Ingleside Precinct – Draft Biodiversity Assessment Report

Prepared for
Department of Planning and Environment

October 2016

DOCUMENT TRACKING

Item	Detail
Project Name	Ingleside Draft Biodiversity Assessment Report
Project Number	13SYDPLA-0039
Project Manager	Steven Ward
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Reviewed by	Steven Ward, Mark Adams
Approved by	Mark Adams
Status	Final
Version Number	8
Last saved on	28 October 2016
Cover photo	Top Coastal Upland Damp Heath Swamp (EEC). Bottom left to right: *Xanthorrhoea arborea*, *Grevillea caleyi* (threatened flora species), *Scaevola ramosissima* and Needlebush - banksia wet heath community.

This report should be cited as 'Eco Logical Australia 2016. *Ingleside Biodiversity Certification: Draft Biodiversity Assessment Report*. Prepared for Department of Planning and Environment.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Department of Planning & Environment and Pittwater Council.

4 Conservation and management recommendations

The section provides recommendations on ecological connectivity, identifies recommended areas of priority for ecological management (management units), and provides management recommendations. These informed the development of the Draft Structure Plan.

4.1 Proposed Wildlife Corridors

The Ingleside Precinct is a challenging site with regards to ecological connectivity, as conservation areas adjoin almost all sides of the BCAA, but vegetation within the site is a mixture of cleared lands, remnant vegetation, and disturbed vegetation. There is no single solution with regards to ecological corridors and connectivity. As a consequence, the following approach was used to identify potential wildlife corridors in the BCAA for further consideration:

- The Refined Corridor Mapping (ELA 2010a) and Pittwater Council Corridor (2011) mapping were considered.
- Corridors connected management units see Section 4.1 (i.e. areas identified as having important habitat) with each other and large core habitat areas being Ku-ring-gai Chase, Garigal National Park, Minkara Reserve, Katandra Bushland Sanctuary, and Ingleside Chase Reserve outside the BCAA.
- Corridors may be bisected by roads. Major roads such as Mona Vale Road and Powderworks Road are barriers to fauna movement, and consideration should be given to incorporating measures to enhance fauna movement. RMS are preparing a Fauna Connectivity Strategy as part of the detailed design for the Mona Vale Road upgrade in consultation with DP&E and Council.
- Corridors are generally contiguous areas of native vegetation and do not follow property boundaries.

In addition, buffers to protect adjacent conservation areas such as National Parks and council reserves were mapped. Based on the above, the following were identified and are illustrated in **Figure 30**.

- Regional Corridors:
  - Connect large core habitat outside the Biocertification Area
  - Extends along Wirreanda Creek

- Local Corridors:
  - Connect management units with each other and with large core habitat outside the BCAA

- Habitat Buffers

Where possible ecological corridors and habitat buffers are integrated into the Draft Structure Plan.

4.2 Management units

The ecological values of the site are highly variable. Areas of high biodiversity significance were identified during field validation. Areas include the presence of EECs, threatened flora species or likely habitat for threatened fauna species, highly diverse vegetation and wildlife corridors. Nine management units were

developed from the above criteria and are represented in **Figure 30**. Justification for the selection of each management unit is provided in **Table 13**.

Table 13: Management units and their ecological values.

Name	Ecological Justification	Priority
1 National Parks link	• Corridor occurs on lands owned by Ku-ring-gai Chase National Park • Represents a significant link between Garigal and Ku-ring-gai Chase National Parks • Potential habitat and wildlife corridor for threatened fauna species, in particular Rosenberg's Goanna and potentially Southern Brown Bandicoot. • Facilitates dispersal of fauna species and prevents inbreeding or local extinctions between vegetation • Threatened by road upgrade and weed invasion	High
2 Ingleside Scout Camp	• Red Flags (EEC) - Coastal Upland Damp Heath Swamp (EEC) including both sub-communities present in good condition. • Groundwater Dependant ecosystems (GDE) • Presence of vegetation communities not represented elsewhere within the BCAA • Biodiversity 'hot-spot' - highly diverse floristic assemblage and habitat diversity • High potential for threatened fauna presence • Connectivity with Ku-ring-gai Chase National Park in the north and vegetation patches • Threats include increase in runoff into EECs and National Park and subsequent weed establishment	High
3 Upper Walter Road to Ku-ring-gai Chase National Park link	• Significant biodiversity corridor between Ku-ring-gai Chase National Park and Minkara Reserve, and Katandra Bushland Sanctuary • Contains large tracts of intact vegetation • Potential habitat for threatened species including Eastern Pygmy Possum, Rosenberg's Goanna and Southern Brown Bandicoot • Threats include inappropriate fire regimes, fragmentation, weed invasion and development on the eastern side of precinct	High
4 Cicada Glen Creek junction	• Headwaters of Cicada Glen and unnamed tributary which flows into Ku-ring-gai Chase National Park. • Represents significant flora diversity and diversity of vegetation communities in small area • Large tracts of vegetation and existing wildlife corridor between Ku-ring-gai Chase National Park and adjacent habitats • Contains large remnant trees and potential habitat for threatened species including red flag species • Vegetation threats include infestation of weeds particularly in the riparian areas	Moderate

5 Baha'i Temple grounds and adjacent lands	• Red Flags
	  ○ Population of threatened flora species (*Grevillea caleyi*)
	  ○ EEC - Duffys Forest
	• Important wildlife corridor to adjacent habitats
	• Threats include road upgrades, inappropriate fire regime, weed infestation
		High

6 Wirreanda Creek corridor	• Significant potential habitat for threatened fauna species • Wildlife corridor and vegetation buffer adjacent to Ku-ring-gai Chase National Park • Vegetation buffer along creek line which flows into National Park	Moderate

Name	Ecological Justification	Priority
7 Powderworks Heath	• Known population of Eastern Pygmy Possum (threatened species) • Significant example of large intact vegetation of sandstone heath in highly urbanised area • Provides habitat and wildlife corridor for other threatened fauna • Threats include loss of vegetation and connectivity	Moderate
8 North of Mullet Creek	• Suitable 'stepping-stone' habitat for threatened fauna within urbanised area • Part of linkage between Garigal National Park and Ingleside Chase Reserve • Potential area for rehabilitation • Prone to weed infestation and urban development	Moderate
9 Laurel Road	• Suitable 'stepping-stone' habitat for threatened fauna within urbanised area • Part of linkage between Garigal National Park and Ingleside Chase Reserve • Potential area for rehabilitation • Prone to weed infestation and urban development	Moderate

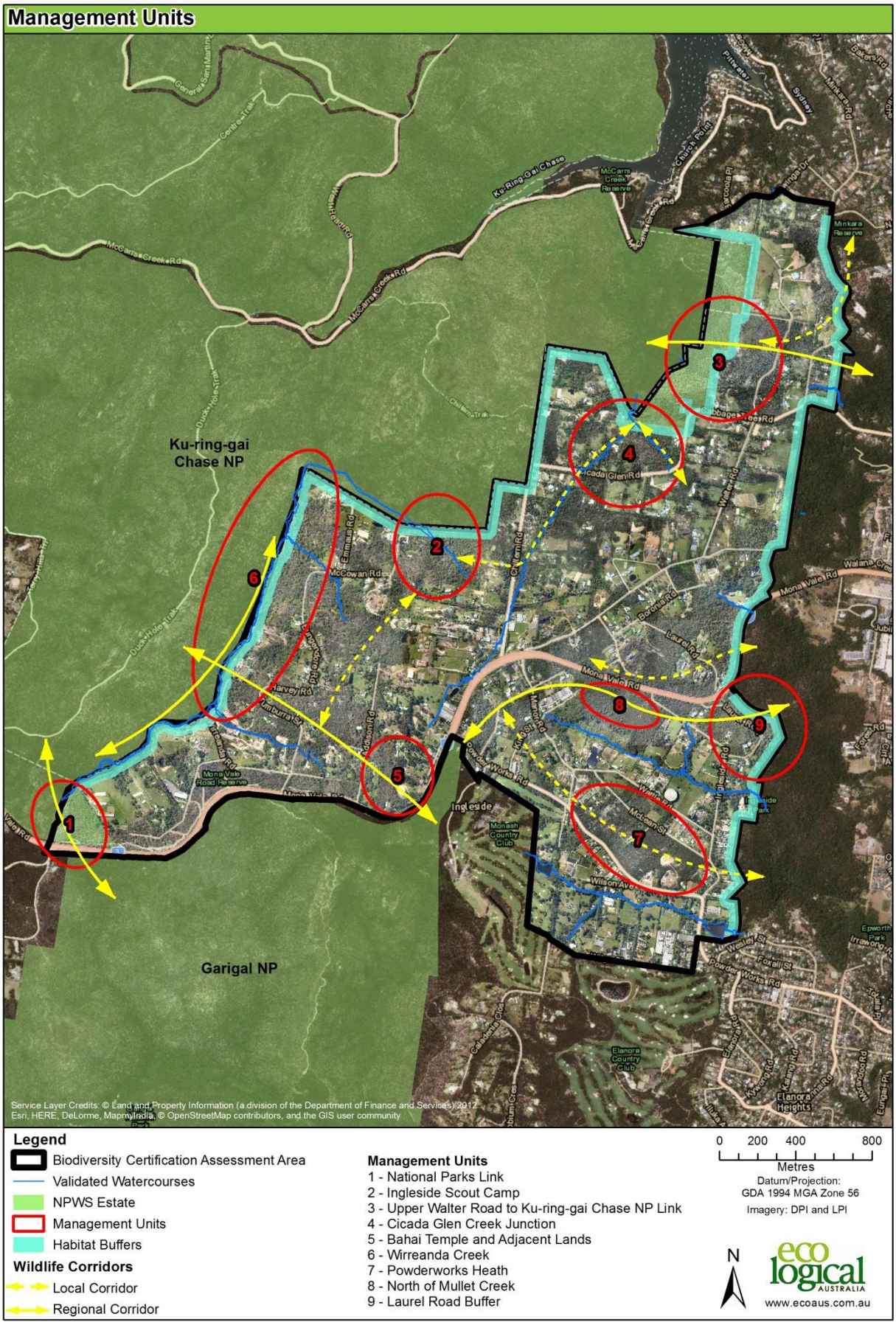

Figure 31: Map of Management Units, habitat buffers and wildlife corridors.

4.3 Management of Ecological Values within the Ingleside Precinct

Vegetation within the BCAA incorporates EECs, other vegetation, riparian zones, threatened species and their habitat. The vegetation has high species diversity and connectivity to large areas of currently conserved lands in some locations, or provides linkage between currently conserved lands. Two EECs have been recorded during the field surveys. While the overall vegetation is in a good condition with high species diversity and connectivity, there are a number of factors which may reduce the biodiversity values of the BCAA.

Infrastructure, clearing of land and urban development has fragmented vegetation with the BCAA. Roads create physical barriers which limit the ability for fauna and flora dispersal. Roads may also facilitate the spread of exotic weed and pest species, and are a source of nutrient flow into the adjacent bushlands and creeks. These factors may have a negative influence on biodiversity within the BCAA.

Appropriate fire regimes are a key management strategy for management of vegetation structure and threatened species habitat. There are examples of areas which require fire and other areas which have fire regimes at too great a frequency. Heath type vegetation mapped within the eastern extent of the BCAA will require future ecological burns to stimulate the regeneration of foraging habitat threatened fauna species, such as the Eastern Pygmy Possum and Southern Brown Bandicoot (DE 2014). However, the needs of various plant and animal species will need be balanced when planning such ecological burns.

Weeds have established across the BCAA. Higher concentrations were observed below cleared / grazed paddocks, along roadside vegetation and waterways. There were three major weed species commonly recorded: *Ageratina adenophora* (Crofton Weed), *Cortaderia selloana* (Pampas Grass) and *Lantana camara* (Lantana). Other weeds such as *Rubus fruticosus* spp. aggregate (Blackberry), *Lonicera japonica* (Japanese Honeysuckle) and *Andropogon virginicus* (Whisky Grass) were less widely dispersed but have the potential to spread rapidly under suitable environmental conditions. Observations of a number of *Ludwigia peruviana* (Peruvian Primrose) within Cicada Glen Creek are a concern and it is recommended that this weed be controlled before it spread into adjacent lands.

Control of weeds needs to target areas of high native resilience and EECs and threatened species habitat. Priority weed control areas include Baha'i Temple (around *Grevillea caleyi* population and DFEC) and along Wirreanda Creek (especially near the nursery).

Mona Vale Road and other major roads such as Powderworks Road are likely to currently be physical barriers for the dispersal of fauna into adjoining habitats. RMS are in the process of designing an upgrade of a 3.3 km section of Mona Vale to a dual lane carriage, and that fauna crossings will be included as part of the design. Wherever possible, the location of fauna crossings should link with the ecological corridors adopted in the Structure Plan (refer to **section 5.1** and **Figure 32**). Cleared areas also limit the movement of fauna species between habitats. Information on potential ecological corridors within the BCAA is provided in **Section 4.2**.

Evidence of feral animals and domestic animal activity were noted within the BCAM including conservation areas (Ku-ring-gai Chase National Park). The European Red Fox (*Vulpes vulpes*) is listed as a key threatening process in the decline of the Southern Brown Bandicoot (DEC 2006; DE 2014) and may also impact on other native fauna such as Eastern Pygmy Possum. A collaborative approach between Pittwater Council and OEH (and any conservation landholders) for fox control is recommended for the Southern Brown Bandicoot and Eastern Pygmy Possum. Rabbit warrens were noted in within a patch of DFEC which contained *Grevillea caleyi*. It is recommended that the timing of rabbit control program(s) should follow fox baiting.

Weed invasion, herbivory, urban development and land clearing have the potential to impact threatened flora species within the BCAA. Weed invasion by *Lantana camara, Ligustrum sinense* (Narrow-leaved Privet) and *Ageratina adenophora,* and grazing by rabbits, may have reduced the population of *G. caleyi*. High density weed invasion was noted during targeted surveys in areas of previously recorded threatened species (*Pimelea curviflora* var. *curviflora*).

Urban runoff from stormwater outlets, horse arenas and roads are a source of pollutants, nutrients and weed propagules. The BCAM contains GDEs and is the source for a number of creeks which drain into the Hawkesbury River system, and ultimately Broken Bay.

Cleared areas which do not contain native vegetation (**Figure 9**) are considered low ecological constraints and are suitable for urban development. These areas are located outside riparian and wildlife corridors and are unlikely to impede the movement of fauna species through the landscape. Areas of vegetation which are identified as 'fragmented' and 'weedy' may also be suitable for development, though areas which are consistent with EECs may provide some constraint.

Recommendations are made which apply to the entire site, followed by additional specific recommendations for each management unit in the following sections.

4.4 Management recommendations

The following management recommendations have been provided for areas to be conserved within the BCAA.

4.4.1 General management unit recommendations

1. Protect and manage areas of 'high' ecological constraint (**Table 13**).
2. Retain the majority of areas of 'moderate' ecological constraint (**Table 13**). The long-term management of smaller areas of 'moderate' constraint should be considered, and if these patches are not retained their loss should be offset through rehabilitation or restoration to consolidate remnants and link priority areas.
3. Provision of a vegetation buffer along conservation areas such as National Park and Council reserves to retain wildlife corridors and protect conservation areas. Buffer areas would also assist in bushfire management, both ecologically and by reducing the level of bushfire risk for development. Seek to manage invasive weed species in these buffer areas.
4. Asset protection zones should not be located in areas set aside for conservation (either wildlife corridors or in National Parks or Council reserves).
5. Investigate the possibility of "ecological burns" in a matrix of unburnt and burnt design to provide foraging habitat for threatened fauna species such as the EPP. The aim of these would be to remove weed growth and rejuvenate native shrub growth in heath, woodland and riparian habitats. Management post fire would also be required.
6. Undertake best practice soil erosion control during construction, and maintain as required, to prevent sediment flow into watercourses and into management units.

The following specific management recommendations have been provided for each management unit.

4.4.2 National Parks link Management Unit Recommendations

- Maintain corridor link between Garigal and Ku-ring-gai Chase National Park. Liaise with RMS on Mona Vale Road upgrade and ecological crossings to retain wildlife links and reduce fauna mortality

4.4.3 Ingleside Scout Camp Management Unit Recommendations

- Seek to retain vegetation and consider conservation options - area may be suitable for Biobanking site
- Monitoring of water quality before and on-going during development to protect sensitive waterways and GDE ecosystems

4.4.4 Upper Walter Road to Ku-ring-gai Chase National Park link Management Unit Recommendations

- Seek to retain vegetation and consider conservation options
- Establish a weed control program for weed infestations, mainly along the road verge
- Control *Eucalyptus saligna* encroachment into adjacent vegetation and revegetate with local provenance species
- Restrict access into corridor by dogs, and recreational users such as horse riders, and trail bikes

4.4.5 Cicada Glen Creek Junction Management Unit Recommendations

- Seek to retain vegetation and consider conservation options
- Maintain riparian vegetation buffer
- Retain significant remnant trees with hollows
- Control weeds for weed infestations along headwaters and off Cicada Glen Road
- Exclude APZ from within this vegetation buffer to protect threatened species habitat

4.4.6 Baha'i Temple grounds and adjacent lands Management Unit Recommendations

- Protect DFEC and *Grevillea caleyi* from further clearing and disturbance
- Collaborate with land holders and RMS for vegetation and *Grevillea caleyi* management, weed control, fire management and feral animal control

4.4.7 Powderworks Heath Management Unit Recommendations

- Seek to conserve area due to significant EPP habitat and consider conservation options
- Seek to conduct feral animal control (primarily foxes)
- Seek to fence boundaries to protect trampling and human interference
- Seek to maintain connectivity with Ingleside Chase Reserve to east using 'stepping stone' habitat
- Consider additional ecological connectivity resources such as culverts.

4.4.8 North of Mullet Creek Management Unit Recommendations

- Seek to retain vegetation
- Seek to enhance connectivity to Ingleside Chase Reserve
- Consider conservation options

4.4.9 Laurel Road Management Unit Recommendations

- Seek to maintain connectivity with adjacent Katandra Bushland Sanctuary and to 'North of Mullet Creek Management Unit'
- Seek to protect habitat including large remnant trees
- Consider conservation options

5 Draft Structure Plan Outcomes

The Draft Structure Plan has been assessed for its ecological impacts and the broad outcomes are:

- Just over 30% of lands within the Ingleside Precinct are proposed to be either an Environmental Conservation or Environmental Management land use. This is in addition to lands currently conserved within National Parks.
- The vast majority (96%) of the 9.05 ha of EECs present are being conserved.
- Of the 291.87 ha of native vegetation which is not listed as threatened and is in 'good' condition:
    - 48% will be conserved,
    - 29% retained (no change in status),
    - 22% being impacted by development land use,
    - 1% is within water management land use.
- For threatened flora, no *Grevillea caleyi* are within development areas. For *Microtis angusii* (Angus Onion Orchid) 69% of *Microtis angusii* individuals are in conservation areas, 9% are within development areas, and land use for the remainder will not change.
- As the majority of good condition native vegetation on site is being conserved or retained, similarly the majority of habitat for threatened fauna species credit species is also being conserved or retained.
- It is anticipated that red flag variations will be required for the minor impacts on Coastal Upland Swamp EEC (due to impact on 0.35 ha of the total 3.33 ha present, and all areas triggering a red flag), *Microtis angusii* (as 373 individuals within the development land use is more than the 150 'negligible loss' permitted per CMA area before a red flag is triggered), and Southern Brown Bandicoot habitat (as any impact on habitat triggers a red flag).

These outcomes for biodiversity values in terms of ecosystem and threatened species credits will be quantified when Biodiversity Certification is sought, which is anticipated to occur in conjunction with the rezoning application.

The amount of native vegetation within these groupings was identified, and is presented in **section 5.1**.

5.1 Ecological Corridors

Ecological corridors across the Ingleside Precinct have been considered and integrated into the Draft Structure Plan via proposed ecological corridor connections. The recommended wildlife corridors shown in **Figure 31** have been compared against the Draft Structure Plan outcomes, in **Table 14** below. The numbering in **Table 14** refers to labelled ecological corridors in **Figure 32**.

Table 14: Comparison of Draft Structure Plan Corridors against recommended wildlife corridors.

Corridor No. (Figure 32)	Comment
1	The Draft Structure Plan is consistent with the recommended wildlife corridor.

Corridor No. (Figure 32)	Comment
2	A portion of this recommended wildlife corridor will be secured as the Baha'i Temple lands within management unit 5 are proposed for Environmental Management, and some of the lands in the centre of this corridor are proposed for Environmental Conservation. There is also no proposed adjustment to land use in this region, and thus any proposed vegetation removal in this area would continue to be subject to current development approval requirements. The Draft Structure Plan proposes to secure the recommended local wildlife corridor via Environmental Conservation, and to extend this to the and across Mona Vale Road by linking in with a proposed fauna underpass (**Figure 32**).
3	The Draft Structure Plan is broadly consistent with the recommended wildlife corridors.
4	The Draft Structure Plan is broadly consistent with the recommended wildlife corridors.
5	The Draft Structure proposes to deliver an additional ecological corridor connection via Environmental Conservation to provide additional ecological connectivity. This corridor includes an area of Coastal Upland Swamps EEC, and will help to facilitate ecological connectivity. Revegetation of some lands north of Land Cove Road will be required to make this corridor functional from an ecological perspective.
6	The Draft Structure Plan includes an ecological corridor along the northern tributary of Mullet Creek, though it does not extend as far west as the recommended wildlife corridor. Revegetation of some lands will be required to make this corridor functional from an ecological perspective.
7	The Draft Structure Plan is broadly consistent with these lands proposed to be Environmental Conservation or Environmental Management, delivering connectivity in an east-west direction.
8	The Draft Structure Plan includes an ecological corridor along the southern tributary of Mullet Creek, which is in addition to the recommended wildlife corridor. Revegetation will be required to make this corridor functional from an ecological perspective.

The proposed ecological corridors in the Draft Structure Plan generally accommodate the wildlife corridors recommended in this report (**Figure 31**).

It is also noted that regional and local road corridors pass through the proposed ecological corridors. A number of fauna movement structures are proposed with the Mona Vale Road upgrade works, and are being considered by Roads and Maritime Services as part of the upgrade for this road. To allow the proposed ecological corridors to function effectively with facilitating fauna movements, it is recommended that options are investigated for fauna movement structures for the local road corridor network in the future. In this regard, a *Fauna Connectivity on Local Roads Strategy* will be prepared to support the Biodiversity Certification application. This will broadly identify the target species, the crossing points, and engineering feasibility and cost. However, **Figure 33** identifies both existing culvert locations and potential future fauna crossing points over local roads.

Existing culvert locations may require upgrades to facilitate fauna movements. It is noted that the delivery of these fauna culverts on local roads may be subject to engineering constraints.

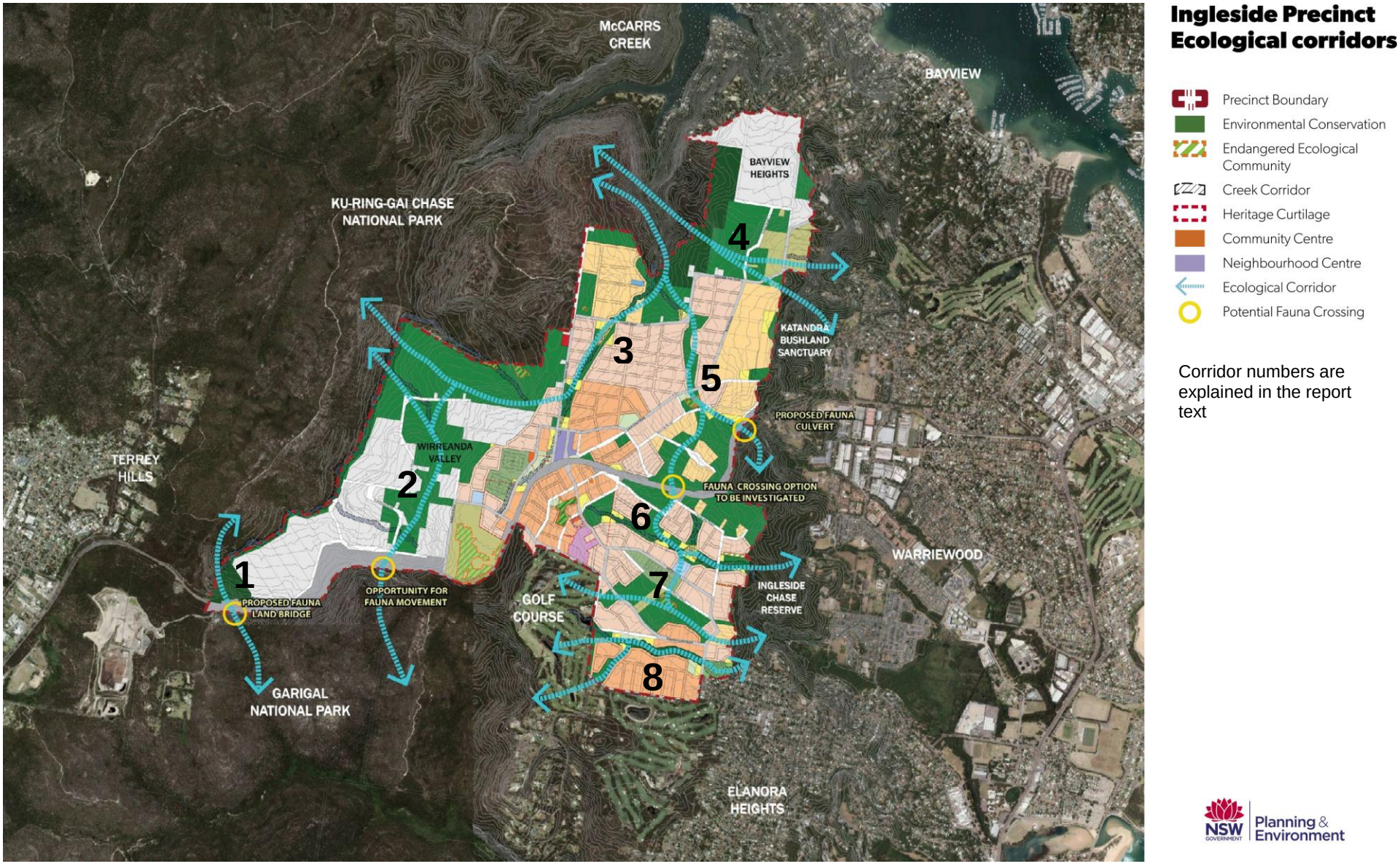

Figure 32: Draft Structure Plan for ecological corridor connections

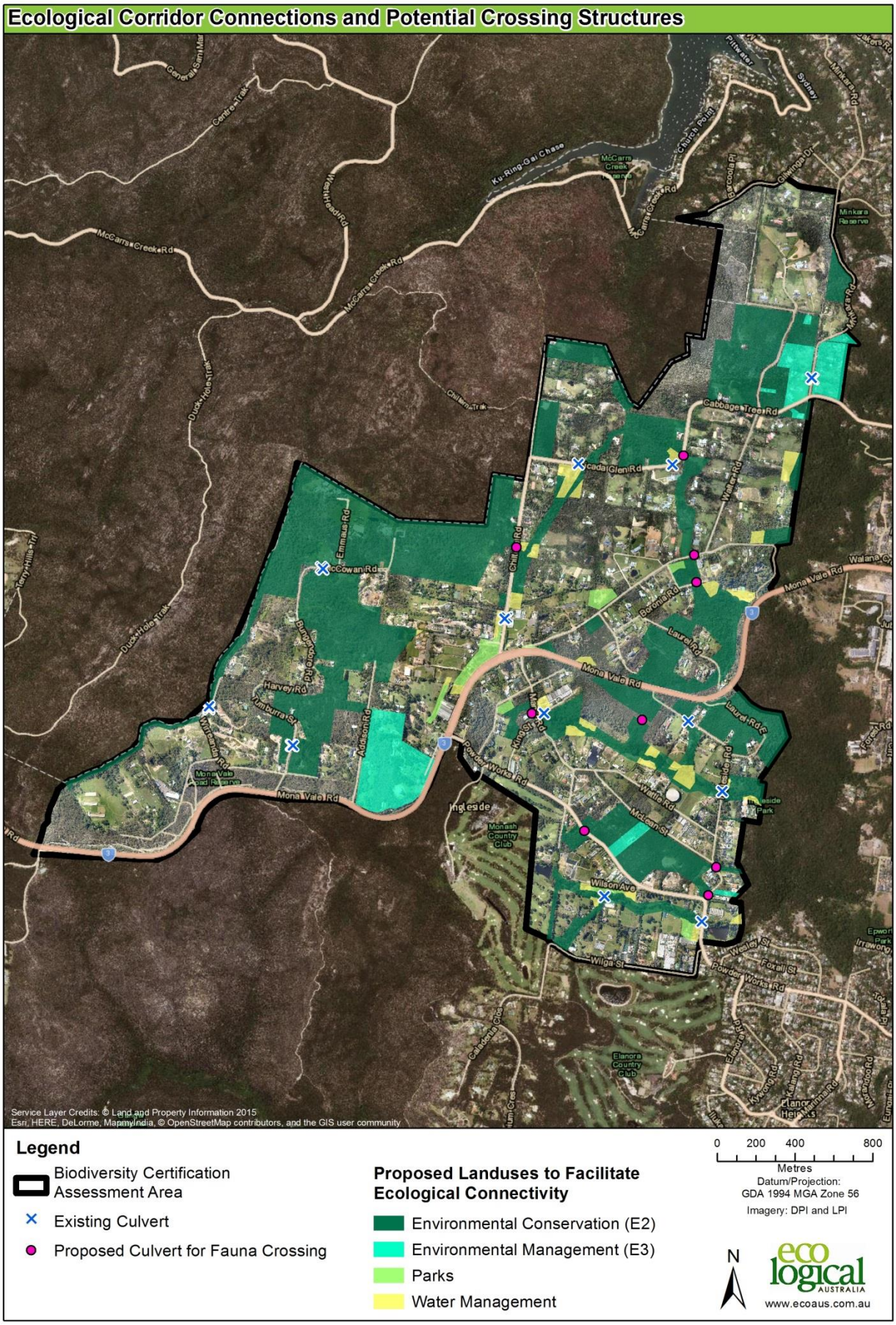

Figure 33: Ecological corridor connections and potential crossing structures

5.2 Vegetation Outcomes

Two Endangered Ecological Communities (EECs) are located within the Ingleside Precinct. A small area of 0.35 ha of Coastal Upland Swamp will be affected by development, but the remainder will be conserved (**Table 15**). Duffy's Forest Ecological Community (DFEC) either falls within Environmental Management area, or lands which will be retained with no change in land use (**Table 15**). The amount of EEC to be developed (0.35ha) is 4% of the total amount of EEC within the precinct (9.05 ha).

Of the 350.94 ha of native vegetation within the Ingleside Precinct, a total of 299.96 ha (85%) was mapped as being in "good" condition (**Table 15**). Of this total, 8.09 ha consist of EEC vegetation in "good" condition.

Overall, of the 291.87 ha of native vegetation which is not listed and is in 'good' condition, a total of 141.29 (48%) will be conserved within the Environmental Conservation and Environmental Management land use areas combined, 2.43 ha (1%) will be within water management, 84.65 ha (29%) is within retained lands where any subsequent development will be subject to standard assessment protocols, and 63.5 ha (22%) is within the development footprint (**Table 15**).

Table 15: Landuse outcomes for native vegetation.

Vegetation	Condition	Proposed Environmental Conservation (ha)	Proposed Environmental Management (ha)	Water Management (ha)	Retained (ha)*	Development (ha)**	Total*
Coastal Upland Swamp in the Sydney Basin Bioregion	All good condition	2.98	-	-	-	0.35	3.33
Duffys Forest ecological community in the Sydney Basin Bioregion	4.76 ha good condition and remainder weedy or fragmented	-	5.02	-	0.7	-	5.72
Other native vegetation	Good	136.94	4.35	2.43	84.65	63.5	291.87
	Bluegum (where canopy trees replaced by planted bluegum trees)	0.74	-	-	0.5	-	1.24
	Fragmented (mainly native canopy trees)	0.49	0.89	-	3.74	6.51	11.63
	Weedy (moderate to heavy weed presence)	11.59	0.35	0.92	7.69	16.6	37.15
Cleared		38.12	14.26	7.38	96.12	208.64	364.52
Total		**190.86**	**24.87**	**10.73**	**193.4**	**295.6**	**715.46**

This report has utilised the original precinct boundary which includes approximately 12.08 ha in additional areas due to the golf course land being removed from the revised precinct boundary, plus multiple other boundary adjustments. The golf course and any other areas that are not included in the new boundary have been treated as 'status quo' (or 'retained') in terms of outcomes; and thus these differences in area will not affect the biodiversity outcomes from an impact assessment perspective.

* Retained – These are lands where the current land use will remain. This includes the Mona Vale Road Corridor, National Park estate, and lands which will continue to be rural land use and associated local roads servicing these areas.

** Development – All other proposed land uses not covered by the other categories above. It includes areas proposed for housing development, local roads in areas to be developed, schools, and sporting fields.

5.3 Threatened Species Outcomes

For *Grevillea caleyi* none of the individuals detected are in areas proposed for development as part of the Draft Structure Plan. All are in areas identified for Environmental Management land use associated with the Baha'i Temple or in retained lands.

Due to the uncertainty regarding the current classification of *Microtis angusii*, a precautionary approach has been taken. Based on this approach, approximately 69% of *Microtis angusii* recorded across the precinct are proposed to be conserved in an environmental conservation land use (**Table 16**).

Table 16: *Microtis angusii* within the Precinct

Precinct Land Use	Numbers of *Microtis angusii*	Percentage
Conservation	2,966	~ 69%
Retained	937	~ 22%
Development	373	~ 9%
Total	4,276	

The habitat for the threatened fauna species credit species is generally associated with the areas of native vegetation present, though full details of how the species polygons have been provided in **Appendix B**. Thus the outcomes for these species will general reflect the outcomes for native vegetation. These outcomes will be quantified in the full Biodiversity Certification Assessment.

5.4 Red Flag Variations and Expert Reports

5.4.1 Red Flag Variations

Red flag variations are required when red flags are triggered. Based on the Draft Structure Plan the following outcomes are anticipated with regards to red flag variations:

- A critically endangered or endangered ecological community listed under the TSC Act or EPBC Act:
    - Coastal Upland Swamps in the Sydney Basin Bioregion EEC. A red flag variation will be required for the development of a small (0.35 ha) patch of this vegetation community
    - Duffys Forest ecological community in the Sydney Basin Bioregion EEC. None of this vegetation is within proposed development areas, and thus no red flag variation will be required.
- A vegetation type that is greater than 70% cleared as listed in the Vegetation Types Database:
    - None of the vegetation communities are >70% cleared in the Hawkesbury Nepean CMA and thus no red flag variation will be required.
- Areas listed as a State Environmental Planning Policy (SEPP) 14 wetland:
    - No SEPP 14 wetlands are present and thus no red flag variation will be required.
- One of more threatened species in the Threatened Species Profile Database that cannot withstand further loss in the CMA:
    - *Grevillea caleyi.* None of the individuals detected are in areas proposed for development as part of the Draft Structure Plan, and thus a red flag variation should not be required.
    - *Microtis angusii*. A total of 373 individuals are currently identified as being present within the development lands. The 'negligible loss' is 150 per CMA area (and Ingleside straddles

Sydney Metro and Hawkesbury Nepean CMA's so total negligible loss may be up to 300. Nevertheless, a red flag variation will be required as the total loss is greater than 300.
    - The remaining threatened flora species have not been detected despite survey, and thus it is anticipated that red flag variation will not be required for these species.
    - Southern Brown Bandicoot will require red flag variation.
    - With regards to the koala endangered population, the population on the Barrenjoey peninsula is now considered locally extinct. The potential koala habitat which has been mapped is connected to the much larger areas of habitat and koala population within Ku-ring-gai and Garigal National Parks. Therefore it is considered that should koalas be present within the Pittwater Precinct, these would not be part of this endangered population and therefore a red flag variation would not be required.
    - The remaining threatened fauna species do not have red flag variation triggers.
- Areas of vegetation recognised as having regional or state biodiversity conservation significance:
    - Small portions of Wirreanda Creek, Cicada Glen Creek, and the Mullet Creek tributaries are identified as red flag areas (**Figure 30**) and will be within the Water Management landuse. It is anticipated that this vegetation will not require clearing, and thus red flag variation will not be required.

In summary, it is anticipated that red flag variations will be required for Coastal Upland Swamps in the Sydney Basin Bioregion EEC, *Microtis angusii,* and Southern Brown Bandicoot.

5.4.2 Expert Reports

The presence of threatened species in development areas proposed for biodiversity certification can be assumed. However, existing information, known population locations, targeted survey, or expert reports are required to support the generation of credits for threatened species in biodiversity certification conservation lands.

Surveys have been undertaken for threatened flora species and none have been detected, so it is anticipated that expert reports will not be required for these species. There are recent records of presence for Eastern Pygmy Possum (*Cercartetus nanus*) within lands proposed for conservation in the Draft Structure Plan. Thus, it is anticipated that an expert report will not be required for this species.

It is anticipated that expert reports will be required for the presence of habitat within the biodiversity certification conservation lands for the following threatened species, which do not have recent records or surveys undertaken:

- *Heleioporus australiacus* (Giant Burrowing Frog)
- *Pseudophryne australis* (Red-crowned Toadlet)
- *Phascolarctos cinereus* (Koala)
- *Myotis macropus* (Southern Myotis)
- *Isoodon obesulus obesulus* (Southern Brown Bandicoot)
- *Varanus rosenbergi* (Rosenberg's Goanna)

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Appendix A: Database species list

Flora species

Scientific Name	Common Name	Conservation status		BCAM Survey Months	Data Source			Likelihood of occurrence	Does this species require consideration under BCAM?
		TSC Act	EPBC Act		TSC (5km)	EPBC (5km)	Other*		
Acacia bynoeana	Bynoe's Wattle	E1	V	Sept - Mar		N/A	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Acacia prominens - endangered population	-	E2	-	All year		N/A	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Acacia pubescens	Downy Wattle	V	V	All year		N/A	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Acacia terminalis subsp. terminalis	Sunshine Wattle	E1	E1	All year		✓	2	Potential, suitable habitat	Yes
Allocasuarina portuensis	-	E1	E1	All year			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Ancistrachne maidenii	-	V	-	Dec - Feb			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Asterolasia elegans	-	E1	E1	All year	N/A	2	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Caladenia tessellata	Thick Lip Spider Orchid	E1	V	Sept- Oct	N/A	2	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Callistemon linearifolius	Netted Bottle Brush	V	-	Sept - Mar	✓		2	Potential, suitable habitat	Yes
Chamaesyce psammogeton	Sand Spurge	E1	-	n/a	✓			Unlikely, not suitable habitat	No, this species is unlikely to occur in BCAA
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Nov - Feb	✓	✓	2	Unlikely, one old record	No, this species is unlikely to occur in BCAA
Darwinia biflora	-	V	V	Sept - Feb	N/A		2	Potential, suitable habitat	Yes
Darwinia glaucophylla	-	V	-	All year	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Darwinia peduncularis	-	V	-	All year	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA

Scientific Name	Common Name	Conservation status		BCAM Survey Months	Data Source			Likelihood of occurrence	Does this species require consideration under BCAM?
		TSC Act	EPBC Act		TSC (5km)	EPBC (5km)	Other*		
Diuris bracteata	-	E1	-	n/a	✓			Unlikely, occurs in Gosford area. No suitable habitat	No, this species is unlikely to occur in BCAA
Epacris purpurascens var. purpurascens	-	V	-	All year	✓		2	Potential, suitable habitat	Yes
Eucalyptus camfieldii	Camfield's Stringybark	V	V	All year	✓	✓	2	Potential, suitable habitat	Yes
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	n/a	✓			Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Eucalyptus scoparia	Wallangarra White Gum	E1	V	n/a	✓			Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Galium australe	-	E1	-	Nov - Mar	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Genoplesium baueri	Bauer's Midge Orchid	E1	-	Dec- Mar	✓		2	Unlikely, old records	No, this species is unlikely to occur in BCAA
Grammitis stenophylla	Narrow-leaf Finger Fern	E1	-	n/a	✓			Unlikely, old records	No, this species is unlikely to occur in BCAA
Grantiella picta	Painted Honeyeater	V	V	n/a		✓		Unlikely, suitable habitat is west of the dividing range	No
Grevillea caleyi	Caley's Grevillea	CE	E1	All year	✓	✓	1, 2	Known, previous records	Yes
Grevillea parviflora subsp. supplicans	-	E1	-	All year	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Haloragodendron lucasii	-	E1	E1	All year	✓	✓	2	Unlikely, occurs outside study area	No, this species is unlikely to occur in BCAA
Hibbertia puberula	-	E1	-	All year			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Hibbertia procumbens	Spreading Guinea Flower	E1	-	Dec - Mar	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Hygrocybe rubronivea	-	V	-	May - Aug			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Kunzea rupestris	-	V	V	All year	N/A	✓	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA

Scientific Name	Common Name	Conservation status		BCAM Survey Months	Data Source			Likelihood of occurrence	Does this species require consideration under BCAM?
		TSC Act	EPBC Act		TSC (5km)	EPBC (5km)	Other*		
Lasiopetalum joyceae	-	V	V	All year	N/A		2	Potential, suitable habitat	Yes
Leptospermum deanei	*Leptospermum deanei*	V	V	All year	N/A		2	Potential, suitable habitat	Yes
Melaleuca biconvexa	Biconvex Paperbark	V	V	n/a	N/A	✓	2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Melaleuca deanei	Deane's Paperbark	V	V	Dec - Feb	1	✓	2	Potential, suitable habitat	Yes
Melaleuca groveana	Grove's Paperbark	V	-	All year	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Micromyrtus blakelyi	-	V	V	All year	N/A		2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Microtis angusii	Angus's Onion Orchid	E1	E1	May - Oct	1	✓		Known to occur	Yes
Pelargonium sp. striatellum (G.W.Carr 10345)	Omeo Stork's-bill	-	E1	n/a		✓		Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Persoonia hirsuta	Hairy Geebung	E1	E1	Dec - May	1	✓	2	Potential, records in area	Yes
Persoonia laxa	-	Ex	Ex	n/a	1			Unlikely, presumed extinct	No, this species is unlikely to occur in BCAA
Persoonia mollis subsp. maxima	-	E1	E1	All year			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Pimelea curviflora var. curviflora	-	V	V	All year	1	✓	2	Potential, records in area	Yes
Prasophyllum fuscum (Tawny Leek-orchid)	-	V	CE	Sept - Dec			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Prostanthera junonis	-	E1	E1	Sept - Nov			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Prostanthera marifolia	Seaforth Mintbush	CE	CE	n/a	1	✓		Unlikely, outside study area	No, this species is unlikely to occur in BCAA
Pterostylis sp. Botany Bay	-	E1	E1	Aug - Sept			2	Unlikely, outside study area	No, this species is unlikely to occur in BCAA

Scientific Name	Common Name	Conservation status		BCAM Survey Months	Data Source			Likelihood of occurrence	Does this species require consideration under BCAM?
		TSC Act	EPBC Act		TSC (5km)	EPBC (5km)	Other*		
Streblus pendulinus	Siah's Backbone	-	E	n/a		✓		Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Syzygium paniculatum	Magenta Lilly Pilly	V	V	n/a	1	✓		Unlikely, no suitable habitat	No, this species is unlikely to occur in BCAA
Tetratheca glandulosa	Glandular Pink-bell	V	V	Jul - Nov	1	✓	1, 2	Previous records.	Yes
Thesium australe	Austral Toadflax	V	V	n/a		✓		No. Habitat occurs west of the dividing range.	No
Triplarina imbricata	Creek Triplarina	E	E	n/a	N/A	✓		Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell	E2	-	All year			2	Unlikely, no records in 5 km radius. No suitable habitat	No, this species is unlikely to occur in BCAA

Other*

1: ELA (2008)

2: Identified as a species credit species by the Biocertification Credit Calculator v1.08

It is noted that marine and migratory species from database searches are not included in this list.

Fauna species

Target Species or Type	Status under TSC Act	Status under EPBC Act	BCAM Survey Months	Data Source			Likelihood of Occurrence	Field survey within BCAM survey months	Does this species require consideration under BCAM?
				TSC (5km)	EPBC (5km)	Other*			
Amphibians									
Heleioporus australiacus (Giant Burrowing Frog)	V	V	Sep - May	✓	✓	1, 2	Known, previously recorded in Ingleside Precinct	Yes	Yes.
Litoria aurea (Green and Golden Bell Frog)	E1	V	Aug - Mar	✓	✓	2	Unlikely, not suitable habitat, old record from 1975.	Yes	No, not predicted in CMA sub-region
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	N/A	N/A	✓		Unlikely, no records or suitable habitat present	-	No, not predicted in CMA sub-region
*Mixophyes balbus (*Stuttering Frog)	E1	V	N/A	N/A	✓		Unlikely, no records or suitable habitat present	-	No, not predicted in CMA sub-region
*Mixophyes iteratus (*Giant Barred Frog)	E1	E1	Oct - May	N/A	✓	2	Unlikely, no records or suitable habitat present	Yes	No. Highly unlikely that this species will occur in the study area.
Pseudophryne australis (Red-crowned Toadlet)	V	-	All year	1	N/A	1 2	Known, previously recorded in Ingleside Precinct	Yes	Yes.
Mammals (non-flying)									
Dasyurus maculatus (Spotted-tailed quoll)	V	E1	N/A	✓	✓	2	Potential, previous records in Warriewood escarpment.	n/a	This is an ecosystem credit species
Isoodon obesulus (Southern Brown Bandicoot)	E1	E1	N/A	✓	✓	2	Potential, previously recorded in local area		Yes.
Cercartetus nanus (Eastern Pygmy Possum)	V	-	N/A	✓		2	Known, recorded in BCAA		Yes.
Petaurus australis (Yellow-bellied Glider)	V	-	N/A	N/A	N/A	2	Unlikely, no records in 5 km radius		This is an ecosystem credit species
Petaurus norfolcensis (Squirrel Glider)	V	-	N/A	N/A	N/A	2	Unlikely, no records in 5 km radius		This is an ecosystem credit species

Target Species or Type	Status under TSC Act	Status under EPBC Act	BCAM Survey Months	Data Source			Likelihood of Occurrence	Field survey within BCAM survey months	Does this species require consideration under BCAM?
				TSC (5km)	EPBC (5km)	Other*			
Petrogale penicillata (Brush-tailed Rock-wallaby)	E1	V	N/A	N/A	✓		Unlikely, no records in 5 km radius		No, not predicted in CMA sub-region
Phascolarctos cinereus (Koala)	V	V	All year	✓	✓	2	Potential	Yes (ELA 2008)	Yes.
Phascolarctos cinereus (Koala) Pittwater endangered population	E2	V	All year	✓	✓		Potential	Yes (ELA 2008)	Yes
Potorous tridactylus tridactylus (Long-nosed Potoroo)	-	V	N/A	N/A	✓		Unlikely, no records in 5 km radius		No, not predicted in CMA sub-region
Pseudomys novaehollandiae (New Holland Mouse)	-	V	N/A	N/A	✓		Unlikely, no records in 5 km radius		No, not predicted in CMA sub-region
Mammals (flying)									
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Sep - May	N/A	✓	1, 2B	Known, has been recorded in area. Suitable foraging habitat present. No breeding	Yes	No. This species does not breed in local area.
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	N/A	N/A		2	Potential, suitable habitat		No. This is an ecosystem credit species
Miniopterus australis (Little Bent-wing Bat)	V	-	N/A	✓		2	Potential, suitable habitat		No. This is an ecosystem credit species
Miniopterus schreibersii subsp. *schreibersii* (Eastern Bent-wing Bat)	V	-	Sep - May	✓		1, 2B	Known, has been recorded in area. Suitable foraging habitat. No breeding habitat present.	Yes	No. This species does not breed in local area.

Target Species or Type	Status under TSC Act	Status under EPBC Act	BCAM Survey Months	Data Source			Likelihood of Occurrence	Field survey within BCAM survey months	Does this species require consideration under BCAM?
				TSC (5km)	EPBC (5km)	Other*			
Mormopterus norfolkensis (Eastern Free-tailed Bat)	V	-	N/A	✓			Potential, recorded in Warriewood escarpment. Suitable foraging habitat present.	n/a	Yes, may be added as ecosystem credit species due to records in proximity to study area and presence of suitable habitat (tool did not predict this species)**
Myotis macropus (Southern Myotis) - breeding habitat	V	-	All year	✓		2B	Potential, suitable foraging and breeding habitat	Yes	Yes - for breeding habitat.
Pteropus poliocephalus (Grey-headed Flying-fox) - breeding habitat	V	V	Sep - May	✓	✓	2B	Known to foraging within study area. No breeding habitat present.	Yes	No. This species does not breed in local area.
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	N/A	✓			Potential, previous records.	n/a	No. This is an ecosystem credit species
Scoteanax rueppellii (Greater Broad-nosed Bat)	V	-	N/A	✓		2	Potential, recorded in Warriewood escarpment. Suitable foraging habitat.	n/a	No. This is an ecosystem credit species
Birds (diurnal)									
Anthochaera phrygia (Regent Honeyeater)	CE	E1	N/A	✓	✓	1, 2	Infrequent vagrant species. Potential foraging habitat present for vagrant individuals.		This species would occur only occasionally as vagrant individuals briefly move through the BCAA whilst migrating, and is unlikely to be present in the BCAA.
Botaurus poiciloptilus (Australasian Bittern)	E1	E1	N/A	N/A	✓	1	Unlikely. Old sightings from Council records prior to urban development.		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Burhinus grallarius (Bush Stone-curlew)	E1	-					Unlikely - vagrant		No, not predicted in CMA sub-region
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	-	N/A	✓		2	Potential, previous records in 5 km radius. Suitable habitat in study area.	Yes	No. This is an ecosystem credit species

Target Species or Type	Status under TSC Act	Status under EPBC Act	BCAM Survey Months	Data Source			Likelihood of Occurrence	Field survey within BCAM survey months	Does this species require consideration under BCAM?
				TSC (5km)	EPBC (5km)	Other*			
Callocephalon fimbriatum (Gang-gang Cockatoo) - endangered population	E2	-					Located outside the BCAA area. This endangered population is unlikely to occur within the BCAA.		No.
Calyptorhynchus lathami (Glossy Black-cockatoo)	V	-	N/A	✓		1, 2	Potential, previous records		No. This is an ecosystem credit species
Daphoenositta chrysoptera (Varied Sittella)	V	-		✓			Unlikely, no suitable habitat		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Dasyornis brachypterus (Eastern Bristlebird)	E1	E1	All year	N/A	✓		Unlikely, no records in 5 km radius	Yes	No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Erythrotriorchis radiatus (Red Goshawk)	CE	V	N/A	N/A	✓		Unlikely, no records in 5 km radius		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Ixobrychus flavicollis (Black Bittern)	V	-		✓	-	1	Unlikely. Old sightings from Council records prior to urban development. Vagrant species only		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Glossopsitta pusilla (Little Lorikeet)	V	-	N/A	✓		2	Potential, previous records and suitable habitat present		No. This is an ecosystem credit species
Hieraaetus morphnoides (Little Eagle)	V	-	All year	✓		2	Potential, previous records and suitable habitat present	Yes	No. This is an ecosystem credit species
Lathamus discolor (Swift Parrot)	E1	E1, Ma	N/A	✓		2	Potential, previous records		No. This is an ecosystem credit species
Pandion cristatus (Eastern Osprey)	V	-		✓			Unlikely, suitable habitat located outside study area		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Petroica boodang (Scarlet Robin)	V	-		N/A		2	Potential (non-breeding)		No. This is an ecosystem credit species
Ptilinopus magnificus (Wompoo Fruit Dove)	V	-		✓			Unlikely, only one record in 5 km radius from 1985.		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.

Target Species or Type	Status under TSC Act	Status under EPBC Act	BCAM Survey Months	Data Source			Likelihood of Occurrence	Field survey within BCAM survey months	Does this species require consideration under BCAM?
				TSC (5km)	EPBC (5km)	Other*			
Neophema pulchella (Turquoise Parrot)	V	-		✓		1	Unlikely, Council predicts locally extinct. No suitable habitat. Previous record from 1983.		No. Species unlikely to occur. Last record in area is from 1983.
Rostratula australis (Australian Painted Snipe)	E1	E1	N/A	N/A	2		Unlikely		No, not predicted in CMA sub-region. This species is unlikely to occur in the area.
Birds (nocturnal)									
Ninox connivens (Barking Owl)	V	-	N/A	✓		1	Known, suitable habitat present		Yes, may be added as ecosystem credit species due to records in proximity to study area and presence of suitable habitat (tool did not predict this species)**
Ninox strenua (Powerful Owl)	V	-	N/A	✓		1	Known, suitable habitat present		Yes, may be added as ecosystem credit species due to records in proximity to study area and presence of suitable habitat (tool did not predict this species)**
Tyto novaehollandiae (Masked Owl)	V	-				1	Potential, suitable habitat present		Yes, may be added as ecosystem credit species due to records in proximity to study area and presence of suitable habitat (tool did not predict this species)**
Tyto tenebricosa (Sooty Owl)	V	-				1	Old Council records. Presumed locally extinct	No	No, this is an ecosystem credit species and is not predicted in CMA sub-region..
Reptiles									
Hoplocephalus bungaroides (Broad-headed snake)	E1	V	Mar - Nov	n/a	✓	2	Unlikely, no records in 5 km radius and no suitable habitat.	No	No. Species unlikely to occur as no suitable habitat present
Varanus rosenbergi (Rosenberg's Goanna)	V	-	Nov - Feb	✓			Previous records. Suitable habitat present	Yes	Yes. This species is known to occur in the region

* Other:

1: ELA (2008)

2: Identified as an ecosystem or species credit species by the Biocertification Credit Calculator v1.08

2B Identified as species credit species (breeding) by the Biocertification Credit Calculator v1.08

**May be added by OEH in the future as the vegetation types and associated data are currently under review.

Appendix B: Candidate species

Flora Species

Scientific Name	Common Name	Conservation status		BCAM Survey Months and whether field survey occurred in those months	Habitat requirements	Associated Vegetation Zones	Spatial requirements for Species Polygon *	Characteristics used during Field Survey Ground-truthing
		TSC Act	EPBC Act					
Acacia terminalis subsp. terminalis	Sunshine Wattle	E1	E1	All year Yes	*Acacia terminalis* subsp. *terminalis* has a very limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay, with most records from the Port Jackson area and the eastern suburbs of Sydney. It occurs in coastal scrub and dry sclerophyll woodland on sandy soils (DECC 2007).	ME012, HN566, HN540, HN541,HN567 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Callistemon linearifolius	Netted Bottle Brush	V	-	Sept – Mar Yes	*Callistemon linearifolius* has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW, growing in dry sclerophyll forest (DECC 2007). For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (DECC 2007).	HN541, HN566, HN586, ME58, ME012 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Darwinia biflora	-	V	V	Sept – Feb Yes	*Darwinia biflora* is an erect or spreading shrub to 80cm high associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have high clay content (NPWS 1997).	HN541, HN566, HN567, ME012 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Epacris purpurascens var. purpurascens	-	V	-	All year Yes	*Epacris purpurascens* var. *purpurascens* has been recorded between Gosford in the north to Avon Dam in the south, in a range of habitats, but most have a strong shale soil influence (DECC 2007).	HN566, HN567, ME012, HN586 non-weedy, non-fragmented	Nil	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Eucalyptus camfieldii	Camfield's Stringybark	V	V	All year Yes	*Eucalyptus camfieldii* is associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (DECC 2007).	HN541, HN566, HN567, non-weedy, non-fragmented	Nil	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Grevillea caleyi	Caley's Grevillea	CE	E1	All year Yes	*Grevillea caleyi* is restricted to an 8 km square area around Terrey Hills, approximately 20 km north of Sydney. It occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills / Duffys Forest within the Ku-ring-gai, Pittwater and Warringah LGAs. It occurs on ridgetops between elevations of 170 to 240 m asl, on laterite soils in open or low open forests, generally dominated by Eucalyptus sieberi, Corymbia gummifera and E. haemastoma (DECC 2007).	HN567 weedy HN 567 and an extended buffer	All Duffy's Forest including weedy / fragmented areas with an adjacent buffer	Lateritic soil profile, usually associated with (or in close proximity to) DFEC
Lasiopetalum joyceae	-	V	V	All year Yes	*Lasiopetalum joyceae* grows in ridgetop woodland, heath, woodland or open scrub, often with a clay influence (NPWS 1997).	HN541, HN566, HN567, HN586 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Leptospermum deanei	*Leptospermum deanei*	V	V	All year Yes	*Leptospermum deanei* has been recorded in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs, in woodland on lower hill slopes or near creeks, at sites with sandy alluvial soil or sand over sandstone (DECC 2007). It has also been recorded in riparian scrub dominated by *Tristaniopsis laurina* and *Baeckea myrtifolia*; woodland dominated by *Eucalyptus haemastoma*; and open forest dominated by *Angophora costata, Leptospermum trinervium* and *Banksia ericifolia* (DECC 2007).	HN586, ME012, HN607 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Melaleuca deanei	Deane's Paperbark	V	V	Dec – Feb Yes	Found in heath on sandstone (DEC 2005), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	HN 566, 567, HN 541 HN 540, ME012, non-weedy, non-fragmented	Contiguous with large core habitat areas	Vegetation not affected by moderate to high levels of disturbance including weed invasion

Scientific Name	Common Name	Conservation status		BCAM Survey Months and whether field survey occurred in those months	Habitat requirements	Associated Vegetation Zones	Spatial requirements for Species Polygon *	Characteristics used during Field Survey Ground-truthing
		TSC Act	EPBC Act					
Microtis angusii	Angus's Onion Orchid	E1	E1	May – Oct No – though RMS survey results available	Currently only known from one site at Ingleside in the north of Sydney (DEC 2005). The dominant species occurring on the highly disturbed Ingleside site are introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna* (ibid.). Most likely associated with the Duffys Forest vegetation community (ibid.). Exists as subterranean tubers during most of the year, producing leaves and then flowering stems in late winter and spring and flowers from May to October (ibid.). By summer, the above ground parts have withered leaving no parts above ground (ibid.).	50m vegetation buffer along Mona Vale Road	Targeted surveys within vegetation adjacent to Mona Vale Rd	New information received from RMS – details to be sought
Persoonia hirsuta	Hairy Geebung	E1	E1	Dec – May Yes	*Persoonia hirsuta* occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (DECC 2007). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2014).	HN566, HN567, ME012, HN586, HN541, non-weedy, non-fragmented	Contiguous with large core habitat areas	May be associated with lateritic soil profile, however may also occur on sandstone derived soils
Pimelea curviflora var. curviflora	-	V	V	All year Yes	*Pimelea curviflora* var. *curviflora* is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (DECC 2007). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	HN 567 HN 566 HN 541 non-weedy, non-fragmented	Contiguous with large core habitat areas,	Vegetation not affected by moderate to high levels of disturbance including weed invasion
Tetratheca glandulosa	Glandular Pink-bell	V	V	Jul – Nov No	Associated with ridgetop woodland habits on yellow earths (Travers Morgan 1990) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	HN540, HN541, HN566, HN567, ME012, non-weedy, non-fragmented	Contiguous with large core habitat areas	Usually associated with sandstone ridgetop midslope landscapes

* Spatial = A broad assessment was made based on whether a threatened flora species would occur in fragmented habitat areas, or only in habitat that is relatively contiguous with core habitat areas (being the large tracts of vegetation that occur within Ku-ring-gai Chase National Park, Garigal National Park, Minkara Reserve, Katandra Bushland Sanctuary, and Ingleside Chase Reserve).

Fauna Species

Target Species or Type	DECC (2004) Threatened Biodiversity Survey and Assessment Guidelines (Appropriate Survey Options)	Survey guidelines for EPBC listed species	Habitat requirements	ELA Approach			
				Associated Vegetation Zones	Spatial Requirements for Species Polygon*	Fragmentation and Disturbance Effects on Species Polygon	Characteristics used during Field Survey Ground-truthing
Heleioporus australiacus (Giant Burrowing Frog)	General (minimum effort): Day searches - 1 hr per stratification unit, include Tadpole search; Night searches - 30 minutes on 2 nights per stratification unit; Minimum of one 200m transect per water body repeated on a minimum of two separate nights. Sept - May after heavy rain.	Day search: Microhabitat search for burrows. Night search: spotlighting after wet conditions best when males call Feb - Apr or within one week of heavy rain during Sep - Mar. Minimum of four nights over several square kilometres in suitable habitat in ideal weather conditions	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	All non-weedy / non-fragmented zones	**Breeding Habitat:** 1st and 2nd order drainage lines that do not intersect weedy vegetation zones. **Foraging Habitat:** 500m buffers on first and second order waterways on sandstone soils in heath, woodland and dry sclerophyll forest vegetation	Exclude area dissected by major road (e.g. Mona Vale Road) and fragmented habitat e.g. on Monash Country Club and where cleared areas are located between habitat and drainage line. Exclude waterways which appear seriously polluted (i.e. surrounded by bright green weed plumes, cleared areas and /or nearby development.	Waterway generally in good condition (i.e. only minor erosion and weed present). Presence of larger pools or ponded areas.
Pseudophryne australis (Red-crowned Toadlet)	Minimum of one 200 m transect in potential habitat listening for male calls with verification by finding calling individual, repeated on a minimum of two separate nights. July–March in late afternoon/early evening or after heavy rain. Active searching for individuals in suitable habitat (exfoliated sandstone rocks, ground cover along ridges and raking amongst moist leaf litter along non-perennial feeder stream beds and at bases of trees.	N/A	Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (DECC 2007). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997). Breeding sites are often characterised by clay-derived soils and generally found below the first sandstone escarpment in the talus slope (NPWS 1997).	All except for non-weedy / non-fragmented zones and ME58 and HN547	Contiguous with large core habitat areas. Ridgelines and upper to mid-slope landscapes	Exclude area dissected by major road (e.g. Mona Vale Road) and fragmented habitat where cleared areas are located between habitat and drainage line. No evidence of weed plumes, nearby development or other obvious disturbance.	Moist soaks and ephemeral drainage depressions, surrounding intact vegetation with minimal evidence of disturbance (e.g. weeds, clearance etc.) Not even mildly polluted drainage lines
Phascolarctos cinereus (Koala)	Call playback two sites per stratification unit up to 200 ha on two different nights and Phillips and Callaghan (2011) spot assessment methodology	Not yet available	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70%, with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis*	All except for non-weedy / non-fragmented zones and ME58 and HN547.	Contiguous with large core habitat areas preferred. Other habitat may be utilised occasionally.	Koala can cross disturbed habitat. However major roads and cleared lands can fragment habitat for the koala. Ingleside is linked to Ku-ring-gai National Park where there are known records	Presence of primary food tree: *Eucalyptus robusta*. Presence of secondary food trees, *E. punctata, E. resinifera, E. scias, E. haemastoma.* Also refer to plot data for presence of food tree species
Myotis macropus (Southern Myotis)	Night survey: Harp traps OR trip lines over waterbodies at dusk for two hours for two nights. AND anabat (two devices over two nights) and spotlight around waterbodies in Oct - Mar	N/A	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Church 2008). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Church 2008). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).	All except for HN540, HN541, and HN560	**Breeding habitat** 50 m buffer on 1st and 2nd order waterways and identified dams.	Waterbodies such as with nearby vegetation patches	Identify potential maternity roost locations: presence of hollow bearing trees. Bridges and enclosed stormwater drains, minimum diameter 1m Farm dams and other waterbodies

Target Species or Type	DECC (2004) Threatened Biodiversity Survey and Assessment Guidelines (Appropriate Survey Options)	Survey guidelines for EPBC listed species	Habitat requirements	ELA Approach			
				Associated Vegetation Zones	Spatial Requirements for Species Polygon*	Fragmentation and Disturbance Effects on Species Polygon	Characteristics used during Field Survey Ground-truthing
Isoodon obesulus obesulus (Southern Brown Bandicoot)	Medium mammal: Hair tube sampling of 10 pairs (10 large and 10 small) at 10m intervals for 4 nights for each stratification unit up to 50 ha. Day survey: 2hrs per 1ha habitat	In areas of suitable habitat or from previous survey results. Day survey for suitable habitat and indirect evidence. Night survey (in areas up to 5ha in size), hair sampling at 10 tubes per ha (suitable habitat) in autumn for a minimum of two surveys (separated by a month AND one survey should follow significant rainfall). Each survey should be 14 days each. AND baited camera traps at one per hectare for two surveys at 14 nights each (preferred in Autumn)	This species is associated with heath, coastal scrub, sedgeland, heathy forests, shrubland and woodland on well drained, infertile soils, within which they are typically found in areas of dense ground cover. Suitable habitat includes patches of native or exotic vegetation which contain understorey vegetation structure with 50–80% average foliage density in the 0.2–1 m height range. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire, but requires a mosaic of burnt and unburnt areas for survival (Menkhorst & Seebeck 1990).	All except for non-weedy / non-fragmented zones and ME58 and HN547	Contiguous with large core habitat areas	Non-fragmented areas. Minimal evidence of bright green weed plumes	Intact vegetation, minimal disturbance. Conical diggings
Cercartetus nanus (Eastern Pygmy Possum)	Small mammal: Elliot 25 traps for 4 nights with sampling effort per stratification unit = 100 trap nights AND/OR Hair-tubes in 10 pairs (10 small and 10 large) for each stratification unit with at least 3 pairs in trees.	N/A	The Eastern Pygmy Possum occurs in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds' nests and in the branch forks of tea-trees (Turner & Ward 1995).	All except for non-weedy / non-fragmented zones and ME58 and HN547	Contiguous with large core habitat areas,	Minimal evidence of bright green weed plumes.	Habitat with an abundance of Banksia, particularly *Banksia ericifolia*. Also areas with *Xanthorrhoea arborea*
Callocephalon fimbriatum (Gang-gang Cockatoo)	No defined effort for area search for diurnal bird species. General: a species-time curve approach to diurnal bird surveys is used in each stratification unit. All year. Area search in 1 ha for 20 mins or point transect for 10 mins along five points along 500m transect. Suggested 20 min census at dawn or dusk for each identified water source. Or 3 x 20 min surveys per 2ha per stratified unit	N/A	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	ME58, HN586, ME012 HN567, HN566	Nil – due to high mobility wherever the suitable vegetation occurs	Nil	Presence of Eucalypt canopy species. Ecosystem species so survey not required.
Anthochaera phrygia (Regent Honeyeater)		EPBC recommended surveys: area search in areas with prolific eucalyptus flowering in woodlands in the morning for total of 20 hrs over 10 days.	Regent Honeyeaters mostly occur in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile sites available, e.g. along creek flats, or in broad river valleys and foothills. In NSW, riparian forests containing Casuarina cunninghamiana (River Oak), and with Amyema cambagei (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage (e.g. when flowering fails in preferred habitats), Honeyeaters also use other woodland types and wet lowland coastal forest dominated by Eucalyptus robusta (Swamp Mahogany) or E. maculata (Spotted Gum) (Franklin et al. 1989; Geering & French 1998; Ley & Williams 1992; Webster & Menkhorst 1992). Regent Honeyeaters sometimes occur in coastal forest, especially in stands dominated by Swamp Mahogany and Spotted Gum, but also in those with Southern Mahogany E. botryoides, and in those on sandstone ranges with banksias Banksia in the understorey (Franklin et al. 1989; Higgins et al. 2001; Menkhorst 1997c). They have been recorded in open forest including forest edges, wooded farmland and urban areas with mature eucalypts (Garnett 1993). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes. As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). In NSW, most records are scattered on and around the Great Dividing Range, mainly on the North-West Plains, North-West Slopes and adjacent Northern Tablelands, to west of Armidale; the Central Tablelands and Southern Tablelands regions; and the Central Coast and Hunter Valley regions. The species is concentrated around two main locations, the Capertee Valley and the Bundarra-Barraba area, but Honeyeaters are also recorded along the coast in the Northern Rivers and Mid-North Coast Regions, and in the Illawarra and South Coast Regions, from Nowra south to Moruya, where small	ME58, HN586, ME012 HN567, HN566	Nil – due to high mobility wherever the suitable vegetation occurs	Nil	Presence of Eucalypt canopy species particularly *E. robusta.* Noted however that this would be for Infrequent vagrant individuals.

Target Species or Type	DECC (2004) Threatened Biodiversity Survey and Assessment Guidelines (Appropriate Survey Options)	Survey guidelines for EPBC listed species	Habitat requirements	ELA Approach			
				Associated Vegetation Zones	Spatial Requirements for Species Polygon*	Fragmentation and Disturbance Effects on Species Polygon	Characteristics used during Field Survey Ground-truthing
			numbers are recorded in most years (Higgins et al. 2001; Webster & Menkhorst 1992).				
Varanus rosenbergi (Rosenberg's Goanna)	Habitat search - 30 minute search on two separate days in pre stratified unit during warmer months (Nov - Mar)	N/A	Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (Environment Australia 2000). Terrestrial termitaria are required for reproduction (King and Green 1999). Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	All except for non-weedy / non-fragmented zones and ME58 and HN547	Contiguous with large core habitat areas,	No fragmented zones	Intact vegetation, minimal disturbance, ground termitaria, ledges and overhangs, outcropping rocks and fallen logs.

Spatial = A broad assessment was made based on whether a threatened fauna species would occur in fragmented habitat areas, or only in habitat that is relatively contiguous with core habitat areas (being the large tracts of vegetation that occur within Ku-ring-gai Chase National Park, Garigal National Park, Minkara Reserve, Katandra Bushland Sanctuary, and Ingleside Chase Reserve). Additionally, whether major roads were likely to present a barrier to fauna movement was considered as part of the spatial assessment in defining the extent of species polygons. Additionally specific spatial assessments were undertaken for the following species due to their specific requirements:

- Giant Burrowing Frog: 1st and 2nd order watercourses were used to identify breeding habitat. Foraging habitat for Giant Burrowing Frog was identified as a 500 m buffer to 1st and 2nd order watercourses.
- Southern Myotis: Breeding habitat for Southern Myotis was also mapped as 50 m buffer to 1st and 2nd order watercourses.

Red-crowned Toadlet: Ridgelines and upper to mid-slope landscapes were used to identify habitat for Red-crowned Toadlet.

Appendix C: Incidental fauna list

Family	Common Name	Scientific Name	Observation
Amphibians			
Myobatrachidae	Common Eastern Froglet	*Crinia signifera*	W
Aves			
Acanthizidae	Brown Thornbill	*Acanthiza pusilla*	O
	Weebill	*Smicrornis brevirostris*	O
Anatidae	Grey Teal	*Anas gracilis*	O
	Pacific Black Duck	*Anas superciliosa*	O
	Australian Wood Duck	*Chenonetta jubata*	O
Apodidae	White-throated Needletail	*Hirundapus caudacutus*	O
Ardeidae	White-necked Heron	*Ardea pacifica*	O
	White-faced Heron	*Egretta novaehollandiae*	O
Artamidae	Grey Butcherbird	*Cracticus torquatus*	O
	Australian Magpie	*Gymnorhina tibicen*	O
	Pied Currawong	*Strepera graculina*	O
Cacatuidae	Sulphur-crested Cockatoo	*Cacatua galerita*	O
	Yellow-tailed Black Cockatoos	*Calyptorhynchus funereus*	O
	Galah	*Eolophus roseicapillus*	O
Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O
Charadriidae	Masked Lapwing	*Vanellus miles*	O
Climacteridae	White-throated Treecreeper	*Cormobates leucophaea*	W
Columbidae	Rock Dove*	*Columba livia*	O
	Peaceful Dove	*Geopelia striata*	O
	Brown Cuckoo-Dove	*Macropygia amboinensis*	O
	Crested Pigeon	*Ocyphaps lophotes*	O
	Common Bronzewing	*Phaps chalcoptera*	O
	Spotted Dove	*Spilopelia chinensis*	O
Coraciidae	Dollarbird	*Eurystomus orientalis*	O
Corvidae	Australian Raven	*Corvus coronoides*	O
Cuculidae	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	W
	Pheasant Coucal	*Centropus phasianinus*	W
	Eastern Koel	*Eudynamys orientalis*	O
	Channel-billed Cuckoo	*Scythrops novaehollandiae*	O
Estrildidae	Red-browed Finch	*Neochmia temporalis*	O
Eupetidae	Eastern Whipbird	*Psophodes olivaceus*	W
Falconidae	Peregrine Falcon	*Falco peregrinus*	O
Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*	O
	Sacred Kingfisher	*Todiramphus sanctus*	O
Hirundinidae	Welcome Swallow	*Hirundo neoxena*	O
Maluridae	Superb Fairy-wren	*Malurus cyaneus*	O
	Variegated Fairy-wren	*Malurus lamberti*	O

Family	Common Name	Scientific Name	Observation
Megapodiidae	Tawny Frogmouth	*Podargus strigoides*	O
Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*	O
	Red Wattlebird	*Anthochaera carunculata*	O
	Little Wattlebird	*Anthochaera chrysoptera*	O
	Noisy Miner	*Manorina melanocephala*	O
	Lewins Honeyeater	*Meliphaga lewinii*	W
	White-cheeked Honeyeater	*Phylidonyris niger*	O
	New Holland Honeyeater	*Phylidonyris novaehollandiae*	O
Monarchidae	Magpie-lark	*Grallina cyanoleuca*	O
Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*	W
Pachycephalidae	Golden Whistler	*Pachycephala pectoralis*	W
	Rufous Whistler	*Pachycephala rufiventris*	W
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*	W
	Striated Pardalote	*Pardalotus striatus*	W
Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*	O
Phalacrocoracidae	Little Black Cormorant	*Phalacrocorax sulcirostris*	O
Phasianidae	Indian Peafowl	*Pavo cristatus*	O
Podargidae	Australian Brush-turkey	*Alectura lathami*	O
Psittacidae	King Parrot	*Alisterus scapularis*	O
	Crimson Rosella	*Platycercus elegans*	W
	Eastern Rosella	*Platycercus eximius*	W
	Rainbow Lorikeet	*Trichoglossus haematodus*	O
Pycnonotidae	Red-whiskered Bulbul*	*Pycnonotus jocosus*	O
Rallidae	Eurasian Coot	*Fulica atra*	O
	Buff-banded Rail	*Gallirallus philippensis*	O
	Purple Swamphen	*Porphyrio porphyrio*	O
Rhipiduridae	Grey Shrike-thrush	*Colluricincla harmonica*	W
	Grey Fantail	*Rhipidura albiscapa*	O
	Willie Wagtail	*Rhipidura leucophrys*	O
Sturnidae	Common Myna*	*Sturnis tristis*	O
	Common Starling*	*Sturnus vulgaris*	O
Timaliidae	Silvereye	*Zosterops lateralis*	W
MAMMALS			
Canidae	Domestic Dog*	*Canis lupus familiaris*	O
	European Red Fox*	*Vulpes vulpes*	Scats, Bird kill
Equidae	Domestic Horse*	*Equus ferus caballus*	O
Leporidae	European Rabbit*	*Oryctolagus cuniculus*	O
Macropodidae	Swamp Wallaby	*Wallabia bicolor*	O
Peramelidae	Long-nosed Bandicoot	*Perameles nasuta*	Killed, diggings
Petauridae	Sugar Glider	*Petaurus breviceps*	Feeding scars
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*	Killed, scats
Pseudocheiridae	Common Ringtail Possum	*Pseudocheirus peregrinus*	O, Drey
REPTILE			
Agamidae	Jacky Lizard	*Amphibolurus muricatus*	O

Family	Common Name	Scientific Name	Observation
Agamidae	Eastern Water Dragon	*Physignathus lesueurii*	O
Elapidae	Red-bellied Black Snake	*Pseudechis porphyriacus*	O
	Eastern Brown Snake	*Pseudonaja textilis*	O
Scincidae	Eastern Water Skink	*Eulamprus quoyii*	O
	Garden Skink	*Lampropholis delicata*	O
Varanidae	Lace Monitor	*Varanus varius*	O

* denotes introduced species

O = Observed

W = Heard

Appendix D: Threatened Species BCAM Steps

Ecosystem credit fauna species

Step 1: Identify the threatened species that are to be assessed in the biodiversity certification assessment area

Using the Biocertification Credit Calculator v1.08 and the OEH Atlas of NSW the following criteria were applied as filters to identify the ecosystem credit species (all fauna species) which are predicted in the BCAA to obtain the list of ecosystem credit species in **Table 8.**

- The distribution of the species includes the BCAA CMA subregion.
- The species is associated with any one or more of the vegetation types in the BCAA.
- The species is classed as an ecosystem credit species in the Threatened Species Profile Database (recently replaced by the more up to date online 'Bionet' database)

Table 17: Ecosystem credit species predicted using criteria

Group	Common name	Scientific Name	Status under TSC Act	Status under EPBC Act
Mammals (non-flying)	Spotted-tailed Quoll	*Dasyurus maculatus*	V	E
	Yellow-bellied Glider	*Petaurus australis*	V	-
	Squirrel Glider	*Petaurus norfolcensis*	V	-
Mammals (flying)	Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-
	Little Bent-wing Bat	*Miniopterus australis*	V	-
	Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-
Birds (diurnal)	Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	-
	Little Eagle	*Hieraaetus morphnoides*	V	-
	Little Lorikeet	*Glossopsitta pusilla*	V	-
	Swift Parrot	*Lathamus discolor*	E	CE, Ma
	Scarlet Robin	*Petroica boodang*	V	-
	Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-

CE = Critically Endangered species

E = Endangered species

V = Vulnerable species

Ma = marine species

Step 2: Assess the habitat components of the vegetation zone on land proposed for biodiversity certification (optional)

The predicted threatened fauna species were reviewed, and it was considered that none of the predicted ecosystem fauna species should be removed.

The Ingleside Precinct straddles the boundary between the Sydney Metropolitan Catchment Management Area (SMCMA) and the HNCMA. There are also two corresponding HNCMA sub-regions (Pittwater A and Pittwater B). It is assumed that information in the Vegetation Types Database and the ecological data component of the OEH Wildlife Atlas of NSW have not been updated to reflect the recent merge of the SMCMA with the HNCMA which has resulted in the omission of some ecosystem species from the step 1 filtered as predicted in step 1.

The 5km OEH Wildlife Atlas database search (OEH 2015b) and a review of other records (DoE 2016; ELA 2008; Pittwater Council unpublished GIS data, **Appendix A**) identified the presence of four additional ecosystem credit species which were not predicted using the filter criteria in Step 1, but are considered to have a high likelihood of presence in the BCAA based on reliability, locality and age of records (**Appendix A**).

Table 18: Additional Ecosystem Credit Species

Species name	TSC Act	EPBC Act
Nocturnal Birds		
Ninox connivens (Barking Owl)	V	-
Ninox strenua (Powerful Owl)	V	-
Tyto novaehollandiae (Masked Owl)	V	-
Mammals (flying)		
Mormopterus norfolkensis (Eastern Free-tailed Bat)	V	-

Species credit flora and fauna species

Step 1. – identify candidate species for initial assessment

A list of candidate species was derived using Threatened Species Profile Database (recently replaced by the ecological data component of the OEH Wildlife Atlas of NSW), refer to **Appendix A** for details of these results.

Step 2. – Review list to include additional species

The list of candidate species was reviewed to include additional species for assessment. The review used OEH Wildlife Atlas database records, the EPBC Protected Matters Search Tool and other records within the BCAA (DoE 2013; ELA 2008; Pittwater Council unpublished GIS data, **Appendix A**).

Step 3. – identify candidate species for further assessment

The list of candidate species was then reduced to identify only those species that require further assessment in the BCAA. The species removed and information supporting the removal of these species from the candidate list is provided in **Appendix A**.

An example of a species predicted by the Threatened Species Calculator and later culled during Step 3 is the *Litoria aurea* (Green and Golden Bell Frog). This species was last recorded within the CMA subregion in 1975. An assessment of the habitat and this species has determined that this species fulfils

one of the categories listed above. It was eliminated from the final list of candidate species. Another is *Anthochaera phrygia* (Regent Honeyeater) as this species would only occur as periodic vagrant individuals.

The final list of candidate species for further assessment within the BCAA is provided below:

Candidate flora species:

- *Acacia terminalis* subsp*. terminalis*
- *Callistemon linearifolius*
- *Darwinia biflora*
- *Epacris purpurascens var. purpurascens*
- *Eucalyptus camfieldii*
- *Grevillea caleyi*
- *Lasiopetalum joyceae*
- *Leptospermum deanei*
- *Melaleuca deanei*
- *Microtis angusii*
- *Persoonia hirsuta*
- *Pimelea curviflora* var*. curviflora*
- *Tetratheca glandulosa*

Candidate fauna species:

- *Heleioporus australiacus* (Giant Burrowing Frog)
- *Pseudophryne australis* (Red-crowned Toadlet)
- *Phascolarctos cinereus* (Koala)
- *Myotis macropus* (Southern Myotis)
- *Isoodon obesulus obesulus* (Southern Brown Bandicoot)
- *Cercartetus nanus* (Eastern Pygmy Possum)
- *Varanus rosenbergi* (Rosenberg's Goanna)

Step 4. – identify potential habitat for species requiring further assessment

Species polygons were created for threatened flora and fauna candidate species (excluding threatened fauna species that are part of ecosystem credits – refer to earlier text in this Appendix). This was done using past records, known population locations, existing information on the species' habitat requirements, targeted survey for threated flora species, and habitat field survey for fauna species as per **Appendix B***.*

The following criteria were used to map the species polygons (refer to **Appendix B**):

- Relationship to associated vegetation zones.
- Relationship with spatial attributes such as drainage lines, ridgetops, or other landscape components.
- Relationship to habitat fragmentation and disturbance, and the effects with regards to delineation of species polygons i.e. whether major roads were likely to present a barrier to fauna movement was considered in defining the extent of species polygons.
- Field survey groundtruthing of species polygons was undertaken and a number of characteristics were used to refine species polygons.

The following species were grouped as they represent the same species polygon extent:

- Acacia *terminalis* subsp*. terminalis*, *Melaleuca deanei* and *Tetratheca glandulosa*
- Red-crowned Toadlet, Koala, and Eastern Pygmy Possum

Appendix E: Assessment of confidence and implications for ‘inaccessible land’ areas

Table 19: Confidence levels for validation of vegetation communities and species polygons in accessed and no-access areas according to BCAM

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Vegetation Zones								
Coastal Enriched Sandstone Dry Forest - Good (HN586)	0.56	4.55	12.31%	Moderate	The majority of the vegetation within this community was recorded in private properties where no access was available. SMCMA (OEH 2013) vegetation mapping was used as a base layer to locate alternative areas outside the BCAM. Validation of this vegetation community was conducted via random meander and vegetation plots in adjacent properties (Katandra Bushland) also mapped as this vegetation community. These patches were mapped at similar topography and altitude along Katandra Creek.	Moderate	This vegetation community does not represent similarities with EECs. There is some risk that the plot/transect data gathered from Katandra Bushland Sanctuary may not completely reflect conditions within the BCAA, but based on visual observation and close proximity of plots to the BCAA it is considered that this risk is relatively low.	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Coastal Enriched Sandstone Moist Forest – Good (ME58)	0.60	1.26	47.62%	High	Only two patches of this vegetation community were accessible for validation (located along the north side of Mona Vale Rd) from within the BCAM. The remaining small patches were located in private properties with no access. Validation of these areas was conducted from adjacent lands (Katandra Bushland Sanctuary) along the eastern boundary of the Precinct. These patches were validated using the 'over-the-fence' methodology from within Katandra Bushland Sanctuary. The remaining patches are isolated in the north-eastern boundary on private lands with no access and no access on adjoining properties. Previous mapping by SMCMA (OEH 2013) and aerial photography interpretation was used to validate these patches. A low confidence rating was assigned to these small patches.	Moderate	This vegetation community does not represent similarities with EECs. There is some risk that the plot/transect data gathered from Katandra Bushland Sanctuary may not completely reflect conditions within the BCAA, but based on visual observation and close proximity of plots to the BCAA it is considered that this risk is relatively low.	Moderate
Coastal Enriched Sandstone Moist Forest - fragmented (ME58)	0.06	0.93	6.45%	Low	A small patch of fragmented vegetation was located within inaccessible area. Some validation of the vegetation canopy was conducted from Minkara Road. This vegetation community was mapped by SMCMA (OEH 2013) outside the BCAM where it was validated. The vegetation contains similar canopy species in landscaped gardens. Species include *Angophora costata, Syncarpia glomulifera* and *Eucalyptus piperita*.	Moderate	This vegetation community does not represent similarities with EECs.	Low

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Coastal Sandstone Gully Forest – good (ME012)	31.06	51.47	60.35%	High	A large extent of this vegetation was accessible along creek lines especially Cicada Glen and Wirreanda Creeks where plots and transects were conducted. Large tracts were also present on private lands where both access and no-access was available. In these situations vegetation was validation using 'over the fence' assessment from accessible land. This contributed up to 15.36 ha validated using this method. Vegetation communities were identified from diagnostic species in each stratum (i.e. high visibility with a high to moderate confidence of the vegetation community).	High	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate
Coastal Sandstone Gully Forest – weedy (ME012)	4.34	11.09	39.13%	High	Most areas of weedy condition ME012 was accessible along roads or residential properties were access was available. Some inaccessible areas along Mullet Creek were visually inspected from adjacent roads ('over the fence' method) and predicted based on identification of native canopy or midstorey species similar to ME012 community.	High	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Coastal Sandstone Gully Forest – fragmented (ME012)	0.31	1.55	20%	Moderate	A majority of fragmented vegetation occur on inaccessible areas. A small patch along Chiltern Road was validated using 'over the fence' method. Several patches were also located behind houses where visibility was low. These low visibility areas were assessed with low confidence levels. The remaining vegetation was identified from diagnostic canopy species.	Moderate	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate
Coastal Sandstone Heath-Mallee – good (HN541)	46.37	70.15	66.10%	High	A majority of the vegetation was accessible within NSW Land and Property Management Authority and NSW Dept. of Planning and Infrastructure. In areas where access was not permitted, such as private properties, vegetation was validated from the road or adjacent properties using the 'over the fence' methodology. This vegetation community is heath dominated by *Allocasuarina distyla* and *Banksia ericifolia*. Presence of mallee growth form of canopy species, namely *Corymbia gummifera* and *Eucalyptus haemastoma* growing on exposed rocky outcrops was a key distinguishing feature in identifying this vegetation.	Moderate	Wet heath components of this community may contain similar species assemblages and occupy similar landscape positions as the Coastal Upland Swamp EEC.	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Coastal Sandstone Heath-Mallee – weedy (HN541)	4.52	10.07	44.89%	High	Weedy condition vegetation is widely distributed throughout the Precinct. Vegetation is fragmented by roads and private properties. Much of this vegetation has been modified by urban landscaped gardens and exists as scattered remnant vegetation (*Allocasuarina distyla* and *Banksia ericifolia*) in landscaped gardens or roadside weed infested patches. Approximately half of these areas were visible from road verge and adjacent properties. The remaining was located in no-access locations where visibility was poor to moderate. Access and the lack of native vegetation within the mid and ground layers, limits the ability to correctly map this vegetation type.	Moderate	Wet heath components of this community may contain similar species assemblages and occupy similar landscape positions as the Coastal Upland Swamp EEC	High
Coastal Sandstone Heath-Mallee – fragmented (HN541)	0.12	0.37	32.43%	High	Several small patches are located along Boronia Rd and few smaller patches in private lands where visibility was low. Access and the lack of native vegetation within the mid and ground layers, limits the ability to correctly map this vegetation type.	Moderate	Wet heath components of this community may contain similar species assemblages and occupy similar landscape positions as the Coastal Upland Swamp EEC	High
Coastal Sandstone Rock Plate Heath – good (HN540)	7.57	9.24	81.93%	High	Although this community represents a small proportion of the vegetation within the Precinct all of the areas were accessible and validated. This vegetation community is also readily visible from aerial photography as rocky outcrops surrounded by heath vegetation communities. The vegetation in this community is also represented in other forms of heath vegetation. However, the presence of large open rocky plates distinguishes this vegetation types from other communities.	High	Wet heath components of this community may contain similar species assemblages and occupy similar landscape positions as the Coastal Upland Swamp EEC.	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Coastal Sandstone Riparian Forest – good (HN607)	6.22	6.60	94.24%	High	This vegetation community was recorded parallel to Wirreanda Creek along the western boundary of the Precinct. This vegetation was not represented in any other location within the Precinct. The vegetation was validated through random meander via the national park, private lands (e.g. 13 Wirreanda Road) and powerline easement. Access was not permitted in one patch due to incorrect information provided by DP&E (i.e. 17 Tumburra St) however the creek line was accessible from adjacent lands so the area was validated with high confidence rating.	High	This vegetation community does not represent similarities with EECs.	Low
Coastal Upland Damp Heath Swamp / Coastal Upland Wet Heath Swamp (HN560)	3.30	3.33	99.10%	High	There were several examples of this vegetation type scattered within the Precinct. These patches were located on crown lands (such as Ingleside Scout Camp) which were accessible. One patch was located on private lands. This patch was identified from visual inspection from the road confirmed that there was potential that this patch also corresponds to the EEC. CMA (OEH 2013) also mapped this vegetation community within the Precinct.	High	Low risk this vegetation community is an EEC almost entire area has been groundtruthed. Noted however that this is a new EEC listing.	Low
Sydney North Exposed Sandstone Woodland Woodland – good (HN566)	102.21	148.60	68.78%	High	This community is widely distributed in Ingleside and much of the vegetation was located on accessible land. Large intact of vegetation often spread over adjoining properties. This assisted in verifying vegetation in inaccessible lands. Small isolated patches in no-access lands were assessed using 'over the fence' visual inspection of canopy from adjacent lands or public roads. There were only a few patches which were not visually accessible and therefore high resolution aerial photography and topography was used to determine vegetation.	High	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Sydney North Exposed Sandstone Woodland – bluegum (HN566)	0.92	0.99	92.93%	High	The main extent of this vegetation community was available on NSW Land and Property Management Authority lands. A small patch extended over National Park lands (Ku-ring-gai Chase) and private lands. This was assessed with a high confidence given that the entire extent of this vegetation community was visible.	High	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate
Sydney North Exposed Sandstone Woodland – bluegum – weedy (HN566)	0.13	0.25	52%	High	This vegetation community occurs as a series of fragmented patches along Walter Road in the north of the Precinct. On the most part vegetation was accessible from the road verge. A small component of the vegetation did occur on private lands; however, it was part of the same patch on accessible lands and assessed using 'over the fence' validation. The vegetation contained representative species of the HN566 (i.e. *Eucalyptus haemastoma* and *Corymbia gummifera*) and mixed exotic shrub and ground layers. Given the small extent and weedy nature of this community the vegetation classification was reliable.	High	May potentially be confused with Duffys Forest EEC but almost entire area has been groundtruthed via direct or high visual inspection	Low

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Sydney North Exposed Sandstone Woodland – weedy (HN566)	8.30	15.99	51.91%	High	This vegetation community was well represented within the Precinct and thus identification of weedy condition vegetation was easy to detect using diagnostic species. There were similar accessible and no-access areas. Much of vegetation validation was conducted using 'over the fence' validation from roads and adjoining lands.	High	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate
Sydney North Exposed Sandstone Woodland – fragmented (HN566)	2.61	8.78	29.73%	Moderate	Fragmented vegetation was validated within Monash Golf Course. Several scattered patches were located on private lands were access was not permitted. An additional 4.12 ha was validated utilising road side access (particularly along Chiltern Road) and adjoining lands using the 'over the fence'. These areas had a high visibility of the vegetation stratums which assisted in the identification of the condition and type. Aerial photograph interpretation accounted for 2.42 ha or 25.34% of vegetation within this vegetation zone. Fragmented zones were located in close proximity to more intact patches of HN566.	Moderate	This vegetation type may be potentially confused with the Duffy Forest EEC. However Duffys Forest is generally restricted to lateritic ridge-tops and upper-slopes along Mona Vale Rd and other discreet areas. As most of these areas were ground-truthed and the Duffys Forest diagnostic test applied at some locations the ecological implications are reduced	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Sydney Ironstone Bloodwood-Silvertop Ash Forest – good (HN567)	4.76	4.76	100%	High	This vegetation community has been extensively mapped within the BCAA by Smith and Smith (2000) and validated during the recent survey. A small extent was accessible via RMS land and publicly accessible Baha'i Temple land. The remaining portion, located on the private part of the Baha'i Temple land, was visually inspected during the field survey. The northern section of the vegetation mapped by Smith and Smith (2000) was not visible during the survey. This patch was validated using the Smith and Smith (2000) mapping and topography. The vegetation community is a unique assemblage of species which correlate to the discrete shale capping over sandstone soils which occurs in this area. The extent of the vegetation occurs on the ridgetop with similar elevations.	Moderate	This vegetation community is an EEC and a relatively small proportion has been groundtruthed. However this vegetation has been comprehensive mapped during a previous study overseen by DECC and Warringah Council (Smith and Smith 2000). ELA has used a conservative approach and extended the Smith and Smith (2000) mapping	Moderate
Sydney Ironstone Bloodwood-Silvertop Ash Forest – weedy (HN567)	0.24	0.24	100%	High	Weedy condition HN567 was identified within the grounds of the Baha'i Temple and RMS lands. A small proportion (0.01 ha) on RMS land was validated using random meander technique. The remaining patches were validated from the publicly accessible bike track and driveways adjacent to Baha'i Temple. High visibility of the vegetation strata (canopy, mid and ground layers) allowed for validation of the vegetation type and condition.	High	This vegetation community is an EEC. This vegetation has been comprehensive mapped during a previous study overseen by DECC and Warringah Council (Smith and Smith 2000). ELA has used a conservative approach and extended the Smith and Smith (2000) mapping	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Sydney Ironstone Bloodwood-Silvertop Ash Forest – fragmented (HN567)	0.72	0.72	100%	High	Restricted access within the Baha'i Temple and limited the ability to traverse this vegetation. A conservative approach to map this vegetation community was used. This included observations from road access and carpark area which are publicly accessible to identify diagnostic canopy species. The remaining vegetation which was not visible was predicted using high quality aerial photography and comparison with Smith and Smith (2000) detailed mapping in the area. Given the scattered nature of the vegetation the confidence rating for some patches was low.	Moderate	This vegetation community is an EEC and a relatively small proportion has been groundtruthed. However this vegetation has been comprehensive mapped during a previous study overseen by DECC and Warringah Council (Smith and Smith 2000). ELA has used a conservative approach and extended the Smith and Smith (2000) mapping.	Moderate
TOTAL	**224.92**	**350.94**	**64.09%**					
Threatened Flora Species								
Acacia terminalis subsp. terminalis Sunshine Wattle	186.55	273.02	68.33%	Moderate	A conservative approach was undertaken to map the potential habitat for this species. Potential habitat for this vegetation community was located within National Parks lands. Continuous vegetation located within private and crown land was also identified as potential habitat. These areas were highly accessible. Only a few private lands contained potential habitat for this species. 21.19% of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. A small area was inaccessible and could not be validated for potential habitat.	Low	There are several unconfirmed records for this species within the BCAM (Smith and Smith 2000). It is difficult to distinguish this species non-threatened *A. terminalis*. While a conservative approach has been used to map potential habitat for this species, the number of individual plants within the polygon is unknown and very difficult to estimate	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Callistemon linearifolius Netted Bottle Brush	176.47	265.99	66.34%	Moderate	A conservative approach was undertaken to map the potential habitat for this species. Potential habitat for this vegetation community was located within National Parks lands. Continuous vegetation located within private and crown land was also identified as potential habitat. These areas were highly accessible. Only a few private lands contained potential habitat for this species. 20.48 % of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. A small area was inaccessible and could not be validated for potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the potential number of individual plants within the polygon is unknown and very difficult to estimate	High
Darwinia biflora	179.93	264.79	67.95%	Moderate	A conservative approach was undertaken to map the potential habitat for this species. Potential habitat for this vegetation community was located within National Parks lands. Continuous vegetation located within private and crown land was also identified as potential habitat. These areas were highly accessible. Only a few private lands contained potential habitat for this species. 24.79% of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. A small area was inaccessible and could not be validated for potential habitat.	Moderate	Despite random meander technique in potential habitat this species may be overlooked due to its discrete habit. However, this species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the potential number of individual plants within the polygon is unknown and very difficult to estimate	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Epacris purpurascens var. purpurascens	135.16	201.13	67.20%	Moderate	A conservative approach was undertaken to map the potential habitat for this species. Potential habitat for this vegetation community was located within National Parks lands. Continuous vegetation located within private and crown land was also identified as potential habitat. These areas were highly accessible. Only a few private lands contained potential habitat for this species. 24.79% of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. A small area was inaccessible and could not be validated for potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the number of individual plants within the polygon is unknown and very difficult to estimate	High
Eucalyptus camfieldii Camfield's Stringybark	149.61	214.51	69.75%	Moderate	A conservative approach was undertaken to map potential habitat for this species. Potential habitat was located within National Parks, crown and private lands. More than half of the potential habitat was accessible. An additional 41.60 ha was identified as suitable habitat for this species, although access was not provided. Only 4.74 ha of potential habitat could not be validated for potential habitat.	Moderate	This species is difficult to correctly identify using 'over-the fence' methods as it may closely represent similar *Eucalyptus* species. However, this species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the number of individual plants within the polygon is unknown and very difficult to estimate	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Grevillea caleyi Caley's Grevillea	4.59	25.71	17.85%	Low	RMS lands were accessed along Mona Vale Road where known population occurs. The Baha'i Temple and adjacent private properties was not accessible. 'Over the fence' inspection identified 39 individuals and 4 dead *Grevillea caleyi* and suitable habitat within these areas. It should be noted that *Grevillea caleyi* seeds may persist for long periods within the soil seed bank before germinating. Finally, one previous Wildlife Atlas record on Addison Road was confirmed by the landholder as planted. Confidence was altered to very low as Baha'i Temple land, which is key habitat area, was not accessible.	Very Low	A count of individual plants was undertaken within accessible lands. Plants were observed within adjacent lands with no access - accurate counts of these plants was not possible. However, implication is low because the Baha'i Temple is proposed for Environmental Management land use, and adjoining lands are predominately retained (i.e. no change in status)	Low
Lasiopetalum joyceae	150.17	219.06	68.55%	Moderate	An assessment of suitable habitat for this species included validation of vegetation communities. A significant proportion of potential habitat was validated using through random meander, plots and transects. Other methods were also employed such as 'over the fence' assessment and aerial photography interpretation based on vegetation zones. A small area was inaccessible and could not be validated for potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the potential number of individual plants within the polygon is unknown and very difficult to estimate	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Leptospermum deanei	37.1	61.44	60.38%	Moderate	More than half of the potential habitat was validated using this method. Other methods were also employed such as 'over the fence' assessment and aerial photography interpretation based on vegetation zones. Only a few private lands contained potential habitat for this species. 29.14% of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. A small area was inaccessible and could not be validated for potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the potential number of individual plants within the polygon is unknown and very difficult to estimate	High
Melaleuca deanei Deane's Paperbark	186.55	273.02	68.33%	Moderate	Potential habitat was traversed during validation of vegetation communities. A small area of potential habitat was not accessed during field surveys, however, a majority of the area was surveyed using over the fence methods to assess potential habitat. Suitable terrain and moist habitats were also considered important for this species and was used during field validation of potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the potential number of individual plants within the polygon is unknown and very difficult to estimate	High
Microtis angusii Angus's Onion Orchid (all habitat rated as high, moderate or low potential from habitat model)	291.79	487.56	59.85%	Moderate	Intensive survey undertaken during suitable survey period. Recent results from genetic testing suggest that *Microtis angusii* and *Microtis unifolia* are the same species.	Moderate	The proposed development areas avoids most impacts on the individuals detected.	Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Persoonia hirsuta Hairy Geebung	180.49	269.35	67.01%	Moderate	A conservative approach was undertaken to map the potential habitat for this species. Potential habitat for this vegetation community was located within National Parks lands. Continuous vegetation located within private and crown land was also identified as potential habitat. These areas were highly accessible. Only a few private lands contained potential habitat for this species. 21.83% of the vegetation within the BCAM was validated from adjoining lands using 'over the fence' methods. These patches had a high to moderate confidence rating that the vegetation represented suitable habitat for this species. Small areas were inaccessible and could not be validated for potential habitat.	Moderate	This species has not previously been recorded within the BCAM. While a conservative approach has been used to map potential habitat for this species, the number of potential individual plants within the polygon is unknown and very difficult to estimate	High
Pimelea curviflora var. *curviflora*	149.61	214.51	69.75%	Moderate	Targeted surveys did not identify recent record of this species. High weed infestations and urban runoff were recorded at the location. Previous records were confirmed as inaccessible or inappropriate locations for this species, mainly due to the high weed infestations. This species is also highly cryptic. Additional surveys should be conducted prior to development in areas identified as potential habitat. Follow-up surveys should be conducted, especially post fire burns in heath-woodland.	Low	This species has been previously recorded with the BCAM. While a conservative approach has been used to map potential habitat for this species, the number of individual plants within the polygon is unknown and very difficult to estimate	High

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Tetratheca glandulosa Glandular Pink-bell	186.55	273.02	68.33%	Moderate	Survey performed at correct time of year, but no individuals located.	Low	This species may occur within the BCAM. While a conservative approach has been used to map potential habitat for this species, the number of individual plants within the polygon is unknown and very difficult to estimate	High
Threatened Fauna Species								
Heleioporus australiacus Giant Burrowing Frog	195.04	284.46	68.57 %	High	This species requires different foraging and breeding habitats in upper catchment regions. The majority of the creeks present within the BCAA were traversed during field validations. This included areas of potential foraging and breeding habitat for the GBF. Quality habitat includes Wirreanda Creek and Cicada Glen Creek and in vegetation adjoining Katandra Bushland.	High	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low - Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Pseudophryne australis Red-crowned Toadlet	196.63	287.51	68.39%	High	This species requires different foraging and breeding habitats in upper catchment regions. The majority of the creeks present within the BCAA were traversed during field validations. This included areas of potential foraging and breeding habitat for the GBF. Quality habitat includes Wirreanda Creek and Cicada Glen Creek and in vegetation adjoining Katandra Bushland.	High	Due to the different vegetation communities required for this species and it is difficult to detect all potential habitat for this species. A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate
Phascolarctos cinereus Koala	196.63	287.51	68.39%	High	Much of this vegetation was located in conservation areas (i.e. Ku-ring-gai Chase and Garigal National Parks and Ingleside Chase Reserve) were access was available and foraging habitat was assessed. Areas of potential corridors between habitats are difficult to identify for this species. A conservative approach was taken to map the species polygon.	Moderate	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate
Myotis macropus (Breeding habitat) Southern Myotis	30.32	44.45	68.21%	High	Only breeding habitat was required for survey (i.e. hollows or culverts adjacent to water bodies). An effort to access all potential water bodies with intact vegetation was surveyed where possible. Given the steep terrain, access was limited by terrain. However, a majority of the creek lines were validated for potential habitat. A conservative approach also utilised high resolution aerial photography identified dams and water courses for this species.	Moderate	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate

Ecological Matter	Area with Access (ha)	Total in study area (ha)	Degree of Access (%zone /habitat)	Guideline Confidence	Comments on Confidence Level	Final Confidence Rating	Comment on Implications	Implication Rating
Isoodon obesulus obesulus Southern Brown Bandicoot	196.63	287.51	68.39%	High	Potential habitat is widely distributed throughout accessible lands. This species is very difficult to survey due to cryptic nature. Mapping of heath vegetation communities was conducted and included areas where evidence of bandicoot diggings were included in the species polygons, however, (it should be noted that bandicoot signs observed could be created from common Long-nosed Bandicoot).	Moderate	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate
Cercartetus nanus Eastern Pygmy Possum	196.63	287.51	68.39%	High	Abundance of *Banksia ericifolia* and *Xanthorrhoea arborea* within heath communities was noted as potential high quality habitat for Eastern Pygmy Possum. Potential habitat was assessed using random meander in large tracts of heath and adjacent to conservation areas. Areas of potential habitat were compared with targeted survey results conducted by Brad Law (2013).	High	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate
Varanus rosenbergi Rosenberg's Goanna	196.63	287.51	68.39%	High	This species is highly mobile and may utilise a majority of the vegetation communities within BCAA. Heath vegetation communities were surveyed for potential rocky outcrops and identification of potential nesting sites.	Moderate	A conservative approach was taken to map the species polygons to capture all potential habitats, accordingly the implications of over-predicting this species is low for proposed development lands and moderate for proposed conservation lands.	Low-Moderate

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