17	-34.581455	150.766455	34° 34' 53.238" S	150° 45' 59.239" E
18	-34.581627	150.766941	34° 34' 53.857" S	150° 46' 0.988" E
19	-34.581963	150.767362	34° 34' 55.068" S	150° 46' 2.504" E
20	-34.582064	150.767441	34° 34' 55.432" S	150° 46' 2.786" E
Internal Boundary 2				
21	-34.580483	150.766113	34° 34' 49.739" S	150° 45' 58.008" E
22	-34.580638	150.76635	34° 34' 50.298" S	150° 45' 58.861" E
23	-34.580917	150.766574	34° 34' 51.302" S	150° 45' 59.665" E
24	-34.581194	150.767339	34° 34' 52.297" S	150° 46' 2.422" E
25	-34.581613	150.767864	34° 34' 53.808" S	150° 46' 4.312" E
26	-34.581997	150.768131	34° 34' 55.190" S	150° 46' 5.273" E

1.3

Locality and property description
The study area covers a total area of 9.65 hectares and is located approximately 20 kilometres south-west of the Wollongong Central Business District, at the southern end of Crest Road, Albion Park, within the Shellharbour Local Government Area (LGA).

The subject site (located within the study area) is adjacent to low density residential development to the north, open pastoral land to the south, and remnant vegetation to the east and west.

The subject site comprises informally fenced paddocks containing scattered native trees with highly modified groundcovers and small corrugated iron structures, informal gravel access trails, and patches of existing remnant native vegetation (Figure 3).

1.4

Size of the development footprint or work area

The proposed 71 lot subdivision, including environmental lot provision and APZ and expected an expected impact of 7.75 hectares.

1.5

Street address of the site

Lot 101 DP 785139 Crest Road, Albion Park

1.6

Lot description

The study area is legally described as Lot 101 DP 785139 Crest Road, Albion Park.

1.7

Local Government Area and Council contact (if known)

The project is wholly within the Shellharbour City Council LGA.

Council's contact officer is:
Tuesday Heather
02 4221 6247
<mailto:Tuesday.Heather@shellharbour.nsw.gov.au>

1.8

Time frame

Vegetation clearance and construction works are scheduled to commence in mid-late 2018 (pending approval) and expected to take 9-12 months to complete. Particular focus will be on the establishment of a conservation area prior to construction.

1.9

Alternatives time frames, locations or activities

X

No

Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3 and 5 (where relevant).

1.11

Commonwealth, State or Territory assessment

No

X

Yes, you must also complete Section 2.5

1.12

Component of larger action

X

No

Yes, you must also complete Section 2.7

1.13

Related actions/proposals

X

No

Yes, provide details:

1.14

Australian Government funding

X

No

Yes, provide details:

1.15

Great Barrier Reef Marine Park

X

No

Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

2.1 Description of proposed action

Spinutu Pty Ltd proposes to undertake low density residential development of the study area. The housing is intended to be constructed within the subject site (Figure 3). This will require the removal of 3.06 hectares of native vegetation and modification of an additional 1.09 hectares for bushfire protection, for APZ management.

The proposed development footprint is shown in Figure 3 and will require the installation of local roads and levelling off the ground surface to provide for appropriate contours. The development will require the installation of stormwater piping and other associated infrastructure, such as electricity and water supply. The development intends to retain native trees where situated outside of dwelling envelopes, boundary fence lines, road soil cuts and recreation areas.

The installation of the APZ will require selective thinning of trees, and suppression of shrubs and ground layer within the environmental lot. All remaining vegetation east of the APZ will be retained as native vegetation and form the residual of the study area.

The development of the study area aims to conserve residual native vegetation within the eastern portion of the study area. The retained native vegetation will include residual vegetation and vegetation modified to be managed as an APZ. The retained residual and modified vegetation will also conserve endangered flora.

An indicative site layout of the development footprint is shown in **Figure 3**.

The key concepts and objectives of the development will be to:

- Permit low density residential development of 71 lots and one large environmental lot.
- Allow for establishment of an inner and outer APZ. This includes selective thinning trees and suppression of shrubs and tall ground covers to maintain low ground fuel levels. The canopy will be retained within the benchmark for this plant community type in NSW (NSW PCT838/ BVT SR545).
- Incorporate and maximise the existing landscape and topographical characteristics of the site by retaining hollow-bearing trees where feasible and safe to do so.
- Retain residual native vegetation, provide ongoing planning controls within an E3 – Environmental Management LEP zone, and enhance biodiversity and sensitive habitats through the implementation of a VMP.
- Protect threatened flora through fencing where appropriate, targeted weed control and landholder monitoring.
- Provide nest boxes for specific fauna types in retained vegetation to compensate for lost habitat in the form of hollow-bearing trees.

A summary of the proposed impacts are provided in Table 1.

Table 1: Areas of native vegetation and impacts due to the proposed works

Vegetation community	Subdivision (ha)	APZ (ha)	Total impact (ha)	E3 Retained Vegetation (ha)	Grand Total
Illawarra Lowlands Grassy Woodland (EPBC Act)	3.06	1.09	4.15	1.60	5.76
Total	3.06	1.09	4.15	1.60	5.76

2.2 Feasible alternatives to taking the proposed action

Consideration of alternative proposals for the subject site has been undertaken throughout the project to ensure that an appropriate balance is achieved between retention and enhancement of the significant biodiversity values of the subject site and surrounds.

In developing the site layout, a number of alternatives were considered including:

1. Clearance of entire lot for residential subdivision.
2. Positioning of development envelopes and roads to maximise retention of highest condition native vegetation and lot yield.
3. GIS modelling of trees and hollow-bearing tree locations to assist in retaining important habitat trees within lots and positioning of development envelopes to assist retention.
4. Offsetting vegetation removal using the NSW Biobanking Scheme.
5. Rezoning and subdivision of the environmental lot in the eastern portion of the study area to E3 - Environmental Management under the Shellharbour LEP.

The residential lot proposed layout was selected within the area supporting the lowest condition CEEC (most floristically depauperate and highest edge to core area ratios) areas and scattered trees with highly modified exotic groundcovers. Prior to the development proposal the subdivision footprint area was rezoned to R2 – Low density residential. The rezoning of the study area and proposed development footprint aims to protect residual CEEC and APZ modified CEEC vegetation and threatened flora within land zoned E3 – Environmental Management and provide for ongoing management through implementation of a VMP.

2.3 Alternative locations, time frames or activities that form part of the referred action

There are no alternative locations, time frames or activities that form part of the referred action.

2.4 Context, including any relevant planning framework and state/local government requirements

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation that relates to the proposed development. It provides a framework for the overall environmental planning and assessment of development proposals. Various legislative instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), and *Rural Fires Act 1979* (RF Act) are integrated with EP&A Act and have been reviewed and outlined within this referral (Table 2). At the time of preparation, the TSC Act has been scheduled for repeal and replacement with the *Biodiversity Conservation Act 2016* (BC Act). This may result in changes to the assessment process and the requirements for vegetation offsets if the principal certifying authority insist on assessing the project within the framework of the new legislation.

A substantial array of legislation, policies and guidelines apply to the subject site as listed below;

Table 2: Legislative context

Name	Relevance to the project
<i>Environmental Planning and Assessment Act 1979</i> (EP&A Act)	The proposed development requires consent under the Shellharbour Local Environmental Plan and is to be assessed under Part 4 of the EP&A Act. Assessments of significance required under Section 5A for impacts to threatened species and endangered ecological communities have been prepared in accordance with the Act.
<i>Threatened Species Conservation Act 1995</i> (TSC Act)	The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The Act is integrated with the NSW EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act) or an activity (Part 5 of the EP&A Act),

Name	Relevance to the project
	is likely to significantly affect threatened species, populations and ecological communities or their habitats.
<i>Biodiversity Conservation Act 2016</i>	The BC Act is currently scheduled to replace the TSC Act on the 25 August 2017. It will in principle fulfil the same function as the TSC Act with modifications to the methods and pathways required under different development scenarios and impact scales.
<i>Biosecurity Act 2015</i>	Section 22 of the Act defines the 'biosecurity duty' for pest species (i.e. priority weeds) that may advertently or inadvertently function as a 'carrier' of 'Terrestrial and Freshwater Weeds' listed under Schedule 2 of the Act. The potential for the proposed development and any of its associated activities to 'act as a carrier' require consideration when addressing the potential for biosecurity impacts. This includes provision of controls to avoid or minimise development impacts on native vegetation.
<i>Shellharbour LEP 2013</i>	Clause 6.5 of the Shellharbour LEP has the objective of protecting, enhancing and managing the terrestrial biodiversity and environmentally sensitive land. The clause applies to the subject land and is triggered by development activities. Before deciding an application, the consent authority must consider various objectives and must be satisfied that the development has avoided potential adverse impacts and if these are not avoided, the minimisation or mitigation of impacts.
<i>Rural Fires Act 1979 and associated provisions</i>	<p>Section 100B RF Act requires an assessment of bushfire risk to be considered by a bushfire safety authority for redevelopment of land for the purpose of subdivision.</p> <p>Clause 44 Rural Fires Regulation 2013, specifies the information requirements for consideration by a bushfire safety authority under section 100B of the Rural Fires Act.</p> <p>Planning for Bush Fire Protection 2006: statutory guideline detailing the specifications and requirements for the development of bushfire prone land. More specifically, Appendix 2 and Addendum: Appendix 3 (2010) provide the assessment methodology applied for this assessment.</p>

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

A Flora and Fauna Impact Assessment is currently being prepared in accordance with the relevant provisions of the EP&A Act, including NSW Assessments of Significance (Section 5A) required for threatened biota listed within the Schedules of the TSC Act. NSW Assessments of Significance have been prepared in accordance with the *Threatened species assessment guidelines, The assessment of significance* (DECC 2007). The assessment is being prepared as part of a Development Application (DA) under Part 4 of the EP&A Act to the principal certifying authority: Shellharbour City Council.

2.6 Public consultation (including with Indigenous stakeholders)

Consultation for the proposal has been undertaken with and by Shellharbour City Council as a part of the DA assessment and previous rezoning process.

2.7 A staged development or component of a larger project

The referral seeks approval for the actions proposed relating to the development of a residential subdivision and an additional environmental conservation lot. The assessment undertaken for this referral has considered the overall (total) impact of the proposed action on the site's environmental values for the total development. The development is a standalone project and is not reliant on, or a component of, a larger project.

2.8 Related actions

There are no related actions to this project.

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

The most recent search using the Protected Matters Search Tool (PMST) was undertaken on 4 April 2017 with a 10 kilometres radius of the Site. Matters of national environmental significance (MNES) identified in the PMST are provided below.

3.1 (a) World Heritage Properties

Description

No World Heritage Property occurs within a 10 kilometre radius of the subject site.

Nature and extent of likely impact

Not applicable.

3.1 (b) National Heritage Places

Description

No National Heritage Place occurs within a 10 kilometres radius of the subject site.

Nature and extent of likely impact

Not applicable.

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

No Wetlands of International Importance occurs within a 10 kilometres radius of the subject site.

Nature and extent of likely impact

Not applicable.

3.1 (d) Listed threatened species and ecological communities

Description

A PMST search was undertaken with a 10 kilometre radius of the study area (3 April 2017). A full listing of ecological communities and threatened species identified in the PMST and is provided within Biosis 2016 (Appendix 1 and 2).

Species and ecological communities identified in the PMST that have potential to be impacted by the proposed action are listed below:

- Ecological communities
 - Illawarra and south coast lowland forest and woodland ecological community (Critically Endangered)
- Flora
 - White-flowered Wax Plant *Cynanchum elegans* (Endangered)
 - Illawarra Zieria *Zieria granulate* (Endangered)
- Fauna
 - Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable)
 - Grey-headed Flying-fox *Pteropus poliocephalus*.

See **Figure 4** and **Figure 5**.

3.1 (e) Listed migratory species

Description

A PMST search was undertaken with a 10 kilometre radius of the study area. A full listing of migratory species identified in the PMST is provided within Biosis 2016 (Table 10). No listed migratory species are considered likely to occur within the subject site.

3.1 (f) Commonwealth marine area

Description

No Commonwealth marine areas occur within the vicinity of the proposed action.

Nature and extent of likely impact

N/A

3.1 (g) Commonwealth land

Description

N/A

Nature and extent of likely impact

N/A

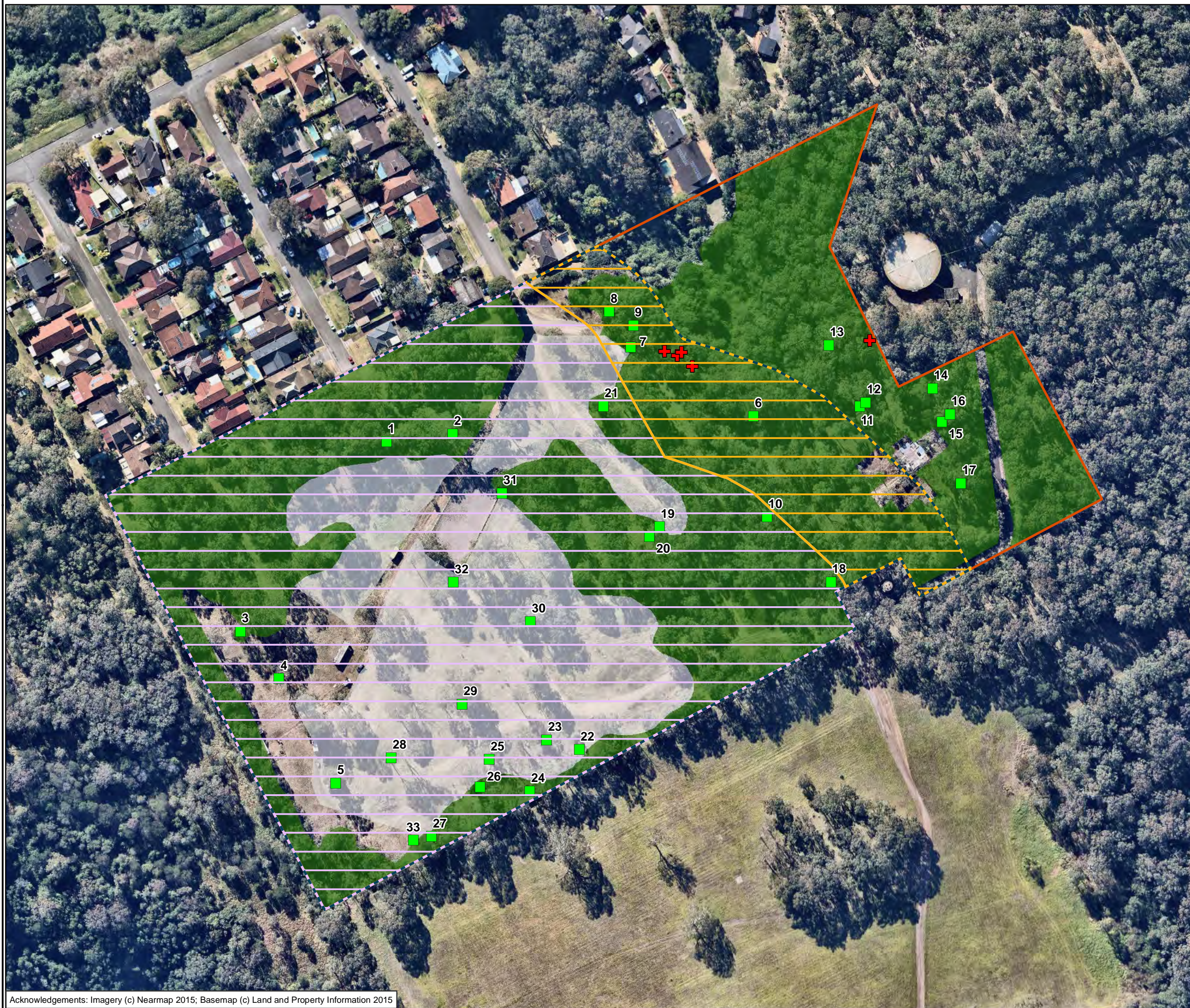
3.1 (h) The Great Barrier Reef Marine Park

Description

N/A

Nature and extent of likely impact

N/A



Legend

- Study area
- Subject site
- Hollow-bearing tree

Zone

- Impact – APZ modification CEEC
- Impact – removal CEEC

Threatened Flora

- + White-flowered Wax Plant (Biosis 2012)

Vegetation community

- Illawarra Lowlands Grassy
- Woodlands EPBC Act (moderate condition class)
- Scattered trees

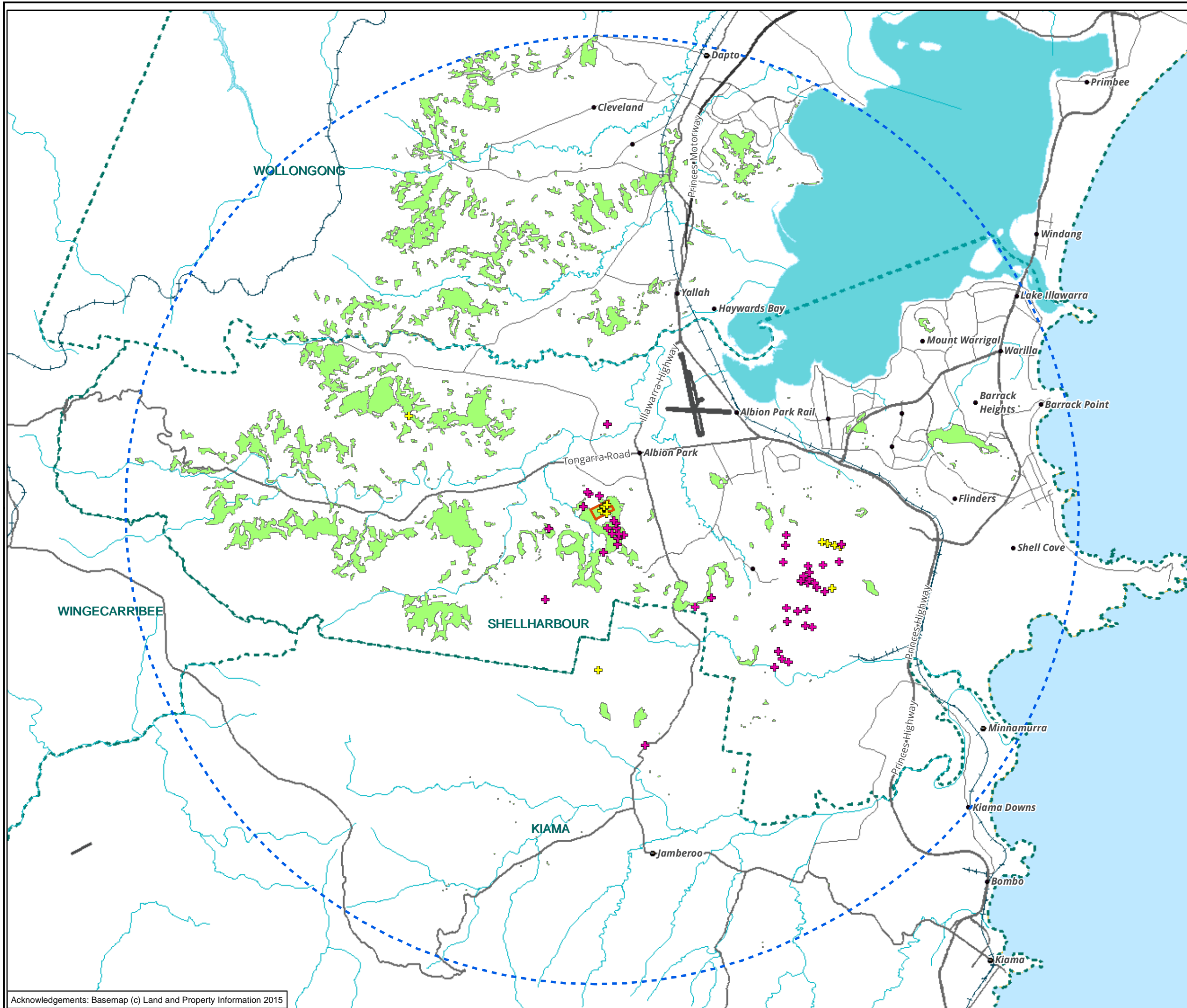
Figure 4: Vegetation mapping of the study area

0 10 20 30 40 50
Metres

Scale: 1:1,800 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 07 August 2017
Checked by: LH, Drawn by: NMG
Location: \\bio-data-01\matters\25300s\25345\mapping\25345_F4_VegComms



Legend

- Study area
- South Coast Grassy Woodland (GWp34)
- Study area 10km buffer

Threatened Flora

- + White-flowered Wax Plant
Cynanchum elegans
- + Illawarra Zieria *Zieria granulata*

Figure 5: Vegetation mapping and threatened flora within the vicinity

0 600 1,200 1,800 2,400 3,000
Metres
Scale: 1:76,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis
Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 14 July 2017
Checked by: LH, Drawn by: NMG
Location: F:\25300s\25345\mapping\25345_F5_VegMapping10km

3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description

N/A

Nature and extent of likely impact

N/A

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)	Is the proposed action a nuclear action?	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

3.2 (b)	Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

3.2 (c)	Is the proposed action to be taken in a Commonwealth marine area?	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))

3.2 (d)	Is the proposed action to be taken on Commonwealth land?	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))

3.2 (e)	Is the proposed action to be taken in the Great Barrier Reef Marine Park?	X	No
			Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))

3.3 Description of the project area and affected area for the proposed action

3.3 (a) Flora and fauna

A total of 174 flora species were identified within the subject site during the various ecological assessment, of which 59 are exotic species.

Four species are listed priority weeds and have management controls under the NSW *Biosecurity Act 2015* in the Shellharbour LGA, and also Weeds of National Significance (WoNS).

The following table outlines the terrestrial weed priority status and control measure for Shellharbour LGA and WoNS identified within the subject site.

Table 3 Priority and WoNS weeds recorded in the subject site.

Scientific Name	Common Name	Priority status
<i>Asparagus asparagoides</i>	Bridal Creeper	Mandatory measure –limit spread, WoNS
<i>Lantana camara</i>	Lantana	Regional mandatory measure limit spread, WoNS
<i>Rubus fruticosus</i> aggregate species	Blackberry	Mandatory measure –do not import, WoNS
<i>Senecio madagascariensis</i>	Fire Weed	Regional mandatory measure limit spread, WoNS

Cynanchum elegans plants were recorded in two general locations in the study area, one of those locations is recorded within the subject site, Figure 4. *Zieria granulata* has been recorded on land to the west of the study area, no plants were recorded during site surveys. There is potential for this species to have propagules present within a soil stored seed bank where dense Lantana is supported within the study area, however a low likelihood to be within the subject site. No other flora species listed under the TSC Act were recorded within the study area.

A range of threatened fauna habitat features were observed within the subject site including vegetated areas of tall open woodland, hollow-bearing trees, leaf litter and woody debris. Habitat within the subject site provides potential foraging, breeding and nesting resources for a range of fauna. A total of thirty 34 hollow-bearing trees were recorded within the subject site. All hollow-bearing trees contained small-medium hollows. Refer to Figure 4.

Fauna surveys for habitat, opportunistic sighting and targeted survey have been undertaken by Eco Logical (2011) and Biosis (11 December 2012 and 23 June 2016). Details of the recorded fauna can be found within the attached Flora and Fauna Assessments.

As a result of the fauna assessments it was considered likely that Grey-headed Flying-fox (Vulnerable) and Large-eared Pied-bat were considered to have potential to utilise the habitat features and be impacted by the proposed development.

3.3 (b) Hydrology, including water flows

No aquatic habitat was recorded within the study area, with strahler class 1 drainage lines occurring as open grassed paddocks or as a dry gully in the retained environmental lot.

Drainage occurs to the west for the most of the study area and also into a dry gully in the eastern portion.

Stormwater flow is proposed to be diverted to west along a dry rock based gully to comply with the certifying authorities requirements for floodplain modelling.

3.3 (c) Soil and Vegetation characteristics

The vegetation occurs in areas of Albion Park and Bombo soils landscapes, where plateaus or medium gradient slopes occur. Outcropping out cropping latite and loose medium sized boulders were noted on occasion in steeper sections of the slope.

Vegetation cover within the subject site includes remnant native vegetation identified as Illawarra Lowlands Grassy Woodland, exotic grasslands and scattered trees within exotic disturbed cover. Refer to Section 3.3 (e) below for further detail.

3.3 (d) Outstanding natural features

3.3 (e) Remnant native vegetation

The subject sites landscape position and underlying soils landscapes, combined with the species recorded are consistent with *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion, Endangered Ecological Community*, TSC Act (TSC 1999).

Further assessment of condition against the Approved Conservation Advice (TSSC 2016) found:

- The vegetation patch is larger than 0.5 hectares.
- The condition of the groundcover was above 30 % native content
- Trees with DBH greater than 50 centimetres and containing hollows.
- The patch was contiguous with at least one hectare of native vegetation (with perennial vegetation cover where 50 % or greater is comprised of native vegetation).

According to these criteria the vegetation is also consistent with the ecological community listings for moderate condition class *Illawarra and south coast lowland forest and woodland ecological community Critically Endangered Ecological Community* under the EPBC Act.

The vegetation within the subject site was found in moderate condition and for the most part supported moderately disturbance groundcovers and almost no midstorey from ongoing grazing.

Areas containing 'scattered trees' were considered to be in low condition. While the vegetation satisfied key diagnostic characteristics such as:

- Appropriate regional context.
- Foliage cover averaging at least 10 %.
- Forest Red Gum canopy trees.

The vegetation failed to meet the condition threshold for Category D. Moderate condition class because it failed to satisfy the following biotic threshold:

- At least 30 % of total perennial understorey cover is comprised of native species.

In addition to this, areas between scattered trees mapped as exotic grassland also supported a total perennial understorey with native species cover less than 30% of the total. Therefore these areas were not considered to represent a derived grassland form of Illawarra Lowlands Grassy Woodland.

Therefore, areas outside of moderate condition CEEC mapped within Figure 4 are considered to be in low condition do not meet the EPBC condition thresholds for the CEEC.

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

The gradient across the subject site slopes slightly downhill to the west.

3.3 (g) Current state of the environment

The total area of the subject site is currently used for the agistment of horses. The area includes both fenced and unfenced grazing areas, tack area, numerous small corrugated sheds, organic waste stockpiling areas and gravel trails. Paddocks and intensively used areas tend to be in poor condition and supporting mostly exotic perennial groundcover.

The vegetation within the subject site varies from moderate to poor condition, for the most part lacking midstorey due to continuous grazing. The remainder of the study area to the east supports a heavy cover of Lantana where moderate slopes occur.

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

The subject site does not contain any Commonwealth Heritage Places or other places recognised as having heritage values.

3.3 (i) Indigenous heritage values

The subject site does not contain any known indigenous heritage values.

3.3 (j) Other important or unique values of the environment

The proposed subdivision occurs within a corridor of vegetation that is orientated north to south and contiguous with the Tongarra – Stockyard Mountain to Dunmore Hills regional biodiversity corridor (WCC et al. 2011).

The vegetation to be permanently removed as part of the proposed action will reduce the area of the corridor, but will not result in a discrete break in the corridors length. The residual CEEC and APZ modified areas to be retained within the east of the study area will retain connectivity to the south.

The proposed action will have a minimal impact to the vegetation to the west of the study area which adjoins native vegetation further to the north. This may include the installation of a piped stormwater easement up to 10 metres wide.

3.3 (k) Tenure of the action area (eg freehold, leasehold)

The site is currently under private ownership and is comprised of a single allotment (Lot 101 DP 785139 Crest Road, Albion Park).

3.3 (l) Existing land/marine uses of area

The majority of the subject site is currently being used for horse agistment.

3.3 (m) Any proposed uses of area of proposed action

The subject site is proposed for residential use and APZ management. The majority of retained land (environmental living lot) most of which will be retained for environmental conservation (CEEC buffer, residual CEEC and threatened species habitat).

4 Environmental outcomes

Proposed environmental outcomes that will be achieved for MNES as a result of the proposed action include the following:

Environmental Outcomes for Illawarra Lowlands Grassy Woodland CEEC EPBC Act.

A cumulative total of 2.68 hectares of CEEC will be retained and undergo conservation management, regeneration and revegetation to ensure ecological benefits and improvements on the current condition of the vegetation community to meet the EPBC Act thresholds. This outcome will be provisioned as follows:

- Retention and management of 1.60 hectares residual CEEC within large environmental lot zoned E3 – Environmental Management (Shellharbour LEP).
- Retention and management of 1.09 hectares of modified CEEC in APZ areas that will function as a critical habitat buffer for Illawarra Lowlands Grassy Woodland CEEC EPBC Act.

Management will involve the implementation of a site specific VMP subject to reporting to the principal certifying authority in perpetuity.

Environmental Outcomes for *Cynanchum elegans* (Endangered Species)

Seven plants, representing one local population will be retained within the environmental lot. Conservation of these plants will be undertaken as directed by VMP specific controls. Areas containing *Cynanchum elegans* will require the following controls to protect the plants during weed control and annual fuel reduction tasks. The additional controls include:

- Initial clearing within the fenced-off area be undertaken by a qualified bush regenerator sufficiently experienced at working with the species, holding a section 132 licence from NSW Office of Environment and Heritage.
- All primary weed control within a 20 metre buffer of *Cynanchum elegans* is to be restricted to manual cut and paint methodologies.
- No herbicide application by spot spray within ten metre buffers of known locations will be allowed, due to *Cynanchum elegans* capacity to sucker at extended distances from the parent plant.
- Mechanical slashing cannot be used to control Lantana within 20 metres of any known location of White-flowered Wax Plant. This is because there is a high likelihood that unrecorded White-flowered Wax Plant could be growing within areas of Lantana, and has the potential to be established within more open areas.
- Guidance of the mechanical plant operator is to be provided by a suitably qualified ecologist or bush regenerator, skilled in the identification of White-flowered Wax Plant, during trittering. If additional plants are identified during weed control activities, then these areas will be recorded, and control undertaken as per the specification detailed above.
- The known *Cynanchum elegans* locations will be identified and buffer areas marked out prior to starting primary weed control.
- Mechanical slashing cannot be used to control Lantana within 20 metres of any known location of *Cynanchum elegans*. This is because there is a high likelihood that unrecorded *Cynanchum elegans* could be growing within areas of Lantana, and has the potential to be established within more open areas.
- Guidance of the mechanical plant operator is to be provided by a suitably qualified ecologist or bush regenerator, skilled in the identification of *Cynanchum elegans*, during trittering. If additional plants are identified during weed control activities, then these areas will be recorded, and control undertaken as per the specification detailed above.

The management of vegetation within the APZ will also require the following additional controls:

- Buffer fencing 20 m from *Cynanchum elegans* locations to protect the plant damage during APZ management.
- All trees or shrubs supporting *Cynanchum elegans* individuals are to be retained within the APZ as a component of the 20% unmanaged vegetation cover allowable within midstorey and groundcover strata of an outer protection zone.
- All vegetation control activities within the fenced-off area will be undertaken manually, and any trees that require removal will be sectioned and lowered in a way to avoid any damage to individual stems or the adjacent supporting vegetation.

Environmental Outcomes for *Zieria granulata* (Endangered Species)

No plants have been recorded within the study area and there is a low likelihood that the subject site contains a soil stored seed bank.

Areas of the environmental lot to be retained as residual vegetation have the potential to contain *Zieria granulata* propagules within a soil stored seed bank. Safeguards to avoid potential impacts to this species are included within the VMP for the environmental lot. Monitoring activities will be undertaken within the environmental lot which include:

- Survey within 3 months of primary control following removal of Lantana.
- If the plant is recorded recruiting, procedures for weed management will apply as per *Cynanchum elegans*.
- If no plants are detected, annual targeted survey for the plant will not be continued after 3 years.

Environmental Outcomes for Grey-headed Flying Fox (Vulnerable Species)

Potential habitat for the Grey-headed Flying Fox will be managed and protected within the local area in the form of the abovementioned Illawarra Lowlands Grassy Woodland environmental outcomes. The total minimum area of habitat that will contribute to the environmental outcomes for these species is 1.60 hectares.

The conservation areas will be improved through a range of ecological restoration works set out in a VMP. A minimum of 2.68 hectares (including APZ) will be subject to the VMP.

5 Measures to avoid or reduce impacts

The design of the proposed action has followed Step 4 of the Guidelines for threatened species assessment (DECC 2004) and importantly considered the Significant Impact Guidelines for MNES (CoA 2013), which both identify important factors that must be considered when assessing the potential impacts on threatened species, populations, or ecological communities, or their habitats; namely to avoid, minimise and finally to offset any residual impacts.

Avoidance

Impacts to CEEC and threatened species were considered in consultation with Biosis, MMJ Pty Ltd and Spinitu Pty Ltd. The ecological assessment and subdivision design process to date have been detailed in Biosis (2016) has been used to inform avoidance and minimisation of direct and indirect impacts to biodiversity values, through the following::

- Consideration of the lot layout design selection to consider all outlined biodiversity constraints of the proposed action.
- Consideration of the lot layout, to be located in areas where the native vegetation and threatened species habitat is in the poorest condition.
- Consideration of the lot layout to be located within the western portion of the lot to avoid fragmentation of existing vegetation.
- Minimise the amount of clearing or habitat loss.

A number of development scenarios were considered with the intent of avoiding and minimising impact to Illawarra Lowlands Grassy Woodland EPBC Act CEEC, within the subject site. However, while impact on CEEC has not been completely avoided, impacts have been minimised as far as practicable to maintain the feasibility of residential development within the subject site.

Overall, if the study area had been cleared the total impact of the proposed action would have been 5.76 hectares of Illawarra Lowlands Grassy Woodland as EPBC Act listed moderate condition CEEC. The redesign of the subdivision has been reduced to 3.06 hectares CEEC removed, 1.09 hectares modified for APZs, leaving 1.60 hectares as residual CEEC not impacted by the proposed subdivision.

These reductions in impact area were subsequently formalised through a planning proposal which rezoned the environmental lot to E3 – Environmental Management from RU1 – Primary Production.

One population (in two locations) of *Cynanchum elegans* (7 plants total) have been retained within an environmental lot.

Retention of hollow-bearing trees within the E3 – Environmental Management area, includes any thinning of trees to reduce tree canopy cover to less than 15 per cent in the inner APZ and 30 per cent in the outer APZ will avoid removal of hollow-bearing trees.

Minimise impacts

The extent and condition of vegetation was recorded and mapped across the study area and subject site. The proposed development footprint was subsequently designed to be located within low condition vegetation and minimise impacts to the CEEC with the lowest edge to core ratios, best able to withstand future development pressure, and to ensure that north to south connectivity with the Stockyard Mountain – Dunmore Hills regional biodiversity connectivity was maintained.

The CEEC vegetation is equivalent to NSW Plant Community Type PCT 838 (Biometric Vegetation Type SR545) (NSW Vegetation Information System (version 2.1)). The installation of an APZ over 1.09 hectares is considered a modification and therefore will cause an impact from the proposed subdivision. The impacts of installation compared to the condition benchmarks for PCT 838 show:

- An inner protection zone (IPZ) will require a reduction of overstorey canopy cover to 15% cover across 0.44 hectares. This will not lower canopy cover to below the lower benchmark canopy cover value expected for this vegetation type (also 15%). Regular slashing to maintain low groundcover will occur in areas that already lack midstorey or shrubs due to horse grazing, therefore additional impacts are unlikely. Overall APZ modification is minimal and on-going management will reduce currently unmanaged weed threats by controlling Lantana, Blackberry and Madeira Vine, improving condition of native vegetation on site.
- An outer protection area (OPZ) will require a reduction of canopy overstorey to 30% over 0.64 hectares. Annual slashing to maintain low groundcover will occur in areas that already lack midstorey or shrubs due to horse grazing, therefore additional impacts are unlikely. Removal of Lantana will be required which is likely to allow for an overall improvement in ground cover condition.

While the area will be considered an impact, the retained APZ area will form a buffer between residual CEEC within the environmental lot greater than 30 metres in width. This retained area is still considered critical habitat for the CEEC (TSSC 2016). Therefore the installation of an APZ in preference to clearing represent impact minimisation of impact for 1.09 hectares that may have been cleared for subdivision.

During the clearing of vegetation, an ecologist should be present during the removal of hollow-bearing trees to salvage any fauna species from hollows. Any hollow-bearing limbs, removed as a part of the subdivision, should be relocated into the E3 – Environmental Management area. Hollow logs should be placed on the ground (outside of APZs) to provide supplementary habitat following the removal of noxious weeds such as *Lantana camara* for general fauna species that may be present within the study area.

Mitigate impacts

Actions to mitigate the potential impacts of the proposed development on Illawarra Lowlands Grassy Woodland CEEC EPBC Act have been provided below. These actions have been drawn from mitigation measures recommended for the associated proposed development, and include:

- 1.60 hectares will be conserved and managed in perpetuity within the environmental lot.
- The CEEC within environmental lot will be improved through a range of ecological restoration works set out in a VMP.
- Sensitive areas will fenced APZ area from residential subdivision, and APZ from areas dedicated to biodiversity conservation (specifically within the environmental lot).
- All access during the pre-construction, construction and operational phases should be limited to existing roads and designated access tracks.
- Install suitable fencing and signage around areas to be conserved.
- A regular audit program carried out by a suitably qualified ecologist will be implemented. The audit will be undertaken annually in perpetuity. Audit results will be submitted to Shellharbour City Council
- Erosion and sedimentation control will be maintained during all construction phases to protect the retained modified CEEC and residual CEEC.

Safeguards and controls to mitigate potential indirect and direct impacts to *Cynanchum elegans* will be strictly adhered to, including monitoring and reporting of management actions annually to Council. These will be detailed within the VMP for the environmental lot.

Mitigation measures for the removal of hollow-bearing trees can be established through compensatory hollow/nest boxes at a 1:1 ratio within areas of vegetation to be retained. These nest boxes will be

designed to support the native species which would otherwise utilise the hollows to be removed. Nest boxes will be installed by a suitably qualified ecologist one month prior to trees removal.

6 Conclusion on the likelihood of significant impacts

6.1 Do you THINK your proposed action is a controlled action?

<input type="checkbox"/>	No, complete section 4.2
<input checked="" type="checkbox"/>	Yes, complete section 4.3

6.2 Proposed action IS NOT a controlled action.

6.3 Proposed action IS a controlled action

Matters likely to be impacted

<input type="checkbox"/>	World Heritage values (sections 12 and 15A)
<input type="checkbox"/>	National Heritage places (sections 15B and 15C)
<input type="checkbox"/>	Wetlands of international importance (sections 16 and 17B)
<input checked="" type="checkbox"/>	Listed threatened species and communities (sections 18 and 18A) <ul style="list-style-type: none"> Permanent removal of 3.06 hectares of <i>Illawarra and south coast lowland forest and woodland ecological community Critically Endangered Ecological Community</i> in moderate condition (category D). Permanent modification on 1.09 hectares of <i>Illawarra and south coast lowland forest and woodland ecological community Critically Endangered Ecological Community</i> in moderate condition (category D).
<input type="checkbox"/>	Listed migratory species (sections 20 and 20A)
<input type="checkbox"/>	Protection of the environment from nuclear actions (sections 21 and 22A)
<input type="checkbox"/>	Commonwealth marine environment (sections 23 and 24A)
<input type="checkbox"/>	Great Barrier Reef Marine Park (sections 24B and 24C)
<input type="checkbox"/>	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
<input type="checkbox"/>	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
<input type="checkbox"/>	Protection of the environment from Commonwealth actions (section 28)
<input type="checkbox"/>	Commonwealth Heritage places overseas (sections 27B and 27C)

7 Environmental record of the responsible party

		Yes	No
7.1	Does the party taking the action have a satisfactory record of responsible environmental management? Provide details	√	
7.2	Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources? If yes, provide details		√
7.3	If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework? If yes, provide details of environmental policy and planning framework		N/A
7.4	Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act? No Provide name of proposal and EPBC reference number (if known)		√

8 Information sources and attachments

(For the information provided above)

8.1 References

- Commonwealth of Australia 2013. *Matters of National Environmental Significance – Significant Impact Guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999*.
- Department of the Environment Conservation Climate Change and Water (DECCW) 2009 *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus* Available from: <http://www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf>
- Department of the Environment and Energy (DEE) 2016c Species Profile and Threats Database for *Pteropus poliocephalus* Grey-headed Flying-fox Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186
- Office of Environmental and Heritage (OEH) 2016. *Atlas of NSW Wildlife*. Wildlife Data Unit, OEH, Parramatta NSW.
- Biosis 2012. Lot 101 DP 785139, Crest Rd, Albion Park - BioBanking Assessment. Authors: Morrissey B & Garvey N. Biosis Pty Ltd, Wollongong. Project No. 15634.
- Biosis 2016. Flora and Fauna Assessment for Crest Road, Albion Park. Report for MMJ Real Estate and Spinitu Pty Ltd. Authors: N. Garvey, Biosis Pty Ltd, Wollongong. Project no 18852.
- DEC 2005. *Zieria granulata (Illawarra Zieria) Recovery Plan*. NSW Department of Environment and Conservation, Hurstville NSW
- DECC 2004. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004. Department of Environment and Conservation (NSW).
- ELA 2011. Flora and Fauna Assessment: Lot 101 DP 785139 Crest Road, Albion Park. EcoLogical Australia. Sydney.
- NPWS 2002. Threatened Species Information. *Cynanchum elegans*. NSW National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee (NSW SC) 1999. *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion - endangered ecological community listing*.
- Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B and Beukers P. 2010. Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11, 359-406.
- Threatened Species Scientific Committee (TSSC) 2016. Approved Conservation Advice (incorporating listing advice) for the Illawarra and South Coast Lowland Forest and Woodland Ecological Community. Canberra: Department of the Environment and Energy.
- WCC et al. 2011. *Illawarra Biodiversity Strategy*. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

8.2 Reliability and date of information

The information utilised to prepare this referral has been prepared by suitably qualified consultants who are experienced in their areas of expertise, or is information that has been prepared and disseminated by the Australian or New South Wales Governments. The information prepared has been subject to peer review processes internally. The information utilised is considered to be current and suitable for use to support the preparation of this referral.

8.3 Attachments

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project locality (section 1)	✓	See Figure 1 and 2
	GIS file delineating the boundary of the referral area (section 1)	✓	Attached to email
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	See Figure 4 and 5
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)	N/A	-
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)	✓	Flora and Fauna Assessment (Biosis 2016) PMST 10kilometre radius (April 2017)
	copies of any flora and fauna investigations and surveys (section 3)	✓	Preliminary Biobanking Assessment (Biosis 2012)
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)	✓	Bushfire Hazard Assessment & Compliance Report (Bushfire Evacuations & Solutions 2015)
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)	N/A	-

9 Contacts, signatures and declarations

Project title:

9.1 Person proposing to take action

1. Name and Title: Peter Robertson
2. Organisation: Spinitu Pty Ltd
3. EPBC Referral Number :
4: ACN / ABN : 77003361573
5. Postal address P.O. Box 745 MIRANDA, NSW 2228
6. Telephone: 029525 6277
7. Email: spinitu@idx.com.au

8. Name of designated proponent (if not the same person at item 1 above):
9. ACN/ABN of designated proponent (if not the same person named at item 1 above):

I qualify for exemption from fees under section 520(4C)(e)(v) of the EPBC Act because I am:

☐ an individual; OR

☐ a small business entity (within the meaning given by section 328-110 (other than subsection 328-119(4)) of the *Income Tax Assessment Act 1997*); OR

☒ not applicable.

If you are small business entity you must provide the Date/Income Year that you became a small business entity:

N/A

I would like to apply for a waiver of full or partial fees under Schedule 1, 5.21A of the [EPBC Regulations](#). Under sub regulation 5.21A(5), you must include information about the applicant (if not you) the grounds on which the waiver is sought and the reasons why it should be made:

Declaration

I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.
I understand that giving false or misleading information is a serious offence.
I agree to be the proponent for this action.
I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.

Signature

Date

22/8/17

9.2 Person preparing the referral information (if different from 9.1)

Name Mathew Misdale

Title Botanist

Organisation Biosis Pty Ltd.

ACN / ABN (if applicable) 65 006 175 097

Postal address 8 Tate Street Wollongong NSW 2500

Telephone 02 4201 1062

Email mmisdale@biosis.com.au

Declaration

I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.

I understand that giving false or misleading information is a serious offence.

Signature

Date

18/9/17

Attachment A: Geographic Information System (GIS) data supply guidelines

If the area is less than 5 hectares, provide the location as a point layer. If the area greater than 5 hectares, please provide as a polygon layer. If the proposed action is linear (eg. a road or pipeline) please provide a polyline layer.

GIS data needs to be provided to the Department in the following manner:

- Point, Line or Polygon data types: ESRI file geodatabase feature class (preferred) or as an ESRI shapefile (.shp) zipped and attached with appropriate title
- Raster data types: Raw satellite imagery should be supplied in the vendor specific format.
- Projection as GDA94 coordinate system.

Processed products should be provided as follows:

- For data, uncompressed or lossless compressed formats is required - GeoTIFF or Imagine IMG is the first preference, then JPEG2000 lossless and other simple binary+header formats (ERS, ENVI or BIL).
- For natural/false/pseudo colour RGB imagery:
 - If the imagery is already mosaiced and is ready for display then lossy compression is suitable (JPEG2000 lossy/ECW/MrSID). Prefer 10% compression, up to 20% is acceptable.
 - If the imagery requires any sort of processing prior to display (i.e. mosaicing/colour balancing/etc) then an uncompressed or lossless compressed format is required.

Metadata or 'information about data' will be produced for all spatial data and will be compliant with ANZLIC Metadata Profile. (http://www.anzlic.org.au/policies_guidelines#guidelines).

The Department's preferred method is using ANZMet Lite, however the Department's Service Provider may use any compliant system to generate metadata.

All data will be provide under a Creative Commons license (<http://creativecommons.org/licenses/by/3.0/au/>)

Appendix 9: Referral variation

**Notification of
VARIATION OF PROPOSED ACTION****Residential Subdivision Lot 101 DP 785139 Crest Road, Albion Park, New South Wales
(EPBC 2017/8048)**

This request to vary the proposal has been accepted in accordance with section 156B of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

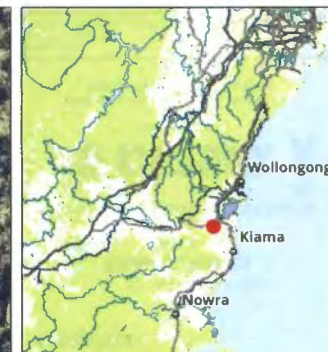
proposed action	Residential subdivision of Lot 101 DP 785139) Crest Road, Albion Park, New South Wales [see EPBC Act referral 2010/1324]
varied proposed action	Residential subdivision of Lot 101 DP 785139) Crest Road, Albion Park, New South Wales [see EPBC Act referral 2010/1324 and variation dated 30 November 2017]
person proposing to take the action	Spinitu Pty Ltd ACN 003 361 573
variation	to excise the proposed public Crest Road extension from the referred action, as reflected in the plans at <u>Annexure 1</u>

Decision-maker

name and position	Dane Roberts Acting Assistant Secretary Assessments (ACT, NSW) & Waste Branch
--------------------------	---

signature**date of decision** 30 November 2017

Figure 3 Previous (29/09/2017) and Updated (30/10/2017) (EPBC 2017/8048)



Legend

- Study area
- Subject site
- APZ

Proposed subdivision

- Proposed lot boundary

Zoning Boundaries

- E3 Environmental Management
- R2 Low Density Residential
- Development - APZ
- Development - Building envelope
- Development - Lots
- Development - Roads
- Environmental management
- Environmental management - Inner APZ
- Environmental management - Outer APZ

Figure 3: Development footprint

0 10 20 30 40 50

Metres

Scale: 1:1,800 @ A3

Coordinate System: GDA 1994 MGA Zone 56



Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong



Legend

- Study area
- Subject site
- Crest Road Extension (DA 119/2016)
- APZ

Proposed subdivision

- Proposed lot boundary

Zoning Boundaries

- E3 Environmental Management
- R2 Low Density Residential
- Development - APZ
- Development - Building envelope
- Development - Lots
- Development - Roads
- Environmental management
- Environmental management - Inner APZ
- Environmental management - Outer APZ

Figure 3: Development footprint

0 10 20 30 40 50

Metres

Scale: 1:1,800 @ A3

Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne,
Sydney, Wangaratta & Wollongong

Matter: 25345
Date: 30 October 2017
Checked by: LH, Drawn by: NMG
Location: P:\25300s\25345\Mapping\1
25345 E3 DevFootprint CrestRoadExtension

Appendix 10: Department of the Environment and Energy request for additional informatio



Mr Peter Robertson
Spinitu Pty Ltd
PO Box 745
MIRANDA NSW 2228

Dear Mr Robertson

**Additional information required for preliminary documentation
Residential subdivision of Lot 101 DP 785139 Crest Road, Albion Park, New South Wales
(EPBC 2017/8048)**

I am writing to you in relation to your proposed residential subdivision of Lot 101 DP 785139 Crest Road, Albion Park, New South Wales (EPBC 2017/8048).

On 30 November 2017, a delegate of the Minister determined that the the proposed action is a controlled action and that it will be assessed by preliminary documentation. Further information will be required to be able to assess the relevant impacts of the proposed action.

Details of the further information required are at Attachment A.

Details on the assessment process and the responsibilities of the proponent are set out in the enclosed fact sheet. Further information is available from the Department's website at www.environment.gov.au/epbc.

If you have any questions about the assessment process or the further information required, please contact Jamie Machin, by email to jamie.machin@environment.gov.au, or telephone 02 6274 2303, and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Mike Smith
Director
Southern NSW Assessments Section

2 March 2018

Preliminary documentation – specified information requirements

**Residential subdivision – Lot 101 DP 785139 Crest Road, Albion Park,
New South Wales (EPBC 2017/8048)**

On 30 November 2017, your proposed action was determined to be a controlled action for the purposes of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), subject to the following controlling provisions:

- listed threatened species and communities

At the same time, it was determined that your proposed action will be assessed on preliminary documentation. This is a flexible assessment approach that is commonly used to assess proposed actions that have relatively limited public interest, utilise conventional methods and technologies, and are expected to impact relatively few protected matters.

This document sets out the specified information required by the Minister under section 95 A of the EPBC Act for the assessment of the impacts of your proposed action (the 'preliminary documentation').

It is important that you read this document carefully and make sure that you understand it. If you have not followed the guidance in this document, your draft preliminary documentation will be rejected. Please contact your Assessment Officer (Jamie Machin – telephone 02 6274 2303 or e-mail jamie.machin@environment.gov.au) as early as possible if you have any questions or concerns.

Format and style

It is important to the integrity of the assessment process that your preliminary documentation, consisting of a main document and any number of indexed appendices, is presented in a way that is intelligible to the general public, who may not be familiar with the history of your proposed action or with the technical aspects of its assessment. You should:

- present your documentation in standard formats, noting that it will be published in hardcopy (eg A4 / A3 hardcopies) and electronic formats (eg PDF or MSWord files)
- include all key claims, findings, proposals and undertakings in the main document
- use maps and / or diagrams where appropriate to support textual information
- present all maps and diagrams at an appropriate size and scale
- explain (or avoid) technical jargon and acronyms
- reference all supporting documentation (including websites) clearly and consistently
- publish key supporting documents (eg survey data, technical reports) as appendices
- ensure that other supporting documents (eg academic studies, regulatory standards) are publicly accessible, with electronic links provided where possible

Content

Your preliminary documentation must include all the information provided in your referral documentation (updated or corrected as necessary), as well as the additional information requested in this document. It may be useful to include the referral itself as an appendix.

Your preliminary documentation should enable the Minister (or delegate) and any other interested stakeholders to understand the impacts of the proposed action. Variables, assumptions and uncertainties must be clearly identified.

Your preliminary documentation must make reference to all relevant standards, policies and other guidance material published by the Department. Any instances where published guidance is not followed must be justified. Where no Commonwealth standards exist, state government and / or industry standards may be useful.

Names, roles and qualifications (where relevant) of all persons involved in preparing the preliminary documentation must be provided.

If it is necessary to rely on any confidential material, you should consult the Department on the handling of that material before submitting your preliminary documentation for publication.

Controlling provision – listed threatened species and communities

Under this controlling provision, any listed threatened species or community is potentially relevant to the assessment. However, based on the information provided in your referral, and other available information, the Department is particularly interested in the species and communities tabulated below.

Relevant guidance material (including in particular survey guidelines, conservation advices, recovery plans, threat abatement plans and policy statements) is available through the Department's [Species Profile and Threats \(SPRAT\)](#) database. It is your responsibility to ensure that you have identified the relevant documents.

Species / communities adequately addressed in your referral
The Department broadly accepts the claims and conclusions made in your referral documentation in relation to the following species / communities. Unless circumstances have changed, your preliminary documentation only needs to repeat or reference information provided in the referral documentation.
Illawarra Zieria (<i>Zieria granulata</i>) – endangered
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>) – vulnerable

Species / communities for which further information is required	
Further evidence (eg field surveys) and / or a more detailed argument is required to satisfy the Department of claims and conclusions made in your referral documentation in relation to the following species / communities and / or explain how impacts on them will be addressed.	
Species	Details of information required (if applicable)
Illawarra and south coast lowland forest and woodland – critically endangered	<ul style="list-style-type: none"> • information on management of edge effects, including APZ specifications • areas of impact, APZs and 30 metre notional buffer mapped and tabulated • proposals to offset residual significant impacts
White-flowered Wax Plant (<i>Cynanchum elegans</i>) – endangered	<ul style="list-style-type: none"> • information on management of retained individuals, including APZ specifications • proposals to offset residual significant impacts (if any)

Additional species / communities to be addressed
The Department considers that the following species / communities should have been addressed in the referral but were not. Information is required on likelihood of occurrence and impacts, and mitigation / offset response if applicable.
Thick-lipped Spider-orchid (<i>Caladenia tessellata</i>) – vulnerable
Leafless Tongue-orchid (<i>Cryptostylis hunteriana</i>) – vulnerable
Illawarra Socketwood (<i>Daphnandra johnsonii</i>) – endangered
Yellow Gnat-orchid (<i>Genoplesium baueri</i>) – endangered
Spiked Rice-flower (<i>Pimelea spicata</i>) – endangered
Illawarra Greenhood (<i>Pterostylis gibbosa</i>) – endangered
Spot-tailed Quoll (<i>Dasyurus maculatus</i> subsp. <i>maculatus</i> [SE mainland population]) – endangered
Koala (<i>Phascolarctos cinereus</i> [combined populations of Qld, NSW and the ACT]) – vulnerable
New Holland Mouse (<i>Pseudomys novaehollandiae</i>) – vulnerable

While all relevant species and communities must be addressed, the Department understands that it is appropriate to address different matters at different levels of detail and that some matters can

Attachment A – preliminary documentation requirements

best be addressed in thematic groups. The following factors must be considered in relation to each species or community:

- its occurrence at the site of the proposed action
- its potential to be impacted by the proposed action
- measures proposed to avoid or mitigate potential impacts
- compensation (offsets) proposed for any residual significant impacts (ie impacts that cannot be avoided or mitigated)

Occurrence

Occurrence of species and / or communities at the site of the proposed action should be informed by relevant experts following relevant survey standards. Survey methodology must be described and results appended to the preliminary documentation,

Consideration must be given to occupancy trends relating to season and time of day. Longer term trends including climate change may also be relevant. In relation to habitat for listed threatened species, the type of habitat (eg foraging, breeding, dispersal etc) must also be considered.

Impacts

Direct and indirect impacts of the proposed action must be considered, in relation to the specific needs and characteristics of relevant listed threatened species and communities. The Department has identified the following types of impacts as being particularly relevant to your proposed action:

Expected impacts of the proposed action
clearing (direct impact) associated with the development of residential lots and construction of associated infrastructure
edge effects (indirect impacts) on retained listed threatened communities or species habitat arising from adjacent suburban activities, including but not necessarily limited to noise and light disturbance, roadkill, trampling, littering, weed invasion, predation by pets, altered fire regime and altered hydrology (in terms of quality and quantity)

Consideration must also be given to cumulative impacts of the proposed action when considered in conjunction with concurrent and expected future developments. Note that cumulative impacts may include interactive and / or compounding impacts as well as additive impacts.

Avoidance and mitigation measures

Proposed avoidance and mitigation measures must be discussed in terms of their expected effectiveness and cost. Note that in deciding whether to approve the proposed action, the Minister is required to consider whether (as far as possible) any condition is a cost-effective means for achieving its intended objective.

Management commitments by the person proposing to take the action must be clearly distinguished from recommendations or statements of best practice made by the author or other technical expert. It is preferable to provide a consolidated table of management commitments, including details on funding, roles and responsibilities and measurable performance criteria.

Offsets

Significant residual (ie after any avoidance and mitigation measures have been considered) impacts on any listed threatened species or community must be offset in accordance with the Department's [EPBC Environmental Offsets Policy 2012 and offset assessment guide](#), or other endorsed offset framework (see separate heading below). If using the offset assessment guide, be sure to provide and clearly justify the scores entered into the tool.

Offsets will generally need to be underway prior to commencement of the proposed action, but not necessarily prior to approval.

Economic and social matters

Your preliminary documentation must provide information about the expected economic and social impacts of the proposed action. This should include, but not necessarily be limited to, the following:

- consideration of both costs (eg disruption to existing community infrastructure or environmental features) and benefits (eg increased housing or employment)
- consideration of different scales of impact where relevant (eg local versus national)
- specific dollar or other numerical values where relevant

Environmental history of the person proposing to take the action

Your preliminary documentation must provide details of any proceedings under a Commonwealth, state or territory law for the protection of the environment, or the conservation and sustainable use of natural resources, against the person proposing to take the action (or if the person is a corporation, its executive officers).

If the person proposing to take the action is a corporation, details of the corporation's environmental policy and planning framework must be provided.

Relevant policies and other considerations

Various [policy statements](#) and other [publications](#) that may be relevant to your assessment can be found on the Department's website. Some key policies are summarised below.

Be sure to identify where Commonwealth definitions, methodologies and standards differ from those required or recommended by state government agencies. Ensuring that Commonwealth survey and identification requirements are incorporated into surveys at the earliest opportunity will reduce the likelihood of additional surveys being required. Ask your assessment officer if you are unsure.

Endorsed offsetting frameworks

In the interests of streamlining regulatory requirements for proponents, the Commonwealth has endorsed some state government policies, as reflected in the Department's [EPBC Act Condition-setting Policy 2016](#). These include the rules established under section 127B of the New South Wales *Threatened Species Conservation Act 1995* (the BioBanking scheme).

In 2017, the BioBanking scheme was effectively replaced by the new Biodiversity Assessment Method (BAM). Although the BAM has not been endorsed by the Commonwealth, offsetting

Attachment A – preliminary documentation requirements

outcomes achieved through the BAM will generally be accepted for the purposes of the EPBC Act, provided that they are 'like for like' in relation to listed threatened species / communities as defined for the purposes of the EPBC Act. Payment into a Biodiversity Conservation Trust will generally not be considered acceptable.

If you are proposing offsets developed using the BAM, you should append all relevant BAM documentation to your preliminary documentation – this would generally include a biodiversity development assessment report (BDAR) and possibly a biodiversity stewardship site assessment report (BSSAR).

Defining patches of a community

A patch is a discrete and mostly continuous area of an ecological community (or species habitat), as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances that do not significantly alter the overall function of the patch. Permanent structures, such as roads and buildings, are typically excluded from a patch, although a patch may be considered to be continuous across or around them.

When it comes to defining a patch of an ecological community allowances are made for 'breaks' between areas that meet the key diagnostics (eg a narrow strip of other native vegetation along a watercourse). The size of break that can be included within a patch without altering its overall function varies for different ecological communities – further guidance on a specific community may be provided in a conservation advice, policy statement or similar.

Variation in structure, quality or condition of vegetation across a patch of an ecological community does not necessarily mean it should be split into multiple patches. For example, woodland communities often incorporate areas of derived native grassland, which should generally be considered as part of the same patch. Average quality across the largest area that meets the key diagnostics should be used in determining the overall condition of the ecological community. Where the average condition falls below the minimum condition thresholds for a patch as a whole, the largest area or areas that meet minimum condition thresholds should be identified as the patch or patches of the nationally listed ecological community.

Buffer zones

A buffer zone is an area adjacent to a patch of an ecological community (or species habitat) that is important for protecting the integrity of the ecological community. The purpose of a buffer zone is to minimise the risk of indirect impact by physically separating the patch from direct impacts and by identifying it to land managers. For instance, a buffer zone will help protect the root zone of edge trees and other components of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, polluted water runoff and other damage. The best buffer zones are typically comprised of native vegetation. A buffer zone is not part of the ecological community, so while having a buffer zone is strongly recommended, it is not protected as part of the ecological community and is not included in the calculation of the patch size.

The Department may not consider that a retained patch of an ecological community (or species habitat) has been effectively avoided if the design of a development does not include a buffer zone. In these cases, the Department will generally consider the outer edge of the patch (typically up to 30 m) to have been impacted or partially impacted, requiring an appropriate offset.

Outcomes based conditions

Outcomes-based conditions can provide approval holders with greater flexibility and autonomy while still holding them accountable for achieving sound environmental outcomes. The Department promotes the use of outcomes-based conditions where possible, in accordance with its [Outcomes-based Conditions Policy 2016](#).

However, outcomes-based conditions are generally only appropriate where the person proposing to take the action has a good environmental record and the baseline condition of a site is well understood and documented.

Please advise your Assessment Officer if you would like to pursue this approach. Your preliminary documentation would need to:

- thoroughly document the baseline condition of the relevant impacted matter(s)
- identify conservation objectives (outcomes) for the relevant impacted matters, preferably with reference to any applicable conservation advices, recovery plans and threat abatement plans
- outline how performance against specified objectives will be measured and reported