Preliminary documentation:

Residential development, Lot 101 DP 785139, Crest Road, Albion Park, NSW

(EPBC Ref: 2017/8048)

FINAL REPORT

Prepared for Spinitu Pty Ltd

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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	• Confirmed presence of Illawarra Lowlands Grassy Woodland and White-flowered Wax Plant *Cynanchum elegans*. • Confirmed presence of Flame Robin *Petroica phoenica*, Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Little Bentwing Bat *Miniopterus schreibersii oceanensis*, and Little Bent Wing Bat *Miniopterus australis* listed under the BC Act. • Potential that Illawarra Zieria *Zieria granulata* could occur. • Potential for Migratory Species - Black-faced Monarch *Monarcha melanopsis* and Satin Flycatcher *Myiagra cyanoleuca* listed EPBC Act. • Grey-headed Flying-fox *Pteropus poliocephalus* observed over site.
Biosis (2012)	BioBanking Assessment	Lot 101 DP 785139 Crest Road, Albion Park.	• Confirmed presence of Illawarra Lowlands Grassy Woodland and White-flowered Wax Plant *Cynanchum elegans*. • Confirmed roosting habitat for Greater Broad-nosed Bat *Scoteanax rueppellii* and Eastern False Pipistrelle listed under the BC Act. • Confirm non-limiting foraging habitat for Grey-headed Flying-fox *Pteropus poliocephalus*. • Confirmed presence of non-limiting foraging habitat for Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*, and Little Bent Wing Bat *Miniopterus australis* listed under BC Act. • Potential that Varied Sittella *Daphoenositta chrysoptera* and Illawarra Zieria could occur.
Biosis (2017a)	Flora and fauna impact assessment.	Lot 3 DP 1214606, Albion Park (immediately west of the proposed action).	• 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

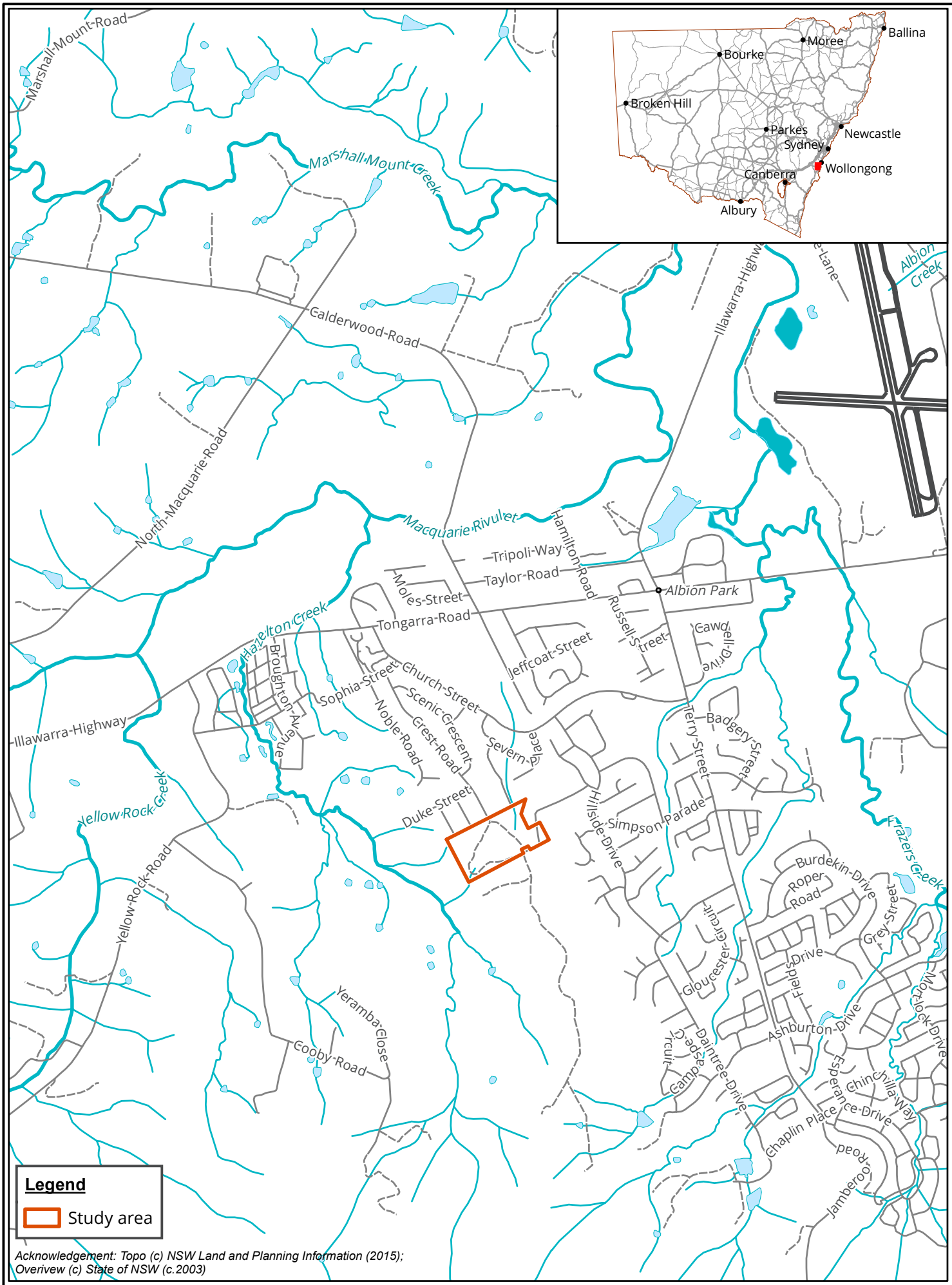
The residential lot proposed layout was selected within the area supporting the lowest condition CEEC (most floristically depauperate and highest edge to core area ratios) areas and scattered trees with highly modified exotic groundcovers. Prior to the development proposal the subdivision footprint area 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.



Acknowledgement: Topo (c) NSW Land and Planning Information (2015); Overivew (c) State of NSW (c.2003)

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\

0 240 480 720 960
Metres
N
Scale 1:24,001 @ A4, GDA 1994 MGA Zone 56

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

N

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_F3_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 eugenioides* 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

N

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_F4_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 *Eucalypt*us 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 *Oryctolagus cuniculus* 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 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:** • 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:** • 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:** • 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:** • 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:** • Retained trees will be protected using appropriate exclusion zoning in accordance with *Australian Standards – Protection of trees on development sites* (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:** • 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		**Construction stage:** • 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: - 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. **Operational stage:** • 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: - 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		**Construction stage:** • 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. **Operational stage:** • 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		**Construction stage:** • 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. **Operational stage:** • 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:** • 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: – 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:** • 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:** • Waste enclosures will be used for all rubbish on site and rubbish will be removed when required or full. **Operational stage:** • 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.	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. 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. • 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	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. Measures including silt fencing, appropriate citing of stockpiles, etc. will substantially reduce the potential for sedimentation or erosion to occur beyond the referral boundary. 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.	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 easy 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	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. The effectiveness of nest boxes varies widely, thus is difficult to predict. Nest box monitoring will guide adaptive management actions if required.	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 tress 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 crtieria 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 Spinitu 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 Spinitu 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
		Alisterus scapularis	Australian King-parrot		#
		Cracticus tibicen	Australian Magpie	#	
		Corvus coronoides	Australian Raven	#	#
		Ceyx azureus	Azure Kingfisher	#	
		Elanus axillaris	Black-shouldered Kite		#
		Acanthiza pusilla	Brown Thornbill	#	
		Scythrops novaehollandiae	Channel-billed Cuckoo	#	#
		Sturnus tristis	Common Myna *	#	#
		Ocyphaps lophotes	Crested Pigeon	#	#
		Platycercus elegans	Crimson Rosella		#
		Eudynamys orientalis	Eastern Koel	#	
		Platycercus eximius	Eastern Rosella		#
		Acanthorhynchus tenuirostris	Eastern Spinebill	#	
		Psophodes olivaceus	Eastern Whipbird	#	
	V	*Petroica phoenicea*	Flame Robin		#
		Eolophus roseicapillus	Galah	#	#
		Cracticus torquatus	Grey Butcherbird	#	#
		Rhipidura albiscapa	Grey Fantail	#	#
		Dacelo novaeguineae	Laughing Kookaburra	#	#

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

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

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	• 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	• 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	• 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	• 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							
Botaurus poiciloptilus	Australasian Bittern	EN	E1	#	Negligible	Suitable habitat not present.	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including *Typha* spp. and *Eleoacharis* spp.. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Rostratula australis	Australian Painted Snipe	VU	E1	1970/#	Negligible	Suitable habitat not present.	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or 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
Ninox connivens	Barking Owl		V	1988	Low	The Barking owl may forage within the study area on occasion. Suitable breeding habitat, in the form of large hollows, not present.	Generally found in open forests, 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.
Ixobrychus flavicollis	Black Bittern		V	1983	Negligible	Suitable habitat not present.	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, 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
Ephippiorhynchus asiaticus	Black-necked Stork		E1	1962	Negligible	Suitable habitat not present.	Found in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated lands and occasionally forages in open grassy woodland. Nests in live or dead trees usually near water.
Dasyornis brachypterus	Eastern Bristlebird	EN	E1	#	Negligible	Suitable habitat not present.	Found in coastal Woodland, dense scrub and heathlands, particularly where it borders taller Woodland.
Sternula nereis nereis	Fairy Tern	VU		#	Negligible	Suitable habitat not present.	A small piscivorous (fish-eating) bird, the Fairy Tern is approximately 22–27 cm in length, 70 g in weight and has a wingspan of 44–53 cm. The Fairy Tern is bulky and round bodied. Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Petroica phoenicea	Flame Robin		V	2011	Recorded	This species was recorded by ELA (2011) along the northern boundary of the site. 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.
Stictonetta naevosa	Freckled Duck		V	2003	Negligible	Suitable habitat not present.	The Freckled Duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.
Callocephalon fimbriatum	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
Calyptorhynchus lathami	Glossy Black-Cockatoo		V, E2	1999	Low	Although indviduals may overfly the study area on occasion significanthabitat features, including breeding habitat and foraging resources, not present	Inhabits forest with low nutrients, characteristically with key *Allocasuarina* species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.

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

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Anthochaera phrygia	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: *E. microcarpa, E. punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E. mckieana, E. macrorhyncha, E. laevopinea* and *Angophora floribunda*. Nectar and fruit from the mistletoes *A. miquelii, A. pendula, A. cambagei* are also eaten during the breeding season. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Lathamus discolor	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 E. robusta, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens.* Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis.* This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Daphoenositta chrysoptera	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							
Hoplocephalus bungaroides	Broad-headed Snake	VU	E1	#	Negligible	Suitable habitat not present.	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.
Amphibians							

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

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

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

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

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Miniopterus schreibersii oceanensis	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
Falsistrellus tasmaniensis	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
Mormopterus norfolkensis	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
Scoteanax rueppellii	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.
Pteropus poliocephalus	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
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	VU	V	#	Low	There are few records of the Koala from the Illawarra floodplain and the species is considered unlikely to occur.	Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include *E. robusta, E. tereticornis, E. punctata, E. haemostoma* and *E. signata*. They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha.
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	#	Low	Whilst individuals may forage over the study area on occasion the study area does not provide roosting habitat.	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in dry sclerophyll forests and 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
Miniopterus australis	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.
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V, E2	#	Negligible	Suitable habitat not present.	Cobaki Lakes and Tweed Heads West population: Occurs from Queensland to Victoria, normally within 50 km of the coast. Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer. This species appears to benefit from a lack of recent disturbance.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pseudomys novaehollandiae	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.
Pseudomys fumeus	Smoky Mouse	EN	E4A	#	Negligible	Suitable habitat not present.	Appears to prefer heathy ridgetops and slopes within sclerophyll forests, heathland and open forest from the coast to sub-alpine regions of up to 1800 m.

Scientific Name	Common Name	EPBC Status	BC Status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	EN	E1	#	Negligible	Suitable habitat not present.	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.
Dasyurus maculatus	Spotted-tailed Quoll	EN	V	#	Low	There is only a few records from the Illawarra floodplain for this species. The study area does not contribute to a significant movement 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
Actitis hypoleucos	Common Sandpiper	#
Anthochaera phrygia	Regent Honeyeater	#
Apus pacificus	Fork-tailed Swift	#
Ardea ibis	Cattle Egret	2015/#
Ardea modesta	Eastern Great Egret	2014/#
Calidris acuminata	Sharp-tailed Sandpiper	2007
Calidris canutus	Red Knot	#
Calidris ferruginea	Curlew Sandpiper	
Calidris melanotos	Pectoral Sandpiper	2007
Calidris ruficollis	Red-necked Stint	2014
Cuculus optatus	Oriental Cuckoo	#
Chalcophaps indica	Emerald Dove	2000
Danaus plexippus	Monarch Butterfly	2009
Gallinago hardwickii	Latham's Snipe	2011/#
Haliaeetus leucogaster	White-bellied Sea-Eagle	2014/#
Hirundapus caudacutus	White-throated Needletail	2010/#
Hydroprogne caspia	Caspian Tern	2012
Lamna nasus	Porbeagel, mackerel shark	#

Scientific Name	Common Name	Most recent record
Limosa lapponica	Bar-tailed Godwit	2011
Merops ornatus	Rainbow Bee-eater	#
Monarcha melanopsis	Black-faced Monarch	2013/#
Motacilla flava	Yellow Wagtail	#
Myiagra cyanoleuca	Satin Flycatcher	#
Neophema chrysogaster	Orange-bellied Parrot	#
Numenius madagascariensis	Eastern Curlew	2002
Pandion haliaetus	Osprey	2014/#
Plegadis falcinellus	Glossy Ibis	1985
Pluvialis fulva	Pacific Golden Plover	1999
Rhipidura rufifrons	Rufous Fantail	2012/#
Rostratula australis	Australian Painted Snipe	2011/#
Symposiachrus trivirgatus	Spectacled Monarch	#
Tringa nebularia	Common Greenshank	2011
Tringa stagnatilis	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	*Acacia binervata*	Two-veined Hickory					1	
	Fabaceae - Mimosoideae	*Acacia fimbriata*	Fringed Wattle						
	Fabaceae - Mimosoideae	*Acacia implexa*	Hickory Wattle						
	Fabaceae - Mimosoideae	*Acacia maidenii*	Maiden's Wattle	1					
	Fabaceae - Mimosoideae	*Acacia mearnsii*	Black Wattle						
	Fabaceae - Mimosoideae	*Acacia parramattensis*	Sydney Green Wattle						
*	Fabaceae - Mimosoideae	*Acacia podalyriifolia*	Queensland Silver Wattle						
	Fabaceae - Mimosoideae	*Acacia saliciformis*							
*	Polygonaceae	*Acetosella vulgaris*	Sorrel						
	Myrtaceae	*Acmena smithii*	Lilly Pilly						

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

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

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

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

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

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

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

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

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

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

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

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

Status	Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6
*	Verbenaceae	*Verbena bonariensis*	Purpletop	2					
	Asteraceae	*Vernonia cinerea* ssp *cinerea*							
	Scrophulariaceae	*Veronica calycina*	Hairy Speedwell						
	Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	1				1	
*	Poaceae	*Vulpia muralis*							
	Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell						
	Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell						
*	Asteraceae	*Xanthium occidentale*	Noogoora Burr						
	Asteraceae	*Xerochrysum bracteatum*	Golden Everlasting						
	Fabaceae - Faboideae	*Zornia dyctiocarpa*	Zornia						
Occurrence of *E.longifolia* or *E.tereticornis*				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	• 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	• 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	• 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	• 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
Boronia deanei	Deane's Boronia	VU	V	#	Negligible	Habitat not present on site	Occurs in Hawkesbury/Nepean and Southern Rivers Catchments. There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains. The species grows on the margins of high altitude swamps, in wet heath and in drier open forest on low nutrient, poorly drained peaty soils on sandstone or granite.
Caladenia tessellata	Thick Lip Spider Orchid	VU	E1	#	Low	This species has not been recorded within 5 kilometres of the study area. Marginal habitat present (low quality & extent).	*Caladenia tessellata* is found in the following Catchment Management Regions Sydney Metropolitan, Southern Rivers, Hawkesbury/Nepean, and Hunter/Central Rivers. Currently known from three disjunct areas: Braidwood on southern tablelands, Ulladulla on the south coast and three populations in Wyong area on the Central Coast. It is generally found in grassy, dry sclerophyll forests/woodland, particularly those associated with clay loam, or sandy soils. However, there is one population at Braidwood in lowland on stony soil. This species only grows in very dense shrubbery in coastal areas. Flowers appear between September and November, but generally late September or early October in extant southern populations.

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Chorizema parviflorum	Eastern Flame Pea		E2	2007	Low	Marginal habitat present (low quality & extent).	Heath and sclerophyll woodland and forest on heavy soils. The endangered population has been recorded from between Austinmer and Albion Park in the local government areas of Wollongong and Shellharbour. All known sites (excluding the site at Austinmer) occupy woodland or forest dominated by Forest Red Gum *Eucalyptus tereticornis* and/or Woollybutt *E. longifolia*. At Austinmer, the species is recorded from a coastal headland.
Cryptostylis hunteriana	Leafless Tongue Orchid	VU	V	#	Low	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 *E.sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis*; appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata*. It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers. Inconsistent flowering times Dec-February; Jan-February (in Victoria)

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Cynanchum elegans	White-flowered Wax Plant	EN	E1	2005/#	Recorded	Species recorded on site in the current and previous surveys.	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan. *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum, Banksia integrifolia subsp. integrifolia*; *E. tereticornis* open forest and woodland; *E. maculata* open forest and woodland; and *Melaleuca armillaris* scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific.
Daphnandra johnsonii	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.	
Genopleasium baueri	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.
Irenepharsus trypherus	Illawarra Irene	EN	E1	2001/#	Negligible	Habitat not present on site	Occurs on coast and escarpment between Wollongong and the Shoalhaven River. Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River. Associated vegetation includes moist sclerophyll forest, Ironwood *Backhousia myrtifolia* thicket, and rainforest.

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Melaleuca biconvexa	Biconvex Paperbark	VU	V	#	Negligible	Habitat not present on site.	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Catchment regions include: Hunter/Central Rivers, Hawkesbury/Nepean, Southern Rivers, and Northern River Catchments. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October.

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pimelea spicata	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).	Once widespread on the Cumberland Plain, *Pimelea spicata* occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Catchment areas are Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment. In the Illawarra region, *P. spicata* is found in open woodland and also in coastal grassland communities with emergent shrubs. Dominant species within the woodland habitat include *E. tereticornis, E. eugenioides, Themeda australis*, and *Lomandra longifolia*. In coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey. *Pimelea spicata* flowers sporadically throughout the year, with flowering likely to depend upon climatic conditions, particularly rainfall. Flowering times recorded for *P. spicata* vary. Rye (1990) noted flowering period as May - January; Benson and McDougall (2001) noted peak flowering period as March/ April.

Scientific Name	Common Name	EPBC status	BC status	Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description
Pterostylis gibbosa	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 *Eucalyptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E.tereticornis* and *E. paniculata*. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. The Illawarra Greenhood can survive occasional burning and grazing because of its capacity to reshoot from an underground tuber.
Solanum celatum			E1	2010	Low	Marginal habitat present (low quality & extent).	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forest

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Thesium australe	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. *Thesium australe* is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass. It is often found in damp sites in association with *Themeda australis*, but also found on other grass species at inland sites. Occurs on clay soils in grassy Woodland or coastal headlands.
Zieria granulata	Illawarra Zieria	EN	E1	2010/#	Medium	Records of species adjacent to the site. Habitat present on site.	Occurs in the Kiama district where it grows on dry rocky ridges in sclerophyll forest to rainforest margins. The species primarily occupies the coastal lowlands between Oak Flats and Toolijooa, in the local government areas of Shellharbour and Kiama. The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments. Associated vegetation includes *Melaleuca armillaris* scrub, *E. tereticornis* woodland and rainforest margins, although the species has been recorded from a number of other vegetation types

* - 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.