ANGLICARE SITE: STURDEE AVENUE BULLI

Biodiversity Development Assessment Report

For:

Anglicare Pty Ltd

August 2018

Final

PO Box 2474
Carlingford Court 2118

Report No. 17145RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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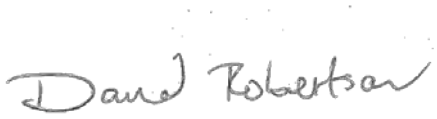
Approved by: David Robertson

Position: Director



Signed:

Date: *28 August, 2018*

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Glossary of Terms

Anglicare Property	The area of land owned by the proponent comprising Lots 2 & 3 DP 1176767
AOBV	Area of Outstanding Biodiversity Value
Assessment area	Area of land within a 1500 m buffer around the outer boundary of the subject land
BAAS	Biodiversity Assessor Accreditation System
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Calculator
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BOPC	Biodiversity Offsets Payment Calculator
BOS	Biodiversity Offset Scheme
EEC	Endangered Ecological Community
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
Locality	The area of contiguous, or near-contiguous ecosystems and habitats within a 5km radius of the subject site
NSW	New South Wales
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type

the Project	The proposed development of Anglicare lands within the wider Sandon Point development area, the subject of Concept Plan Approval No MP06 0094
SAII	Serious and Irreversible Impacts
SEPP	State Environmental Planning Policy
study area	The area including the subject site and any areas affected by the proposal, either directly or indirectly. Also referred to as the Anglicare Property
Subject land	The land proposed as a development site
TEC	Threatened Ecological Community
TS	Threatened Species

Chapter 1

Introduction

Cumberland Ecology was commissioned by Anglicare Pty Ltd (Anglicare) to prepare a Biodiversity Development Assessment Report (BDAR) for the Anglicare Project located at Sturdee Avenue, Bulli, NSW (the 'Project'). The Project involves the development of medium density residential housing and a residential aged care facility.

This BDAR will form part of the required documentation to support an application to the Department of Planning and Environment (DP&E) to modify an Approved Concept Plan MP 06_0094 in accordance with Section 75W of the *Environment Protection and Assessment Act 1979* (EP&A Act).

1.1 Requirement for BDAR

Under the NSW Land Management and Biodiversity Conservation (LMBC) reform, the NSW Parliament passed the following two Acts in November 2016:

- *Biodiversity Conservation Act 2016* (BC Act), which replaced the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and parts of the *National Parks and Wildlife Act 1974*; and
- Local Land Services Amendment Act 2016 (LLSA Act), which replaced the *Native Vegetation Act 2003* and the Native Vegetation Regulation 2005.

These reforms commenced on 25 August 2017.

The Project was assessed under the *Threatened Species Conservation Act 1995* (TSC Act) prior to the introduction of these reforms, and concept plan approval was granted in 2006 (Concept Plan Approval No MP06_0094). The concept plan approval has been modified several times. Anglicare now proposes an additional modification to the concept plan approval under Section 75W of the EP&A Act.

Secretary's Environmental Assessment Requirements (SEARs) have been received from DP&E which describe what Anglicare are required to prepare for the S75W modification submission. As the Project comprises a former Part 3A development, it is considered a State Significant Development (SSD) under the BC Act and is required to be assessed under the Biodiversity Offsets Scheme (BOS). Assessment under the BOS requires an assessment using the Biodiversity Assessment Methodology (BAM) by an accredited BAM assessor and the preparation of a Biodiversity Development Assessment Report (BDAR) in accordance with BAM requirements.

Although detailed designs for accurate assessments are currently not available for the project as it comprises a high level Concept Plan, the SEARs issued for the Project specify that a BDAR be prepared to accompany the S75W modification submission. Therefore, in accordance with the requirements of the SEARs, a BDAR has been prepared for the proposed modification.

It is noted that the SEARs for Flora and Fauna specifically state "*Assess any **additional biodiversity impacts** associated with the proposal, including any additional impacts on adjoining areas".* Therefore this BDAR largely focuses on impacts to biodiversity due to changes in conditions since the approval of the project (eg vegetation regrowth) and identifies areas that would require further assessment, in the form of additional BDARs, during future development application stages.

1.2 Purpose

The purpose of this BDAR is to document the findings of an assessment undertaken for the Project in accordance with Stage 1 (Biodiversity Assessment) and Stage 2 (Impact Assessment) of the BAM. Specifically, the objectives of this BDAR are to:

- Identify the landscape features and site context (native vegetation cover) within the subject land and assessment area;
- Asses native vegetation extent, plant community types (PCTs), threatened ecological communities (TECs) and vegetation integrity (site condition) within the subject land;
- Assess habitat suitability for threatened species that can be predicted by habitat surrogates (ecosystem credits) and for threatened species that cannot be predicted by habitat surrogates (species credit species);
- Identify potential prescribed biodiversity impacts on threatened species;
- Describe measures to avoid and minimise impacts on biodiversity values and prescribed biodiversity impacts during project planning;
- Describe impacts to biodiversity values and prescribed biodiversity impacts and the measures to mitigate and manage such impacts;
- Identify the thresholds for the assessment and offsetting of impacts, including:
    - Impact assessment of potential entities of serious and irreversible impacts (SAII);
    - Impacts for which an offset is required;
    - Impacts for which no further assessment is required;

- Describe the application of the no net loss standard, including the calculation of the offset requirement.

1.3 Project Description

1.3.1 Location

The Project forms part of a larger site known as Sandon Point, which is located within the suburbs of Thirroul and Bulli, approximately 14km north of Wollongong. Sandon Point is to be jointly developed by Anglicare (formerly ARV) and Stockland Development Pty Ltd with some lands to be dedicated to Wollongong Council.

The Anglicare Property is located in Bulli and is comprised of Lots 2 and 3 DP 1176767, covering an area of approximately 8 hectares (ha). It is generally bounded by Sandon Drive to the south, Geraghty Street to the west, and Wilkies Street to the north. An un-named walking track borders the site to the east, beyond which is the Pacific Ocean.

A site map and location map have been prepared in accordance with the BAM and are presented in **Figure 1.1** and **Figure 1.2**, respectively.

1.3.2 Project Overview

The Sandon Point Concept Plan was approved by the Minister for Planning on 21st December 2006 for land at Sandon Point comprising a residential subdivision (for Stockland) and retirement development (for Anglicare).

Stockland has modified the Concept Plan on four separate occasions and development on those lands is now substantially complete. To date no development has occurred on the Anglicare (ARV) lands.

The Anglicare property was zoned R2 – Low Density Residential and E2 – Environmental Conservation under the *State Environmental Planning Policy (State Significant Precincts) 2005*. These zones have been retained in the amended in the *State Environmental Planning Policy (Major Development) Amendment (State Significant Precincts) 2016*.

Under the approved Concept Plan, the R2 zone within the Anglicare lands is divided into three development precincts, namely the Hilltop Precinct, Oceanview Precinct and Central Precinct. The approved Concept Plan allowed for the following development of the Anglicare lands:

- A residential aged care facility up to four storeys containing up to 120 beds;
- A mix of apartment buildings of up to 3 storeys containing up to 250 independent living units;
- Community facilities and services to support residents of the retirement village;
- Access and car parking;

- Landscaping and access pathways, including rehabilitation of riparian corridors and forest; and

- Stormwater management and utility services.

The proposal also included two creek crossings: a weir across Cookson's Creek, linking the Ocean View precinct to the Central precinct and a road bridge across Tramway Creek to the south of the proposed development. The Tramway creek crossing was proposed to be located adjacent to the existing rail line crossing to minimize impacts upon the flora and fauna values of this creek. Although the approved Concept Plan development largely avoided the E2 zone, minor incursions into the E2 zone for creek crossings and creation of a weir and associated pond to the west of the weir for flood management and drainage purposes were approved.

The original 2006 proposal and associated statement of commitments and approvals entailed the conservation and management of vegetation and associated fauna habitat within the E2 zone under a Vegetation Management Plan (VMP). The preparation of the VMP is listed as a requirement in the SEARs which specifically state "*Provide a Vegetation Management Plan for the riparian area and areas of vegetation to be retained outside of the development footprint area*". The VMP has been prepared as a separate document to this BDAR.

The proposed modification application retains the original land uses within the Central Precinct. It also proposes the introduction of standard medium density residential accommodation in the Hilltop and Ocean View Precincts. The proposal also seeks to modify the road layout approved on the site. No change is proposed to the land use zoning (developable area), height or floorspace ratio controls. The forest and riparian rehabilitation and protection measures also remain the same. The main changes in the proposed modification, relevant to ecology include:

- Changes in size/location of asset protection zones and road network associated with construction of residential townhouses in the Hilltop and Ocean view precincts in lieu of Residential Aged Care Facilities;

- Replacement of the weir across Cooksons Creek and associated pond with a boardwalk/footpath and bio-retention basin;

- Minor alterations in locations and/or additional access pathways; and

- Avoidance of vegetation associated with protection of the Aboriginal Archaeological zone.

In addition to the above, the site conditions have changed since the 2006 assessments for the Concept Plan. Therefore this BDAR focuses on the change in the condition of the vegetation to be impacted within the development of the three Precincts.

1.3.3 Identification of the Development Site Footprint

As previously noted in Section 1.1, the SEARs for Flora and Fauna specifically state "*Assess any **additional biodiversity impacts** associated with the proposal, including any additional impacts on adjoining areas".*

As the outer boundary of the development footprint has remained largely unchanged compared to the approved Concept Plan and incursions into the E2 zone have not increased beyond those previously assessed, areas within the E2 zone have largely been excluded from further assessment within this BDAR except to provide context of remnant vegetation. The management requirements for the E2 zone have been addressed in the VMP in accordance with the SEARs.

The proposed modified Concept Plan layout of the Project is shown in **Figure 1.3**. The development site footprint comprises the area of land directly impacted by the Project. This includes the majority of the R2 land with the exception of an Aboriginal Archaeological Site near the eastern boundary and is hereafter referred to within this BDAR as the 'subject land'. The entire Anglicare land comprising the R2 and E2 zoned land is covered by this BDAR and is referred to as the 'Anglicare Property'

As the project still comprises a high level Concept plan, detailed descriptions of the construction footprint and operational footprint are currently not available. However all constructional and operational footprints associated with future development applications will largely be contained within the development footprint indicated.

Note that the Statement of Commitments based on the original Concept Plan approval required the provision of a 20 metre setback for development from the Turpentine Forest for the purposes of bushfire protection. The current Bushfire Plan for the project indicates that this is no longer required, and that a 6 m defendable zone is adequate for bushfire protection purposes (Peterson Bushfire 2018). Therefore the 20m setback is not included.

As potential indirect impact on the E2 zone remain unchanged from those of the original concept plan, it does not form an 'additional' impact and therefore has not been assessed in this BDAR.

The approved weir across Cooksons Creek and associated flood management/drainage pond to the west of the weir are to be replaced with a boardwalk and bio-retention basin. As the overall 'impact footprint' for the boardwalk and bio-retention basin is reduced compared to that of the approved pond and weir (from ~1800m^2 to ~1600m^2) and will allow for greater level of revegetation of Cooksons Creek, the replacement is not considered to be an 'additional impact' and is not addressed in this BDAR.

Detailed designs of the basin are currently not available. While future detailed design will avoid removal of regrowth vegetation where feasible, it is acknowledged that some regrowth vegetation may require removal, based on the final basin design. These impacts, if relevant following final basin design, should be addressed in future BDARs prepared for the development application stages.

The management of the E2 zone has been addressed in the VMP, prepared in accordance with the SEARs.

1.3.4 General Description of the Development Site

i. Historical and Present Land Use

Historically, the Anglicare property has been cleared of native vegetation. The land uses following clearing have included dairy farming, quarrying and industrial development. The southern parts of the property have been developed and built upon for industrial purposes, parts of the northwest corner developed as a dairy farm and parts immediately east of the Turpentine Forest have also been previously cleared for a quarry.

Currently, the subject site and wider Anglicare property is not currently being utilised for any industrial purposes and is not subject to any active management.

A 1st order creek called Cooksons Creek is located just north of the existing industrial development. The creek flows in an easterly direction and discharges into Tramway Creek to the east of the Anglicare property.

The central to western parts of the Anglicare property comprise a Turpentine Forest that has regenerated since the 1930s following widespread clearing in the region and has been declared an Item of Natural Heritage Significance in the Wollongong Local Environmental Plan 1990.

The Turpentine Forest and Cooksons Creek collectively form the E2 zone within the Anglicare property. These areas are largely excluded from the development footprint and are to be managed in accordance with a VMP.

ii. Topography and Soils

The wider Sandon Point development lies on the Wollongong Plain, east of the foothills at the base of the Illawarra Escarpment. The Plain expresses gentle rises of the Illawarra Coal Measures, low hills of volcanic materials and undulating Budgong Sandstone and Quaternary alluvium (Hazelton and Tille 1990). Sandon Point is located along the eastern margin of the Wollongong Plain and has both alluvial and floodplain formations.

The Soil Landscapes of the Wollongong – Port Hacking 1:100,000 Soil Landscape Series map indicates that the subject land is underlain by shallow brown podzolic soils, brown earths, alluvial soils and heavy clays (Chapman and Murphy 1989).

iii. Hydrology

The hydrology of the study area has been highly modified in response to the historical works.

Tramway Creek borders the southern boundary of the subject land and flows to the east, discharging into the Pacific Ocean at McCauley's Beach. This is a creek with substantial areas of wetland vegetation, particularly broad areas of reed beds consisting of *Typha orientalis* (Cumbungi) and *Phragmites australis* (Austral Reedgrass). It has been classified as a

category 1 stream and is recognised as having a significant wildlife habitat function. Notwithstanding this, it is highly modified and has been subject to considerable weed invasion.

Cookson Creek flows through the centre of the subject site and joins with Tramway Creek prior to discharge into the ocean. Cooksons Creek is not formally labelled on existing topographic maps and is not recognised as having a significant wildlife habitat function despite discharging into Tramway Creek, likely due to a more ephemeral nature. Similar to Tramway Creek, it is highly modified and has been subject to significant weed invasion.

iv. Vegetation

The coastal areas of Bulli have been highly modified since the first European settlement in NSW. Most of the pre-existing vegetation was historically cleared and remaining patches have been subject to a high degree of weed invasion and colonising native species. Urban development for the wider Sandon Point development largely surrounds the subject land and remnant vegetation to the east of the subject site is largely intersected by built cycle and walking pathways and informal tracks.

The central to western parts of the Anglicare property comprise a Turpentine Forest that has regenerated since the 1930s following historical clearing and has been declared an Item of Natural Heritage Significance in the Wollongong Local Environmental Plan 1990. The remainder of the Anglicare property was also historically cleared for various land uses and currently comprises a mix of further Turpentine forest regeneration along the boundaries of the Heritage Item, colonising native scrub and weeds.

1.4 Information Sources

1.4.1 Databases

A number of databases were utilised during the preparation of this BDAR, including:

- NSW Offset of Environment and Heritage (OEH) BioNet Atlas;
- Threatened Biodiversity Data Collection;
- BioNet Vegetation Classification; and
- DoEE Directory of Important Wetlands in Australia.

1.4.2 Literature

This BDAR has utilised the results and/or spatial data from the following documents:

- NPWS (2002). Native Vegetation of the Illawarra Escarpment and Coastal Plain;
- Cumberland Ecology (2004). Flora and Fauna Constraints Analysis at Lot 2 Sandon Point, Bulli. Prepared for Anglican Retirement Villages (Ref: 4047 Let1);

- Cumberland Ecology (2006). Flora and Fauna Assessment of Proposed Concept Masterplan for Residential Aged Care Facility at Sandon Point, Bulli. Prepared for Anglican Retirement Villages (Ref: 4047RP1);
- Cumberland Ecology (2012). Green and Golden Bell Frog Surveys at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 12090 Let 3);
- Cumberland Ecology (2013b). Ecological impacts of mowing vegetation near borehole locations at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 12090 Let 7);
- Cumberland Ecology (2013a). Anglican Retirement Villages, Diocese of Sydney v Wollongong City Council & Kennedy: Land and Environment Court Proceedings No. 10982 of 2012: Individual Expert Report of Dr David Robertson. Prepared for Norton Rose Fulbright and Anglican Retirement Villages (Ref: 12090RP1);
- Cumberland Ecology (2014). Green and Golden Bell Frog Pre-clearing Surveys at Lots 1 and 2 in DP 224431, Sturdee Avenue, Bulli (Ref: 12090Let3); and
- Cumberland Ecology (2017). Commonwealth Assessment: Anglicare Site, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 17145Let2)

1.4.3 Aerial Photography

The aerial imagery utilised in this BDAR is sourced from NearMaps and is dated 2 May 2018.

1.5 Authorship and Personnel

This document has been prepared by Dr David Robertson (BAM Accredited Assessor No: BAAS17027). This document, and associated filed surveys and Geographic Information Systems (GIS) mapping, was prepared with the assistance of additional personnel as outlined in **Table 1.1**. Notwithstanding the assistance of the additional personnel, the assessment presented within this document is Dr Robertson's.

Table 1.1 Personnel involved in BDAR preparation

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
Dr David Robertson	Project supervision, Report review and BAM assessment	Doctor of Philosophy. Ecology, University of Melbourne, 1986 Bachelor of Science (Honours) in Ecology, University of Melbourne, 1980	BAAS17027

Table 1.1 Personnel involved in BDAR preparation

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
		BAM Accredited Assessor Training. Muddy Boots, 2017	
Dr Gitanjali Katrak	Project management, Flora surveys, PCT identification, BAM calculations and report write up	Doctor of Philosophy, Intertidal Wetland Ecology. Flinders University, 2011 Bachelor of Science (Honours) in Biological Sciences. La Trobe University, 2002 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS17064
Timothy Playford	Report write up assistance	Bachelor of Science (Honours) in Ecology, University of Adelaide, 2004 Bachelor of Environmental Management. Flinders University, 2003 BAM Accredited Assessor Training. Muddy Boots, 2018	-
Bryan Furchert	Flora surveys, Flora ID and PCT verification	Bachelor of Biodiversity and Conservation. Macquarie University, 2012 Diploma of Conservation and Land Management. TAFE NSW, 2008 BAM Accredited Assessor Training. Muddy Boots, 2017	-
Michael Davis	GIS	Bachelor of Biodiversity and Conservation. Macquarie University, 2016 BAM Accredited Assessor Training. Muddy Boots, 2017	-
Jesse Luscombe	GIS,	Bachelor of Marine Science. Macquarie University, 2013 Certificate III in Conservation and Land Management. TAFE NSW, 2016 BAM Accredited Assessor Training. Muddy Boots, 2018	-

1.6 Other Legislative Requirements

1.6.1 Commonwealth

The 2006 Flora and Fauna assessment for Concept Plan Approval No MP06 0094 concluded that concluded that a referral to the Commonwealth Department of the Environment and Energy (DoEE) (then the Department of the Environment and Heritage) was not required.

Due to the changes in site conditions since the original 2006 assessment, an updated assessment of the site in relation to matters listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was conducted by Cumberland Ecology in August-September 2017 (Ref: 17145-Let 2, dated 4 September 2017).

The vegetation on the Anglicare Property does not conform to the definition of any EPBC listed vegetation community. No EPBC flora species were recorded within the site and none are considered likely to occur due to past disturbance and clearing. The majority of EPBC listed fauna species known from the locality are considered unlikely to occur due to the highly degraded nature of the Subject Site. EPBC listed species with potential to occur are limited to highly mobile migratory birds or the Grey-headed Flying Fox which may pass through the site as part of a larger foraging range. Therefore no significant impacts are predicted for any EPBC listed species.

The updated 2017 Assessment, therefore, concluded that a referral to DoEE was not required as the modifications are unlikely to have any significant impacts on threatened species or communities listed under the EPBC Act.

1.6.2 State

i. NSW Fisheries Management Act 1994

Threatened species legislation in NSW currently consists of the *Fisheries Management Act 1994* (FM Act), and the BC Act. The FM Act protects threatened fish species and marine vegetation and identifies associated threatening processes and is administered by the DPI Fisheries.

The FM Act has the objective to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. In particular, this Act includes measures to conserve fish stocks and key fish habitats, to conserve threatened species, populations and ecological communities of fish and marine vegetation, and to promote ecologically sustainable development, including the conservation of biological diversity.

No areas of Key Fish habitat occur within the site and no threatened species records occur within the site. Furthermore all creeks and wetland habitat within the site lie outside of the development footprint and are to be managed under a VMP, prepared in accordance with the SEARs. Assessments of semi-aquatic species such as amphibians have been conducted under the BC Act as part of this BDAR.

As matters listed under the FM Act do not occur within the development footprint, no further assessments for matters listed under the FM Act are required.

ii. NSW Water Management Act 2000

Under the *Water Management Act 2000* (WM Act), waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. The NSW Office of Water administers the WM Act and is required to assess the impact of any proposed activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity.

Under the WM Act, a riparian corridor, comprising the channel (the bed and banks of the watercourse to the highest bank) and a vegetated riparian zone (VRZ) adjoining the channel are required to protect waterfront land. The VRZ width is based on watercourse order as classified under the Strahler System of ordering watercourses.

Cooksons Creek and Tramway Creek comprise 1st order streams under the Strahler system and thus require a minimum 10m VRZ on each bank. The current proposal allows for a 20 m wide VRZ on either bank, which will be managed under a VMP prepared in accordance with the SEARs. The VMP is being prepared with due consideration to the VRZ requirements as listed in the Guidelines for Riparian Corridors on Waterfront Land.

The proposed modification to the project is therefore consistent with the requirements for waterfront land under the WM Act.

iii. State Environmental Planning Policy (Coastal Management) 2016

State Environmental Planning Policy (Coastal Management) 2016 (Coastal Management SEPP) came into force on 3 April 2018, replacing *State Environmental Planning Policy No 14—Coastal Wetlands*, *State Environmental Planning Policy No 26—Littoral Rainforests* and *State Environmental Planning Policy No 71—Coastal Protection*.

The following zones of the Coastal Management SEPP occur within the Anglicare property:

- Coastal Wetlands;
- Proximity Area for Coastal Wetlands;
- Coastal Environment Area; and
- Coastal Use Area.

The consistency of the proposed modification with the objectives of each zone is outlined below.

a. Coastal Wetland Zone

Under the Coastal Management SEPP, development can be carried out in areas mapped as Coastal Wetlands (as Designated Development) if the consent authority is satisfied that

sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland.

The areas within the Anglicare Property mapped as Coastal Wetland occur within the E2 zone and therefore do not form part of the development footprint. Furthermore these areas will be managed and enhanced under a VMP, prepared in accordance with the SEARs. The proposed development is therefore consistent with the objectives for areas mapped as Coastal Wetlands under the Coastal Management SEPP as these areas will be protected and enhanced thus improving ecological integrity above existing conditions.

b. Proximity to Coastal Wetland Zone

Under the Coastal Management SEPP, development can be carried out in areas mapped "proximity area for coastal wetlands" if the consent authority is satisfied that the proposed development will not significantly impact on the biophysical, hydrological and ecological integrity of the coastal wetland or the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

The areas mapped as 'Proximity to Coastal Wetland' occur within both the R2 and E2 zoned land of the Anglicare property. Although the areas within the R2 land will be cleared, the areas within the E2 zone will be managed under a VMP. The areas mapped as 'Proximity to Coastal Wetland comprise a mix of existing developed areas that have limited to no ecological integrity and areas of weedy regrowth that pose a significant threat to wetlands via weed infestations. The ecological integrity of the Proximity zones on E2 land will be enhanced through active management under a VMP and will serve as a buffer between the development and wetlands. Therefore the proposed development is consistent with the objectives for areas mapped as 'Proximity to Coastal Wetland' as there will be no significant impacts on the biophysical, hydrological and ecological integrity of the coastal wetland or the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

c. Coastal Environment Area

Under the Coastal Management SEPP, can be carried out in areas mapped within the coastal environment area if the consent authority is satisfied that the proposed development will not significantly impact on the following:

- the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,
- coastal environmental values and natural coastal processes,
- the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,
- marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,

- existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
- Aboriginal cultural heritage, practices and places,
- the use of the surf zone.

The proposed modification has been sited and designed to avoid impacts to ecological integrity, marine environments, surf zones and cultural places as well as improve public access. Potential impacts to ecological integrity will be managed under a VMP. The proposed modification is therefore consistent with the objectives of the Coastal Environment Area zone.

d. Coastal Use Area

Under the Coastal Management SEPP, development can be carried out in areas mapped within the Coastal Use area if the consent authority is satisfied that the proposed development will not significantly impact on the following:

- existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
- overshadowing, wind funnelling and the loss of views from public places to foreshores,
- the visual amenity and scenic qualities of the coast, including coastal headlands,
- Aboriginal cultural heritage, practices and places,
- Cultural and built environment heritage.

The proposed modification has been sited and designed to avoid impacts to items listed above and will improve access to coastal areas for members of the public. The proposed modification is therefore considered to be consistent with the objectives of the Coastal Use Area zone.

iv. NSW Wetland Management Policy 2010

The NSW Wetland Management Policy promotes the sustainable conservation, management and use of the state's wetlands.

The NSW Wetland Management Policy recognises that several Acts help to protect wetlands, including, but not limited to:

- *Biodiversity Conservation Act 2016;*
- *Environmental Planning and Assessment Act 1979;*
- *Fisheries Management Act 1994*; and
- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999.*

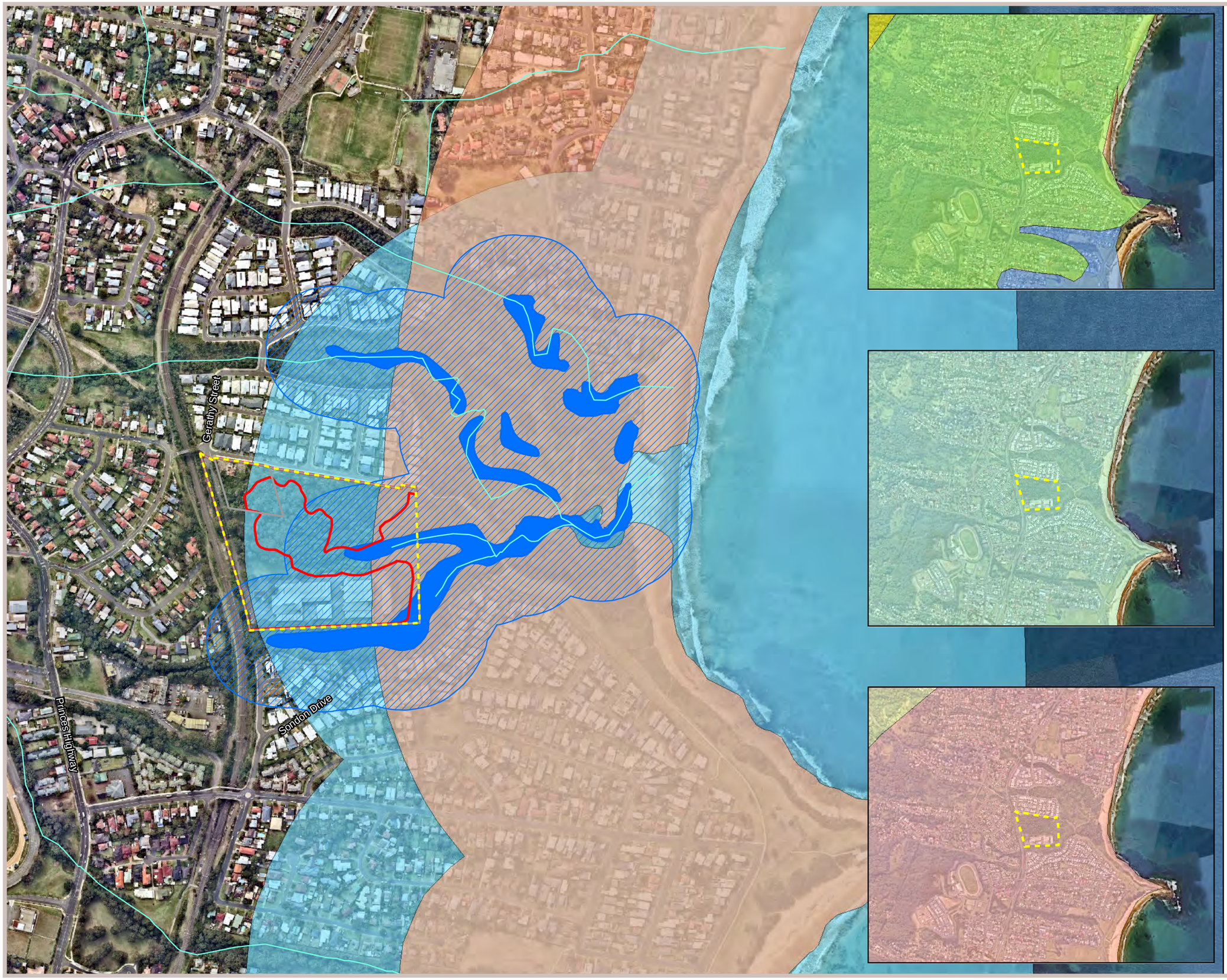
The wetland areas within the Anglicare property will be retained, managed and enhanced. The proposed modification is therefore consistent with the guiding principles of the NSW Wetland Management Policy 2010.

v. NSW State Rivers and Estuaries Policy 1993

The NSW State Rivers and Estuaries Policy 1993 is based on the fundamental principle that government agencies, private landholders, resource users and the community in general must all share responsibility for managing natural resources. Specifically the policy focusses on the protection or management of ecosystem processes and associated values balanced against other social and economic objectives.

The primary waterway within the Anglicare property, Cooksons Creek, lies within the E2 zone and is largely excluded from the development with the exception of access pathways in accordance with objectives of the Coastal Management SEPP and WM Act. Furthermore the wetland/riparian areas along the waterway will be managed and enhanced under a VMP thus improving the integrity of ecosystem processes in the long term while enabling improvements to social and economic objectives in the wider area.

The proposed modification is therefore consistent with the principles of the NSW State Rivers and Estuaries Policy.



Legend

- Subject Land
- Anglicare Property
- Lot Boundaries
- Watercourses

Coastal Wetlands

- Coastal Wetlands
- Proximity area for Coastal Wetlands
- Coastal Envirmonment
- Coastal Use

Mitchell Landscapes

- Bulli Coastal Escarpment
- Dapto - Wollongong Coastal Slopes
- Lake Illawarra Barrier

IBRA Bioregions

- Sydney Basin

IBRA Subregion

- Illawarra
- Sydney Cataract

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Data Source:
State Environmental Planning Policy (Coastal Management) 2018
© Department of Finances, Sercives and Innovation 2017

DECCW (2008). Landscapes (Mitchell) of NSW - Version 3.

DSEWPaC (2012). Interim Biogeographic Regionalisation for Australia (IBRA) - Version 7.

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 100 150 200 m

I:\...\17145\Figures\RP1\20180808\Figure 1.1. Site Map

Figure 1.1. Site Map

Legend

- Subject Land
- Anglicare Property
- Lot Boundaries
- localgovernmentarea_region
- Watercourses

Coastal Wetlands

- Coastal Wetlands
- Proximity area for Coastal Wetlands
- Locality 1500 m

Mitchell Landscapes

- Bulli Coastal Escarpment
- Dapto - Wollongong Coastal Slopes
- Lake Illawarra Barrier

IBRA Bioregions

- Sydney Basin

IBRA Subregion

- Illawarra
- Sydney Cataract

Data Source:
State Environmental Planning Policy (Coastal Management) 2018
© Department of Finances, Sercives and Innovation 2017

DECCW (2008). Landscapes (Mitchell) of NSW - Version 3.

DSEWPaC (2012). Interim Biogeographic Regionalisation for Australia (IBRA) - Version 7.

Coordinate System: MGA Zone 56 (GDA 94)

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I:\...\17145\Figures\RP1\20180716\Figure 1.2. Location Map

0 150 300 450 600 m

Figure 1.2. Location Map

Legend

- Subject Land
- Anglicare Property
- E2 Zone
- Aboriginal Site
- Development Precincts

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

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0 50 m

I:\...\17145\Figures\RP1\20180719\Figure 1.3. Layout of the Project

Figure 1.3. Layout of the Project

Chapter 2

Landscape Features

2.1 Assessment Area

As the Project is being assessed as a non-linear project, the assessment area comprises the area of land within a 1500 m buffer around the outer boundary of the subject land. The location of the assessment area is shown in **Figure 1.2**.

2.2 Landscape Features

Landscape features identified within the subject land and assessment area are outlined below. The extent of these features within the subject land is shown in **Figure 1.1** and the extent within the assessment area is shown in **Figure 1.2**.

2.2.1 IBRA Bioregions and IBRA Subregions

The subject land and assessment area occurs within the Sydney Basin Bioregion and within the Illawarra Subregion.

2.2.2 Rivers, Streams and Estuaries

The main surface drainage systems in the study area include Tramway Creek and Cookson's Creek. Within the Anglicare property, Cookson's Creek is the primary flow path through the site. This ephemeral creek flows from west to east and discharges into the Pacific Ocean, approximately 300 m to the east of the subject land boundary. The creekline lies completely within E2 zoned land.

It is noted that a single crossing across Cooksons Creek is proposed as part of the modification. However as a single crossing (in the form of a weir) was approved as part of the original Concept Plan approval and the current proposed boardwalk crossing represents a reduced impact footprint compared to the approved Concept Plan, it is not considered an 'additional impact. The E2 zone is therefore excluded from the development footprint for this BDAR.

Tramway Creek and Cooksons Creek both comprise 1st order streams as per the Strahler system and therefore are classified as Category 1 streams under the BAM. In accordance with Appendix 3 of the BAM, a minimum buffer of 10 m, on either side of the waterways applies to both creeks.

Outside of the subject land to the east, a minor estuary is present where Tramway Creek, Cookson's Creek and Woodlands Creek converge prior to discharge into the ocean

2.2.3 Important and Local Wetlands

No important wetlands listed in the Directory of Important Wetlands in Australia are present in the subject site or study area.

Tramway Creek borders the southern boundary of the subject land and is a creek with substantial areas of wetland vegetation, particularly broad areas of reed beds consisting of *Typha orientalis* (Cumbungi) and *Phragmites australis* (Austral Reedgrass). It has been classified as a category 1 stream and is recognised as having a significant wildlife habitat function. Notwithstanding this, it is highly modified and has been subject of considerable weed invasion. Some wetland habitat is also present along the Cookson's Creek riparian corridor but the area is largely infested with weeds such as Crofton Weed and Morning Glory.

Tramway Creek and Cookson's Creek have been mapped as Coastal Wetlands under the Coastal Management SEPP, and an area surrounding each of these wetlands has been mapped as occurring within the Proximity Area for Coastal Wetlands (see **Figure 1.1**). Areas within the subject site have also been mapped as Coastal Use Area and Coastal Environment Area (see **Figure 1.1**). The proposed development is consistent with the relevant objectives of the various zones of the Coastal Management SEPP as outlined in **Section 1.6.2 (iii)**.

2.2.4 Habitat Connectivity

The subject land and wider Anglicare property are located in a highly urban context and are surrounded by development on the northern, western and southern boundaries. The South Coast Rail Line is located adjacent to the western boundary and forms a hostile barrier to native vegetation in the wider Illawarra Escarpment area to the west of the subject land

There is some limited habitat connectivity between vegetation on the subject land and wider Anglicare property and nearby areas of remnant vegetation and open space to the east and north-east via the riparian areas of Cooksons Creek. The main connectivity corridor on the Anglicare property occurs within E2 zoned land and is excluded from the development footprint. This area is to be managed and enhanced under a VMP, thus retaining connectivity with bushland areas to the east of the subject land.

2.2.5 Karsts, Caves, Crevices, Cliffs and Areas of Geological Significance

No karsts, caves, crevices, cliffs or areas of geological significance have been identified within the assessment area.

2.2.6 Areas of Outstanding Biodiversity Value

No Areas of Outstanding Biodiversity Value (AOBV) have been mapped within the assessment area.

2.2.7 Additional Features Required by SEARs

No additional features requiring assessment have been listed in the SEARs. The areas within the Anglicare property that lie outside the development footprint (mainly vegetation and habitats within the E2 zone) are to be managed under a VMP. The VMP has been prepared as a separate document to this BDAR.

2.2.8 Mitchell Landscapes

The Mitchell Landscape that occurs in the subject land and surrounds is "Dapto – Wollongong Coastal Slopes". This landscape is described as a narrow area lying between the coast and the escarpment, formed on Permian sandstone and shale with areas of interbedded basalt. It generally comprises thin stony soils on crests and upper slopes and deeper, well-structured red and red brown loam and clay loam with some areas of mellow texture-contrast soils of high fertility high and good water holding capacity on mid and lower slopes. Yellow solodic soils with bleached A2 horizons are common on the lowest slopes and stream terraces.

2.2.9 Soil Hazard Features

The subject site potentially has soil hazard features, in particular Acid Sulphate Soils. Detailed information on the occurrence of this soil hazard feature within the subject land is currently unknown as detailed soil testing is only proposed for future detailed design stages. Therefore further assessments of soil hazard features will be required for future BDARs prepared for future development application stages.

Table 2.1 Summary of Landscape Features

Feature	Occurrence within the Subject Land and Assessment Area
IBRA bioregions and IBRA subregions	Sydney Basin Bioregion/Illawarra subregion
Rivers, streams and estuaries (classified according to stream order and including riparian buffers as outlined in Appendix 3 of the BAM)	Cookson's Creek – 1st order stream Tramway Creek – 1st order stream
Important and local wetlands on, adjacent and downstream of the site	Cooksons Creek and Tramway Creek are listed as 'Coastal Wetlands' under the Coastal Management SEPP
Habitat connectivity identifying the area/s of connectivity joining different areas of habitat that intersect with the subject land and the areas of habitat that are connected	Riparian Corridors associated with Cooksons Creek and Tramway Creek
Karst, caves, crevices, cliffs and areas of geological significance	Absent

Table 2.1 Summary of Landscape Features

Feature	Occurrence within the Subject Land and Assessment Area
Areas of outstanding biodiversity value that have been identified under the BC Act	Absent
Additional features and any other landscape features required to be assessed by the Secretary's Environmental Assessment Requirements (SEARs) for a major project.	Absent
Mitchell Landscapes	Dapto – Wollongong Coastal Slopes
Soil hazard features	Details for subject site currently not available – subject to further assessment at future development application stages

Chapter 3

Methodology

3.1 Native Vegetation Extent

The extent of native vegetation cover within the subject land and the 1,500m buffer was assessed by mapping native vegetation and categorising it into cleared land, non-native vegetation, as well as woody and non-woody native vegetation. The percent cover was estimated for each of those categories relative to the approximate benchmarks for the PCT as per **Section 4.3.2.** of the **BAM** (OEH 2017a). The final native vegetation cover value is assigned to a class, being 0–10%, >10–30%, >30–70% or >70%.

In accordance with the BAM, the areas that are not native vegetation (i.e. land not included in native vegetation extent) were not assessed further except where it was assessed as habitat for threatened species.

3.2 Flora Survey

3.2.1 Vegetation Mapping

i. Review of existing information

The following primary sources of information were consulted as part of a desktop assessment of the native vegetation within the development site:

- Cumberland Ecology (2006). Flora and Fauna Assessment of Proposed Concept Masterplan for Residential Aged Care Facility at Sandon Point, Bulli. Prepared for Anglican Retirement Villages (Ref: 4047RP1);
- Cumberland Ecology (2013b). Ecological impacts of mowing vegetation near borehole locations at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 12090 Let 7);
- Cumberland Ecology (2017). Commonwealth Assessment: Anglicare Site, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 17145Let2)
- NPWS (2002). Native Vegetation of the Illawarra Escarpment and Coastal Plain; and
- BioNet Vegetation Classification.

The first three assessments listed above were also utilised to determine the development boundaries as per the original approved Concept Plan and focus future survey effort on 'additional impacts' as required by the SEARs.

ii. Surveys

The vegetation within the subject land was ground-truthed by Cumberland Ecology staff Gitanjali Katrak and Bryan Furchert on 29 June 2018 to revise and where necessary update the vegetation mapping. Where vegetation community boundaries were found to differ from the previous mapping, records were made of proposed new boundaries using a hand-held Global Positioning System (GPS) and mark-up of aerial photographs. As the E2 zone within the Anglicare property is excluded from the development, the boundary of the E2 zone was traversed to search for and map any regrowth of the existing Turpentine Forest outside of the E2 zone into the development footprint.

Plant Community Types (PCTs) were identified (see Section 3.2.2) and vegetation zones were mapped within the Anglicare Property where each vegetation zone represents native vegetation of the same PCT and a similar broad condition state. Identification of PCTs/vegetation zones within the subject land and wider Anglicare property was based on a combination of:

- Aerial photography of the subject land and Anglicare property, including historic aerial photography interpretation of previously cleared lands;
- Existing Vegetation Mapping;
- Geology and Soil mapping/conditions; and
- Assessment of ground-truthed conditions, including tree cover/composition, shrub cover/composition, ground cover and weediness

3.2.2 Plot-based Floristic surveys for PCT Identification

For the purposes of assigning PCTs to native vegetation communities, plot based full floristic surveys were undertaken within the subject land on 29 June 2018 following the vegetation mapping. In order to be consistent, the floristic plot survey method used to identify PCTs within the subject land is identical to the floristic plot survey method used to ascertain vegetation integrity and quality scores.

As the Turpentine Forest within the E2 zone does not form part of the development footprint, plot based surveys as per BAM methodology were not conducted within the Turpentine Forest. However as this remnant vegetation represents the most likely original PCT for the subject land, the data on species composition and community structure collected during full floristic plots (20m x 20m) from prior surveys on 16 August 2017, in accordance with the former BioBanking Assessment Methodology (OEH 2014), was utilised to assign a PCT to the Turpentine Forest according to the NSW PCT classification as described in the BioNet Vegetation Classification (OEH 2017b).

3.2.3 Vegetation Integrity Assessment

In accordance with the BAM, plants are assigned to predefined growth forms in lieu of assessment of vegetation strata. The integrity of each vegetation zone was assessed for composition, structure and function against the benchmark data for the relevant PCT. The growth forms and integrity attributes utilised are shown in **Table 3.1** below.

Table 3.1 Growth form groups and attributes used to assess the composition, structure and function components of vegetation integrity

Growth form groups used to assess composition and structure	Attributes used to assess function
Tree	a) Number of large trees
Shrub	b) Tree regeneration
Grass and grass like	c) Tree stem size diversity
Forb	d) Total length of fallen logs
Fern	e) Litter cover
Other	f) High threat exotic vegetation cover
	g) Hollow bearing trees

Plots were located within each vegetation zone in accordance with the minimum plot numbers required under the BAM. Due to the highly disturbed nature of the vegetation within the subject land from previous land uses, complete avoidance of tracks and edges of disturbances was not feasible. The minimum plot numbers required and conducted are shown in **Table 4.3** of **Chapter 4**.

Each survey plot comprised the following:

- A central 50m transect;
- One 400m^2 plot (standard 20m x 20m) to assess all of the composition and structure attributes set out in **Table 3.1**;
- One 1,000m^2 (standard 20m x 50m) plot to assess the function attributes set out in **Table 3.1**; and
- Five 1m^2 sub-plots to assess average litter cover and other groundcover components.

The vegetation composition was assessed within the 20m × 20m plot and includes full species name, growth form, status and abundance rating. The vegetation structure assessed within the 20m x 20m plot includes percent foliage cover for each species, which comprises all living

plant material of all individuals of the species present, including leaves, twigs, branchlets and branches as well as canopy overhanging the plot even if the stem is outside the plot.

The vegetation function assessment was assessed within the 20m x 50m plot and included tree stem classes, regeneration, length of fallen logs, litter cover and tree hollows.

The information collected within each plot is shown in **Table 3.2** below.

Table 3.2 Vegetation Integrity Assessment Attributes

Attribute	Survey requirement
Stratum (& layer)	Stratum & layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	Estimated % foliage projective cover across the plot of each species rooted in or overhanging the plot. Cover is recorded in decimals if less than 1% (0.1, 0.2…), or whole numbers up to 5% (1,2,3…), or to the nearest 5%. where greater than 5% cover (5,10,15,20,25…)
Abundance rating	Number of native plant species (richness) observed within each plot. For species with cover less than or equal to 5%, number of individuals or shoots of each species is estimated within the plot, using the following intervals: 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000,1500,2000, etc. Numbers above 20 are estimates only, and the recorded abundance is the upper end of each class (e.g. 50 represents an estimated abundance of between 20 and 50). For species with cover greater than 5%, abundance estimates are not required.
Number of large trees	Tree stem size classes are measured on living trees at 1.3m above ground height, referred to as 'diameter at breast height over bark' or DBH. For multi-stemmed tree, only the largest living stem is included in the count. Tree stem size classes are: <5, 5–9, 10–19, 20–29, 30–49, 50–79, and 80+ cm DBH and include all species in the tree growth form group. Regeneration is based on the presence or absence of living trees with stems <5cm DBH.
Length of fallen logs	The length of fallen logs is the total length in metres of all woody material greater than 10cm in diameter that is dead and entirely or in part on the ground within the 20m x 50m plot. Where logs extend outside of the plot, only the length of fallen log that is contained within the plot is recorded.
Litter cover	Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots evenly located along the central transect. It includes leaves, seeds, twigs, branchlets, branches (<10cm in diameter) and all plant material that is detached from a living plant. Dead material still attached to a living plant (such as a grass) is assessed as litter cover where it is in contact with the ground. It includes litter under the canopies of erect plants.

Table 3.2 Vegetation Integrity Assessment Attributes

Attribute	Survey requirement
Number of trees with hollows	The number of trees with hollows is established by counting hollows that are visible from the ground in both living and dead trees.

3.2.4 Threatened Flora Searches

As desktop assessments had determined a probable PCT based on the 2017 data, searches for threatened flora associated with the PCT were incorporated into the 29 June 2018 surveys. The flora searches were incorporated into the vegetation mapping meanders and flora quadrats and included searches for the following sub-set of species associated with the PCT which can be surveyed all year:

- *Grammitis stenophylla;*
- *Melaleuca biconvexa*; and
- *Zieria granulata*.

3.2.5 Flora Survey Effort

Table 3.3 below shows the flora survey effort, including dates, staff members and weather conditions.

Table 3.3 Flora Survey Effort

Survey Detail	Date	Effort	Personnel	Weather Conditions	Notes
Vegetation Mapping	29 June 2018	8 person hours (4 x 2 personnel)	Gitanjali Katrak, Bryan Furchert	Clear skies, light breeze, Temperature range: 8 -16ºC	
BAM plots	29 June 2018	2 x BAM plots	Gitanjali Katrak, Bryan Furchert		
Threatened flora searches	29 June 2018	6 person hours (3 x 2 personnel	Gitanjali Katrak, Bryan Furchert		

Table 3.3 Flora Survey Effort

Survey Detail	Date	Effort	Personnel	Weather Conditions	Notes
Prior surveys of Turpentine Forest (not part of development)	16 August 2017	2 x BBAM plots	Gitanjali Katrak, Bryan Furchert	Clear skies, light breeze, Temperature range: 15 – 20 ^{o}C	Surveys conducted as part of EPBC Act assessment, prior to release of BAM survey methodology

3.3 Fauna Survey

3.3.1 Habitat Suitability Assessment

The habitat suitability assessment for fauna is based on the following information from the Threatened Biodiversity Data Collection:

- The threatened species that are either known or predicted to occur within the IBRA subregion;
- The threatened species that are associated with each PCT;
- The native vegetation cover class with which the threatened species is associated;
- Minimum patch size in hectares, with which the threatened species is associated;
- Any geographic constraints associated with the occurrence of the threatened species;
- Any habitat constraints associated with the occurrence of the threatened species;
- Past records of the threatened species on the subject land; and
- The class of credit for the threatened species.

Threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection, are included in ecosystem credits. Targeted surveys are not required for these species.

In order to establish the habitat suitability for threatened species (species credits) on the subject site the following steps are taken:

- Identification of threatened species for assessment;
- Assessment of the habitat constraints, geographic constraints and vagrant species;
- Identification of candidate species for further assessment;
- Determination of presence or absence of a candidate species;
- Determination of the area or count, and location of suitable habitat for a candidate species to generate species polygons; and
- Determination of habitat condition within the species polygon for each candidate species assessed by area.

3.3.2 Threatened Species Survey

Due to the timing constraints associated with submission of application for a 75W modification, targeted surveys for threatened species within appropriate survey periods could not be conducted for the majority of species credit species as identified by the BAM calculator.

Therefore a conservative approach has been taken and species credit species are largely assumed to be present. The exceptions to this include:

- Following field assessment the habitat was determined to be substantially degraded such that the species credit species is unlikely to utilise the subject land (or specific vegetation zones) based on a combination of site conditions and the mobility of that specific species;
- Dual ecosystem/species credit species for which suitable breeding habitat, usually in the form of large hollows, was not recorded onsite during habitat assessments; and
- Removal of frog species from the list of candidate species based on the fact that all suitable habitat (wetland and creek habitats) for potentially occurring threatened frogs lie within the E2 zone (outside the development area) and are to be managed and enhanced under a VMP as per the requirements of the original Concept Plan and issued SEARs as well as prior targeted frog surveys (Cumberland Ecology 2012, 2014).

3.3.3 Fauna Survey Methods

A wide range of fauna surveys have been historically conducted in the subject land and surrounds between 2004 and 2018. These include:

- Habitat assessment;
- Targeted searches for the Green and Golden Bell Frog

Detailed survey methods for these historic surveys are described below.

i. Habitat Assessment

Habitat assessments were conducted in October 2004, November 2004, February 2006, September 2012, August 2017 and June 2018.

During these assessments, data was collected about the nature and extent of flora and fauna habitats including the forest, grassland/shrubland and creek. The nature and extent of fauna habitats on the subject site were assessed and areas where threatened fauna species could reside or forage were identified. Site assessments included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the subject land was also undertaken and considered.

Hollows were used as a general indication of habitat quality for arboreal fauna, and hollow-dwelling birds and bats. Hollows observed during surveys were recorded and the general vegetation condition and tree maturity was used to predict whether trees on site were likely to contain hollows.

ii. Green and Golden Bell Frog Surveys

Habitat assessment was undertaken for the Green and Golden Bell Frog across all areas of the subject site that contained water, aquatic vegetation or were in close proximity to water and/or aquatic vegetation.

Assessment of foraging/dispersal, breeding, and shelter habitat involved an assessment of all areas containing standing water, areas adjacent to standing water and areas containing fringing and/or emergent aquatic vegetation. Notes on the type of habitat (e.g. drainage line, pond, wetland, grass field) along with the following features were taken to assess the suitability of areas to provide potential habitat for the species:

- Presence of fringing and/or emergent aquatic vegetation;
- Presence of water; and
- Connectivity to adjacent areas of potential habitat.

Targeted surveys for the Green and Golden Bell Frog have been conducted within the subject site on several occasions. A targeted search for Green and Golden Bell Frogs was conducted by Dr Arthur White on November 10th, 2004. The subject site was assessed for potential frog habitats and frogs were surveyed by netting for tadpoles, active searches for adults and call-playback.

Further targeted surveys for the Green and Golden Bell Frog were undertaken over four consecutive nights from 24 to 27 September 2012 inclusive (Cumberland Ecology 2012). This was within the accepted period for detecting the Green and Golden Bell Frog (September to

March) at the time of surveys. Searches were conducted at five sites. These sites were selected because they represented the most suitable habitat for the species in the vicinity.

For each survey location, the targeted surveys comprised of a five minute listening period for calling frogs, during which lights were not used to avoid deterring any frogs from calling. This was followed by a five minute period whereby Green and Golden Bell Frog breeding and territorial calls were broadcasted at the subject site using a loudhailer to elicit a response from resident frogs. A ten minute period of active searching using hand held spotlights was then carried out and any frogs heard or seen were recorded.

Spotlighting random meander surveys were undertaken by two ecologists after dusk and included a random meander using a hand-held torch of open areas that contained ephemeral soaks and provide connectivity between water bodies. All amphibian species heard calling and/or observed were recorded.

These surveys were repeated as part of pre-clearance surveys for Green and Golden Bell Frog associated with geotechnical studies for the subject site from 10 – 13 November 2014 (Cumberland Ecology 2014).

3.3.4 Fauna Survey Effort

As previously stated, targeted surveys for species credit species in accordance with the BAM have not been conducted due to timing constraints associated with the submission of the application as a 75W modification.

Due to these constraints, any species credit species or dual ecosystem/species credit species that cannot be justifiably excluded based on previous targeted survey results or habitat assessments are assumed to be present.

As the current application comprises a high level Concept Plan, further assessments will be required at the development application stages when further detailed design is available. These assessments will include targeted surveys for the species credit species identified within the BAM calculator to determine final credit liabilities for impacts to threatened species.

Chapter 4

Biodiversity Assessment (BAM Stage 1)

This Chapter is in accordance with Sections 3 to 6 of the BAM (OEH 2017a).

4.1 Landscape Features

A range of landscape features require consideration under the BAM, since these features may contain biodiversity values that are important for the site context or for informing the likely habitat suitability of the subject land.

The Landscape regions around the subject land are shown in **Figure 4.2** and **Table 4.1** below.

Table 4.1 Features of the Subject Land

Landscape Feature	Feature Name
LGA	Wollongong City Council
IBRA Bioregion	Sydney Basin
IBRA Subregion	Illawarra
Mitchell Landscape	Dapto – Wollongong Coastal Slopes
AOBVs	None mapped
SAII	None mapped
Rivers, streams, creeks and estuaries	Cooksons Creek
	Tramway Creek
Wetlands	Cooksons Creek Wetland
	Tramway Creek Wetland
Areas of geological significance	None mapped
Soil hazard features	Potential for Acid Sulphate Soils but details for subject land currently not available – subject to further assessment at future development application stages

4.2 Native Vegetation

4.2.1 Native Vegetation Extent

The extent of native vegetation cover within the subject land and the 1,500m buffer was assessed by mapping native vegetation and categorising it into cleared land, non-native vegetation and woody native vegetation. No areas of non-woody native vegetation were mapped within the subject land or 1,500m buffer. The final native vegetation cover value was assigned to a class, being 0–10%, >10–30%, >30–70% or >70%. In accordance with the BAM, the areas that are not native vegetation (i.e. land not included in native vegetation extent) were not assessed further assessment except if assessed as habitat for threatened species.

The native vegetation extent is shown in **Figure 4.1** and summarised in **Table 4.2** below.

Table 4.2 Native Vegetation Cover within Buffer area

Native Vegetation Cover Category	Estimated % Cover in 1,500m buffer	Estimated % cleared in 1,500m buffer	Estimated % cleared for selected PCT
Woody Native Vegetation	19.5%	80.5%	50%

4.2.2 Review of Existing Information on Native Vegetation

Existing information on native vegetation within the Anglicare Property and surrounds was reviewed, which includes:

- Cumberland Ecology (2006). Flora and Fauna Assessment of Proposed Concept Masterplan for Residential Aged Care Facility at Sandon Point, Bulli. Prepared for Anglican Retirement Villages (Ref: 4047RP1);
- Cumberland Ecology (2013). Ecological impacts of mowing vegetation near borehole locations at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 12090 Let 7);
- Cumberland Ecology (2017). Commonwealth Assessment: Anglicare Site, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages (Ref: 17145Let2); and
- NPWS (2002). Native Vegetation of the Illawarra Escarpment and Coastal Plain.

The NPWS mapping for the Illawarra region identifies three vegetation communities within the Anglicare Property. These are:

- Turpentine Regeneration
- Acacia Scrub; and

- Floodplain Wetland.

Previous surveys by Cumberland Ecology between 2006 and 2012 confirmed the presence of these three communities within the Anglicare property although the extent within the site differed from that of the broadscale Illawarra mapping. These surveys determined that the Turpentine Regeneration was largely limited to the declared Heritage Item and was fully contained within the E2 zone.

Later surveys by Cumberland Ecology in 2017 confirmed that areas previously mapped as Turpentine Regeneration had matured to the extent that it conformed to the community Escarpment Blackbutt Forest as defined in the 2002 NPWS mapping.

Although native woody plants such as *Acacia longifolia ssp sophorae* and *Pittosporum undulatum* occur within areas mapped as *Acacia scrub*, this map unit shows a very high degree of weed infestation, primarily *Lantana camara*, *Ipomoea indica*, *Ochna serrulata*, *Ageratina adenophora* and *Lonicera japonica*.

The areas of Floodplain wetland are limited to the riparian areas along Cooksons Creek and are contained completely within the E2 zones.

4.2.3 PCTs and Vegetation Zones within the Subject Land

Table 4.3 below shows the PCTs and vegetation zones identified within the subject land and wider Anglicare Property, the stratification units (i.e. quality), the number of plots required under the BAM (OEH 2017a) and the number of plots conducted for each vegetation zone.

It should be noted that the area of Turpentine Forest lies within E2 zone and therefore does not form part of the development footprint (the subject land). However given the level of historic clearing, weed invasion and colonising native regrowth within the subject land, this area has been described within this section of the BDAR to provide context and justification for selection of a PCT for vegetation zones within the subject land.

Table 4.3 PCTs/Vegetation Zones of the Subject Land and Anglicare Property

PCT	Condition	Status	Area (ha)	# Plots required	# Plots conducted
694	Good	Not listed	1.19	n/a: outside the development footprint – data provided only for context for PCT selection	2 floristic plots conducted in August 2017 in accordance with BBAM.
Zone 1: PCT 694 – Turpentine Regrowth	Moderate	Not listed	0.37	1 plot/transect	1 plot/transect

Table 4.3 PCTs/Vegetation Zones of the Subject Land and Anglicare Property

PCT	Condition	Status	Area (ha)	# Plots required	# Plots conducted
Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted	Degraded	Not listed	1.82	1 plot/transect	1 plot/transect

These vegetation zones are mapped in **Figure 4.2** and the communities are described in detail in the sections below. **Figure 4.3** shows the locations of the plots/transects.

i. Turpentine Forest within E2 zone

Vegetation Formation: Wet Sclerophyll Forest (Shrubby sub-formation)

Vegetation Class: North Coast Wet Sclerophyll Forests

TEC status: not listed

Estimated percent cleared value: 50%

Area (ha): 1.19ha

Species relied upon for identification of PCT: *Syncarpia glomulifera* (Turpentine); *Eucalyptus pilularis* (Blackbutt); *Myrsine variabilis*, *Pittosporum undulatum* (Sweet Pittosporum); *Breynia oblongifolia* (Coffee Bush); *Oplismenus imbecillis*, *Pseuderanthemum variabile* (Pastel flower); *Tylophora barbata* (Bearded Tylophora).

Evidence used to identify PCT: i) Occurs along the escarpment foothills and coastal lowlands in the Bateman, Cumberland, Ettrema, Illawarra, Jervis, Moss Vale and Sydney Cataract subregions. ii) known to occur in the Wollongong Administrative area; iii) occurs on a strata of siltstone which is consistent with the Illawarra mapping occurrence on Permian siltstone and shales.

Onsite Community Description: The canopy of the regrowth forest within the E2 zone comprises mainly *Syncarpia glomulifera* and *Eucalyptus pilularis*. The understory contains *Pittosporum undulatum*, the climber *Tylophora barbata* and *Lomandra longifolia* (**Photograph 4.1**). The understory shows a significant level of weed infestation, mainly the shrubs *Ochna serrulata, Ligustrum sinense* and *Ligustrum lucidum* with increasing prevalence of *Lantana camara* toward the margins of the forest (**Photograph 4.2**) where it merges with Acacia scrub regrowth in historically cleared areas.

Photograph 4.1 Regrowth Escarpment Blackbutt Forest (PCT 694) within the E2 zone

Photograph 4.2 Dense Lantana infestation on margins of E2 zone

ii. Zone 1: PCT694 – Turpentine Regrowth

Vegetation Formation: Wet Sclerophyll Forest (Shrubby sub-formation)

Vegetation Class: North Coast Wet Sclerophyll Forests

TEC status: not listed

Estimated percent cleared value: 50%

Area (ha): 0.37 ha

Species relied upon for identification of PCT: *Syncarpia glomulifera* (Turpentine); *Notelaea longifolia* (Large Mock-olive), *Myrsine variabilis, Pittosporum undulatum* (Sweet Pittosporum); *Breynia oblongifolia* (Coffee Bush); *Pseuderanthemum variabile* (Pastel flower).

Evidence used to identify PCT: i) Vegetation zone occurs in a historically cleared area but is located immediately adjacent to an area of regrowth forest that has been regenerating since the 1930s and conforms to PCT 694 as described in **Section 4.2.3 i)** above.

Onsite Community Description: Zone 1 largely occurs to the west of the E2 zone/existing Turpentine Forest. The zone comprises a mix of potential regrowth species from the adjacent Turpentine Forest as well as planted species such as *Casuarina glauca* (Swamp Oak), *Eucalyptus punctata* (Grey Gum), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum) (**Photograph 4.3**). The zone also shows characteristics of the Acacia scrub community, mainly *Acacia maidenii*, as defined in the 2002 NPWS mapping for the Illawarra.

The Acacia scrub community is defined in the NPWS (2002) mapping as a number of Acacia species that recolonise cleared or heavily disturbed native vegetation, often forming dense scrubs on a wide variety of regenerating habitats and environments. While they regularly occur in combination with weeds such as *Lantana camara*, they also occur in combination with native species such as *Syncarpia glomulifera*.

Photograph 4.3 Zone 1: Regrowth Turpentine in western parts of subject land

iii. Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted

Vegetation Formation: Wet Sclerophyll Forest (Shrubby sub-formation)

Vegetation Class: North Coast Wet Sclerophyll Forests

TEC status: not listed

Estimated percent cleared value: 50%

Area (ha): 1.82ha

Species relied upon for identification of PCT: *Myrsine variabilis, Pittosporum undulatum* (Sweet Pittosporum); *Breynia oblongifolia* (Coffee Bush); *Pteridium esculentum* (Bracken); *Imperata cylindrica* (Blady grass).

Evidence used to identify PCT: i) Vegetation zone occurs in a historically cleared area but is located immediately adjacent to an area of regrowth forest that has been regenerating since the 1930s and conforms to PCT 694 as described in **Section 4.2.3 i)** above.

Onsite Community Description: Zone 2 largely occurs to the east of the E2 zone/existing Turpentine Forest. Diagnostic tree species for PCT 694 such as *Syncarpia glomulifera* are absent and the tree layer is characterised by non-diagnostic species such as *Cupaniopsis anacardioides* (Tuckeroo) and *Glochidion ferdinandi* (Cheese Tree). This zone is largely dominated by the colonising *Acacia longifolia subsp. sophorae* (**Photograph 4.4**) as well as

high threat weed species such as *Lonicera japonica* and *Lantana camara* (**Photograph 4.5**). Despite the high levels of colonising Acacias and exotics, there are scattered occurrences of native species, diagnostic of PCT 694, such as *Imperata cylindrica* and *Pittosporum undulatum*. Areas along the southern boundary of the subject land show a higher prevalence of *Casuarina glauca*, particularly in historically landscaped areas.

Photograph 4.4 Zone 2: Acacia regrowth in eastern parts of subject land

Photograph 4.5 Weed infestations within Zone 2

iv. Exotic Vegetation

Several historically cleared areas, particularly in the vicinity of previously developed areas in the north-western and north-eastern parts of the subject land show very dense infestations of *Lantana camara* (**Photograph 4.6 – 4.7**). While some scattered natives may occur in the groundlayer, it is largely dominated by exotics such as *Ochna serrulata* and *Ageratina adenophora* as well as exotic climbers such as *Ipomoea indica.* The Cooksons Creek riparian zone in particular shows a very dense infestation of *Ipomoea indica* and *Ageratina adenophora* infestation (**Photograph 4.8**) which has spread into adjacent areas.

Photograph 4.6 Weed infestation in north-west corner of subject land

Photograph 4.7 Dense lantana growth adjacent to E2 zone, south of Turpentine Forest

Photograph 4.8 Heavy weed infestation of *Ageratina adenophora* within Cooksons Creek

4.2.4 Vegetation Integrity Assessment

The location for each vegetation integrity assessment, i.e. survey plots/transects is shown in **Figure 4.3**. The plot data is included in **Appendix A**, while the scanned datasheets are in **Appendix B**.

The vegetation integrity calculations were performed in the BAM online calculator version 1.2.5.00 (OEH 2018), the results of which are shown in the credit reports in **Appendix C**. A full flora species list is included in **Appendix D.** A fauna species list is currently not available as targeted surveys were not conducted and incidental observations were limited to calls of Common Eastern Froglet (*Crinia signifera*) within Cooksons Creek and Eastern Whipbird (*Psophodes olivaceus*) in the Turpentine Forest.

As vegetation Zone 2: PCT 694 - Acacia/Exotic Regrowth or Planted is largely dominated by *Acacia longifolia ssp sophorae* (50% cover), a species that is not diagnostic of PCT 694 and is a known coloniser of historically cleared areas, an additional assessment for Zone 2, which excluded the field data for *Acacia longifolia ssp sophorae* was conducted for comparative purposes to determine the extent to which credit liability was driven by the presence of the colonising species. The comparative assessment determined a significant reduction in vegetation integrity scores for Zone 2 in the absence of *Acacia longifolia ssp sophorae* and did not generate any credits. The credit report showing the difference in credit requirements when *Acacia longifolia ssp sophorae* is excluded is provided in **Appendix C**.

This discrepancy, where credits were driven solely by a colonising species that is not diagnostic of original vegetation, was conveyed to OEH and advice was sought on potential adjustments to either benchmark values or field data entry for this species/vegetation zone. The correspondence received from OEH is provided in **Appendix E**.

As the concept of non-aligned/planted PCTs and adjustment to determine credit liability is currently still being addressed by OEH, potential options for adjustment of values were not available. However OEH have acknowledged that an adjustment to discount for *Acacia longifolia ssp sophorae* values is "ecologically sensible" (**Appendix E**). Therefore for the purposes of this BDAR, the results of both BAM calculations for Zone 2 have been provided.

As further assessments will be required at the development application stages, further consultation will be required with OEH to determine suitable adjustments within the BAM calculations to more accurately determine a credit liability based on the site conditions, especially as there is a significant difference in the total cost for credits between situations where *Acacia longifolia ssp sophorae* is included and excluded from Zone 2 data (**Appendix C**). These adjustments for colonising *Acacia* species will also inform any future assessments for removal of regrowth vegetation within the E2 zone, if required for creation of an appropriate bio-retention basin.

Table 4.4 below provides a summary of the ecosystem credits generated for each PCT /vegetation zone within the subject land.

Table 4.4 Ecosystem credit liability

PCT	Area (ha)	Integrity Score	Ecosystem Credits
Zone 1: PCT 694 – Turpentine Regrowth	0.37	28	5
Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted (*Acacia longifolia ssp sophorae* included)	1.82	32.1	26
Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted (*Acacia longifolia ssp sophorae* excluded)	1.82	14	0

4.3 Habitat Suitability for Threatened Species

4.3.1 Description of habitats within subject land

The majority of the subject land is highly disturbed and forms mostly degraded and unsuitable habitat for many native fauna species. The majority of the fauna habitat within the Anglicare property occurs within the Turpentine Forest (E2 zone) which will be retained and managed under the VMP, thus improving habitat values for fauna.

The vegetation within the subject land largely comprises vegetation that has regrown following historic clearance. The trees within the subject land comprise a mix of individuals that are not of an age to form hollows or species that generally do not form hollows, resulting in a general lack of roosting habitat for fauna species. Fauna habitat within the subject land is therefore largely limited to foraging habitat for fauna.

The existing structures within the subject land comprise abandoned buildings that are in a state of disrepair and are highly exposed to elements due to broken windows and other damage to the buildings. They are therefore considered relatively unlikely to comprise suitable roosting habitat for microchiropteran bat species that are known to utilise artificial structures. However further targeted surveys are recommended at development application stages to definitively exclude the presence of threatened bat species.

As targeted surveys for threatened species have not been conducted due to timing constraints associated with the submission of a 75W application, a conservative approach has been taken and all species credit species predicted to occur within the PCT that cannot be justifiably excluded have been assumed to occur.

4.3.2 Assessment of threatened species

As discussed in **Section 3.3.1**, some threatened species are included in ecosystem credits and others generate species credits. Some bat and bird species generate species credits for breeding habitat; however, their foraging habitat is included in ecosystem credits. These species are referred to within this BDAR as 'dual' species

The BAM uses a biodiversity risk weighting to evaluate the ecological risks of threatened entities, which comprise two components:

- Sensitivity to loss, which considers the increased threat posed to an entity from offsetting the loss of habitat or population, and
- Sensitivity to potential gain, which considers the ability of a species to respond to improvements in habitat condition at an offset site.

The biodiversity risk weighting for determining the credit requirement for ecosystem credits is based on the sensitivity to loss of either the listed TEC, or the PCT identified at the site, and the highest sensitivity to gain ranking for the ecosystem credit species associated with that TEC or PCT. The biodiversity risk weighting for determining the credit requirement for species credits is based on the sensitivity to loss and the sensitivity to gain for the species.

The biodiversity risk weighting is included in the credit reports in **Appendix C**.

4.3.3 Ecosystem Credit Species

For some threatened species the likelihood of occurrence can be predicted by vegetation surrogates and landscape features. They are included in ecosystem credits of the associated PCT and do not require surveys. For the purposes of this BDAR, all ecosystem credit species and ecosystem components for dual species have been retained.

Table 4.5 below lists all threatened species, which generate ecosystem credits and are predicted to occur within the subject site.

Table 4.5 Ecosystem Credit Species Predicted to occur within the Subject Site

Common Name	Scientific Name	Vegetation Types(s)
Eastern Bentwing-bat (Foraging)	*Miniopterus schreibersii oceanensis*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Eastern Freetail-bat	*Mormopterus norfolkensis*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Gang-gang Cockatoo (Foraging)	*Callocephalon fimbriatum*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Glossy Black-Cockatoo (Foraging)	*Calyptorhynchus lathami*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Grey-headed Flying-fox (Foraging)	*Pteropus poliocephalus*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Koala (Foraging)	*Phascolarctos cinereus*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Little Bentwing-bat (Foraging)	*Miniopterus australis*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Little Eagle (Foraging)	*Hieraaetus morphnoides*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Little Lorikeet	*Glossopsitta pusilla*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Masked Owl (Foraging)	*Tyto novaehollandiae*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Powerful Owl (Foraging)	*Ninox strenua*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion

Table 4.5 Ecosystem Credit Species Predicted to occur within the Subject Site

Common Name	Scientific Name	Vegetation Types(s)
Regent Honeyeater (Foraging)	*Anthochaera phrygia*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Spotted-tailed Quoll	*Dasyurus maculatus*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Square-tailed Kite (Foraging)	*Lophoictinia isura*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Swift Parrot (Foraging)	*Lathamus discolor*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Varied Sittella	*Daphoenositta chrysoptera*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	694-Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion

4.3.4 Species Credit Species

Where the occurrence of threatened species cannot be reliably predicted by habitat surrogates, they generate species credits.

The following species credit species listed in **Table 4.6** below are currently assumed to occur within the subject land as targeted surveys have not been conducted and they cannot be justifiably excluded based on current available data, habitat constraints identified for the species in the Threatened Biodiversity Data Collection, mobility of the species, and habitat assessments conducted in accordance with Step 2 and Step 3 of Section 6.4 of the BAM.

Due to the high degree of weed infestation and colonising species, high density of vegetation with resultant lack of fly-ways and degradation from rubbish dumping within Zone 2, this vegetation zone is not considered to be suitable habitat for these species for the purposes of the current BDAR. However it is acknowledged that detailed surveys and/or expert reports may be required for future BDARs at the development application stages to accurately assess the credit liability for species credit species. This will be done in conjunction with reassessment of the fauna habitat values of colonising revegetation following consultation with OEH as outlined in **Section 4.2.4**.

Table 4.6 Species Credit Species assumed to occur within the Subject Land

Scientific Name	Common Name	Associated PCT/Vegetation Zone	Area of habitat
Lophoictinia isura	Square-tailed Kite	Zone 1: PCT 694 – Regrowth Turpentine	0.37 ha
Petroica rodinogaster	Pink Robin	Zone 1: PCT 694 – Regrowth Turpentine	0.37 ha
Solanum celatum	Solanum celatum	Zone 1: PCT 694 – Regrowth Turpentine	0.37 ha

Table 4.7 below lists all the species credit species and dual species that have excluded from further assessment with this BDAR with justification for exclusion. However it is acknowledged that further assessments of these species may be required in future BDARs at the development application stages to accurately assess the credit liability these species credit species. The requirement for further survey done in conjunction with reassessment of the fauna habitat values of colonising revegetation following consultation with OEH as outlined in **Section 4.2.4**.

Table 4.7 Species Credit Species excluded from further assessment

Scientific Name	Common Name	Justification for Exclusion
Zieria granulata	Illawarra Zieria	Large, distinct shrub - not recorded on site during targeted searches
Litoria aurea	Green and Golden Bell Frog	Not recorded in historical targeted surveys; potential habitat (wetland) is excluded from the development footprint and will be managed/enhanced under a VMP
Pseudophryne australis	Red-crowned Toadlet	Not recorded in historical frog surveys; potential habitat (wetland) is currently highly degraded from weed invasion and is excluded from the development footprint and will be managed/enhanced under a VMP
Anthochaera phrygia (Breeding)	Regent Honeyeater	Subject land does not occur within mapped breeding area
Callocephalon fimbriatum (Breeding)	Gang-gang Cockatoo	Subject land does not contain hollows of suitable size

Table 4.7 Species Credit Species excluded from further assessment

Scientific Name	Common Name	Justification for Exclusion
Calyptorhynchus lathami (Breeding)	Glossy Black-Cockatoo	Subject land does not contain hollows of suitable size
Hieraaetus morphnoides (Breeding)	Little Eagle	Subject land does not contain the large, old trees required for nesting
Lathamus discolor (Breeding)	Swift Parrot	Subject land does not occur within mapped breeding area
Ninox strenua (Breeding)	Powerful Owl	Subject land does not contain hollows of suitable size
Tyto novaehollandiae (Breeding)	Masked Owl	Subject land does not contain hollows of suitable size
Chalinolobus dwyeri	Large-eared Pied Bat	Subject land does not contain and is not in the vicinity of habitat constraints such as rocky areas containing caves, overhangs, outcrops, or crevices, old mines or tunnels
Miniopterus australis (Breeding)	Little Bentwing-bat	Subject land does not contain caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. Existing buildings too highly exposed from damage to provide suitable habitat
Miniopterus schreibersii oceanensis (Breeding)	Eastern Bentwing-bat	Subject land does not contain caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. Existing buildings too highly exposed from damage to provide suitable habitat
Myotis macropus	Southern Myotis	Although the subject land is within 200m of a riparian area/creekline (Cooksons Creek), the creekline does not provide foraging habitat for Southern Myotis due to lack of surface water from heavy Crofton Weed infestation (see Photograph 4.8). Furthermore the vegetation zones within the subject land do not contain hollows so no roosting/breeding habitat is present within the subject land
Cercartetus nanus	Eastern Pygmy-possum	Subject land does not contain suitable hollows for this species. Zone 1 of the subject land lacks the favoured mid-storey

Table 4.7 Species Credit Species excluded from further assessment

Scientific Name	Common Name	Justification for Exclusion
		layer favoured by this species while Zone 2 lacks favoured plants that this species is generally associated with. Train lines, dual carriageways and large areas of development also serve as hostile barriers to potential movement from known occurrences in the Illawarra region
Petaurus norfolcensis	Squirrel Glider	Subject land does not contain suitable hollows species. Both vegetation zones lack either the mixed species stands or midstorey layer favoured by this species. Train lines, dual carriageways and large areas of development also serve as hostile barriers to potential movement from known occurrences in the Illawarra region
Phascolarctos cinereus (Breeding)	Koala	Subject site occurs in a highly fragmented and developed landscape; Habitat assessment has found no indication of koala occurrence. Feed trees are limited to scattered plantings in previously cleared areas. Train lines, dual carriageways and large areas of development also serve as hostile barriers to potential movement from known occurrences in the Illawarra region
Pteropus poliocephalus (Breeding)	Grey-headed Flying-fox	Subject land does not occur in the vicinity of any known camps

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

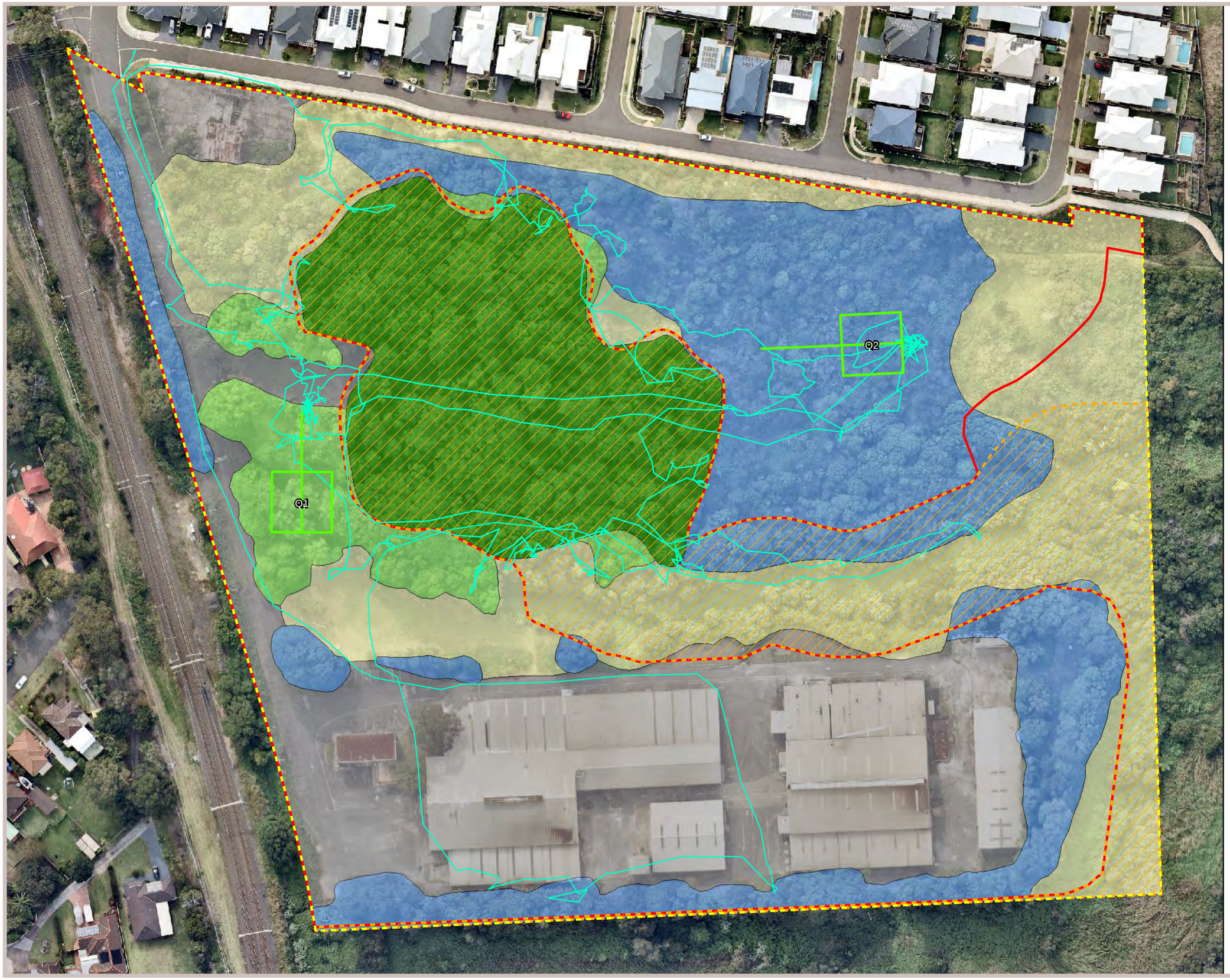
cumberland ecology

0 100 200 300 400 m

I:\...\17145\Figures\RP1\20180716\Figure 4.1. Native Vegetation Extent

Figure 4.1. Native Vegetation Extent

Figure 4.2. PCTs within the Subject Land



Legend

- Subject Land
- Anglicare Property
- E2 Zone

Flora Plot Locations

- Quadrat Locations
- Transect Locations
- Survey Tracks

Vegetation Community

- Turpentine Forest (PCT694)
- Zone 1: PCT 694_Moderate: Turpentine Regrowth
- Zone 2: PCT 694_Degraded: Acacia/Exotic Regrowth or Planted
- Exotic Vegetation
- Cleared/Buildings

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180719\Figure 4.3. BAM plot locations

Figure 4.3. BAM plot locations

Legend

- Subject Land
- Anglicare Property

Solanum celatum Habitat

- Zone 1: PCT 694: Turpentine Regrowth

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180810\Figure 4.4. Threatened Species Habitat (Solanum celatum)

Figure 4.4. Threatened Species Habitat (Solanum celatum)

Legend

- Subject Land
- Anglicare Property

Square-tailed Kite Habitat

- Zone 1: PCT 694: Turpentine Regrowth

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180810\Figure 4.5. Threatened Species Habitat (Square-tailed Kite)

Figure 4.5. Threatened Species Habitat (Square-tailed Kite)

Legend

- Subject Land
- Anglicare Property

Pink Robin Habitat

- Zone 1: PCT 694: Turpentine Regrowth

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180810\Figure 4.6. Threatened Species Habitat (Pink Robin)

Figure 4.6. Threatened Species Habitat (Pink Robin)

Chapter 5

Impact Assessment (BAM Stage 2)

This Chapter is in accordance with Sections 7 to 11 of the BAM (OEH, 2017).

5.1 Avoid and Minimise Impacts

This section includes demonstration of efforts to avoid and minimise impact on biodiversity values identified in **Section 4** of this report, which includes assessment of direct and indirect impacts.

5.1.1 Avoid and Minimise Direct Impacts

i. Project Location

The approved development envelope within Anglicare Land as per approved Concept Plan for MP06-0094 was sited to develop areas that were previously cleared or modified and avoided areas of remnant vegetation, riparian areas and habitat connectivity. Furthermore, as part of the approved Concept Plan, areas outside of the development envelope were required to be managed and enhanced to improve vegetation condition and maintain/enhance connectivity.

The current proposed modification will be contained within the previous approved development envelope. Therefore the proposed modification will continue to:

- Avoid areas containing threatened ecological communities and higher vegetation integrity
- Develop within areas with low to no biodiversity values; and
- Maintain existing connectivity to enable movement of species.

Further refinements will be made, where feasible, at future details design stages to maximise buffer zones between developed areas and retained vegetation within the E2 zone.

ii. Consideration of Alternative Locations

As the current project comprises a modification to an existing approval, to be contained within the approved development envelope, no consideration of alternate locations for the development envelope within Anglicare lands has been considered for the current BDAR.

iii. Consideration of Project Design

As the current project comprises modification of a Concept Plan, detailed designs that would enable maximum reduction of clearing footprint are currently not available. Further assessments will be required during future development application stages to ensure maximum feasible avoidance of native vegetation clearing.

In accordance with the original Concept Plan approvals and statement of commitments management actions will be implemented to demarcate areas of native vegetation and habitat to be retained. Furthermore all vegetation within the E2 zone will be rehabilitated under a VMP prepared in accordance with the requirements of the SEARs.

5.1.2 Avoid and Minimise Indirect Impacts

As the current proposed modification will largely be contained within the previous approved development envelope with no significant alterations to works along previous development boundary edges, no indirect impacts, beyond those previously assessed are likely to occur.

5.1.3 Avoid and Minimise Prescribed Impacts

As the current proposed modification will largely be contained within the previous approved development envelope with no significant alterations to works along previous development boundary edges, no prescribed impacts, beyond those previously assessed are likely to occur. It is noted that improvements in engineering design and regulatory standards are likely to reduce the potential on prescribed impacts such as hydrological processes compared to previous approved assessments.

5.2 Assessment of Residual Impacts

5.2.1 Residual Direct Impacts on Native Vegetation and Habitat

Due to the passage of time since the assessments for the original Concept Plan, there has been significant levels of regrowth, including weed invasion, within the approved development envelope. As removal of this regrowth vegetation was not considered as part of the Concept Plan approval, it is considered to be an 'additional' impact and has been assessed in accordance with the requirements of the SEARs.

Impacts from clearing native vegetation, threatened ecological communities and threatened species habitat on the subject site are based on information from Stage 1 and the final boundary of the project taking into account the measures taken to avoid and minimise impacts.

The future values for composition, structure and function of the vegetation are estimated for each vegetation zone, which generate the future vegetation integrity score. The change in the vegetation integrity score is a measure of the direct impact on native vegetation and threatened species habitat, i.e. before the development takes place and the future vegetation integrity score determined by accounting for the impacts of development.

Table 5.1 below provides a summary of the ecosystem credits generated for each vegetation zone within the subject site after avoiding and minimising impacts.

As previously described in **Section 4.2.4**, results for the BAM calculator for Zone 2, with and without the removal of field data for *Acacia longifolia ssp sophorae* have been provided below to give an indication of the range of potential credit liability. As further assessments will be required at the development application stages, further consultation will be required with OEH to determine suitable adjustments within the BAM calculations to more accurately determine changes in vegetation integrity scores. These updated assessments will need to be included in future BDARs, prepared at future development application stages.

Table 5.1 Change in Integrity Scores and Credit Liability

PCT	Area (ha)	Current Integrity Score	Future Integrity Score	Ecosystem Credits
Zone 1: PCT 694 – Turpentine Regrowth	0.37	28	0	5
Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted (Acacia longifolia ssp sophorae included)	1.82	32.1	0	26
Zone 2: PCT 694 – Acacia/Exotic Regrowth or Planted (Acacia longifolia ssp sophorae excluded)	1.82	14	0	0

5.2.2 Residual Indirect Impacts on Native Vegetation and Habitat

As the project comprises a modification to an approved Concept Plan, the level of detailed design required to enable accurate assessments of indirect impacts is currently not available. However it is anticipated that the following indirect impacts have potential to occur within the study area:

- Edge effects;
- Dust, noise, light spill; and

- Rubbish dumping.

Detailed assessments of these, as well as other potential indirect impacts, will be required within future BDARs prepared at the development application stages.

5.2.3 Residual Prescribed Impacts

As the project comprises a modification to an approved Concept Plan, the level of detailed design required to enable accurate assessments of prescribed impacts is currently not available. However it is anticipated that the following indirect impacts have potential to occur within the study area:

- Removal of existing human structures; and
- Vehicle strike.

Detailed assessments of these, as well as other potential prescribed impacts, will be required within future BDARs prepared at the development application stages. However based on current degraded conditions of existing human structures, the prescribed impacts resulting from the removal of these structures is not considered to be significant as they are unlikely to provide suitable habitat for native fauna.

5.3 Impact Mitigation

5.3.1 Mitigation of Direct Impacts on Native Vegetation and Habitat

The removal of vegetation and habitat, including habitat features not associated with native vegetation from within the project footprint is likely to result in the displacement of resident fauna. Impacts related to the displacement of resident fauna could occur in both the construction and operation phases, including but not limited to:

- Removal of foraging trees and other habitat features during construction;
- Injury or death during construction;
- Disruption to established home range; and/or
- Disruption to connections between suitable habitat for foraging and dispersal.

The following mitigation measures are proposed to minimise direct impacts on native vegetation and habitat:

- Timing of works to avoid or minimise works during critical life cycle events such as breeding seasons;
- Implementation of protocols such as pre-clearing surveys, staged clearing and ecological supervision during clearing; and

- Relocation of all salvageable habitat features (fallen timber, hollow logs) from within the development site.

5.3.2 Mitigation of Indirect Impacts on Native Vegetation and Habitat

The following mitigation measures are proposed to minimise indirect impacts on native vegetation and habitat:

- Clearing protocols that identify vegetation to be retained and prevent inadvertent damage and reduce soil disturbance;
- noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise;
- light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill;
- dust suppression measures:
- temporary fencing to protect significant environmental features such as riparian zones
- hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas; and
- staff training and site briefing to communicate environmental features to be protected and measures to be implemented.

5.3.3 Adaptive Management of Uncertain Impacts

Some impacts are infrequent or difficult to measure prior to commencement. Adaptive management is required to measure and respond to these impacts during construction and operation. These potential entities have not been identified at this stage due to the lack of detailed design for the Concept Plan and will require further assessment at the development application stages when further information is available.

5.4 Assessment Thresholds

The residual impacts by the proposed development are subject to assessment thresholds, i.e. some impacts might not require further assessment. This section comprises:

- Identification and an assessment of the impacts which are candidate serious and irreversible impacts, for impacts on CEECs and for threatened species;
- Identification of impacts requiring offset;
- Identification of impacts not requiring offset; and
- Identification of areas not requiring further assessment.

5.4.1 Serious and Irreversible Impacts

No candidates for Serious and Irreversible Impacts (SAII) have been identified within BAM calculations conducted to date.

5.4.2 Impacts requiring an Offset

The following items have been assessed as impacts requiring an offset:

- Removal of 0.37 ha of Zone 1: PCT 694 – Turpentine regrowth as this vegetation zone has a vegetation integrity score of ≥17 and the PCT is associated with threatened species habitat;
- Removal of 0.37 ha of potential habitat for the Square-tailed Kite;
- Removal of 0.37 ha of potential habitat for the Pink Robin; and
- Removal of 0.37 ha of potential habitat for *Solanum celatum*.

Subject to further negotiation with OEH, the following item has been conservatively assessed as an impact requiring an assessment:

- Removal of 1.82 ha of Zone 2: PCT 694 – Acacia/Exotic regrowth and planting as this vegetation zone has a vegetation integrity score of ≥17 when field data for *Acacia longifolia ssp sophorae* is included and the PCT is associated with threatened species habitat.

The impact assessment for Zone 2 represents a high level upper estimate of credit liability and will require further assessment, in consultation with OEH as outlined in **Section 4.2.4**.

The requirement for species credit species for Square-tailed Kite, Pink Robin and Solanum celatum is based on conservative assumption of occurrence. Targeted surveys as required will be conducted during appropriate survey periods and final credit requirement for these species will be revised for future BDARs for development application stages.

5.4.3 Impacts not requiring an Offset

The following items have been assessed as impacts not requiring an offset:

- Areas of land mapped as Exotic Vegetation; and
- Areas of land mapped as Cleared/Buildings.

Subject to further negotiation with OEH, the following item may comprise an impact assessed not requiring an offset:

- Removal of 1.82 ha of Zone 2: PCT 694 – Acacia/Exotic regrowth and planting as this vegetation zone has a vegetation integrity score of <17 when field data for

Acacia longifolia ssp sophorae is excluded although the PCT is associated with threatened species habitat.

The impact assessment for Zone 2 represents a high level upper estimate and will require further assessment, in consultation with OEH as outlined in **Section 4.2.4**.

5.5 Offset Requirement

Residual impacts of a proposed development require offsetting in order to achieve the overarching goal of the BAM of no net loss of biodiversity. The baseline used for no net loss accounts for the expected annual decline in biodiversity values without management. The residual impacts can be offset by:

- Retirement of the required number of biodiversity credits that meets the like for like rules,
- Payment into the Biodiversity Conservation Trust; or
- Undertaking biodiversity conservation actions that qualify as biodiversity conservation measures under the offset rules and listed in the ancillary rules, and the action is for the benefit of the entity impacted by the proposal.

The credit requirements outlined below comprise a high level estimate of credit liability for the Concept Plan approval and is based on assumptions of species credit species occurrence due to lack of survey data. Further assessments will be required at the detailed development assessment stages in order to determine a more accurate credit requirement.

5.5.1 Ecosystem Credits

Based on current field data, the following ecosystem credits are required

- 31 credits for PCT 694

However as previously stated in **Section 4.2.4**, further negotiation is required with OEH to determine a suitable assessment for regrowth vegetation given the presence of non-diagnostic native colonisers in Zone 2. This estimated credit liability therefore represents an initial upper level estimate that will require refinement during future development application stages.

5.5.2 Species Credits

Based on current conservative calculations and assumptions of occurrence, the following species credit species are required:

Table 5.2 Species credit species requirements

Scientific Name	Common Name	Credits required
Lophoictinia isura	Square-tailed Kite	4

Table 5.2 Species credit species requirements

Scientific Name	Common Name	Credits required
Petroica rodinogaster	Pink Robin	5
Solanum celatum	Solanum celatum	5

5.5.3 Offset Rules

As the final credit requirement is subject to change following negotiations with OEH re: PCT benchmark modifications for planted/regrowth vegetation and outcome of targeted threatened species surveys, no variations to offset rules are currently proposed.

Legend

- Subject Land
- Anglicare Property
- Development Precincts

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180719\Figure 5.1. Direct Impact Zones

Figure 5.1. Direct Impact Zones

Figure 5.2. Impacts requiring an Offset

Legend

- Subject Land
- Anglicare Property

Vegetation Communities

- Exotic Vegetation
- Cleared/Buildings

Image Source:
Image © NearMap 2018
Dated: 2/5/2018

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 m

I:\...\17145\Figures\RP1\20180808\Figure 5.3. Impacts not requiring an Offset_Assessment

Figure 5.3. Impacts not requiring an Offset/Assessment

Chapter 6

Offset Strategy (Part of BAM Stage 3)

It is proposed that the residual impacts of the project will be offset by:

- Retirement of the required number of biodiversity credits that meets the like for like rules; or
- Payment into the Biodiversity Conservation Trust.

As the current assessment represents a high level estimate for the purposes of the Concept Plan modification and will require further assessments at the detailed development application stages, the final offset strategy is yet to be determined.

Species credits have been calculated very conservatively and may be modified when further more detailed targeted surveys are conducted for future development application stages.

References

Chapman, G. A. and C. L. Murphy. 1989. Soil Landscapes of the Sydney 1:100000 sheet. Soil Conservation Service of NSW, Sydney.

Cumberland Ecology. 2004. Flora and Fauna Constraints Analysis at Sandon Point, Bulli. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2006. Flora and Fauna Assessment of Proposed Concept Master Plan for Residential Aged Care Facility at Sandon Point, Bulli. Cumberland Ecology, Epping, NSW.

Cumberland Ecology. 2012. Green and Golden Bell Frog Surveys at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2013a. Anglican Retirement Villages, Diocese of Sydney v Wollongong City Council & Kennedy: Land and Environment Court Proceedings No. 10982 of 2012: Individual Expert Report of Dr. David Robertson. Prepared for Norton Rose Fulbright and Anglican Retirement Villages. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2013b. Ecological impacts of mowing vegetation near borehole locations at Lots 1 and 2 in DP 224431, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2014. Green and Golden Bell Frog Pre-clearing Surveys at Lots 1 and 2 in DP 224431, Sturdee Avenue, Bulli Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2017. Commonwealth Assessment: Anglicare Site, Sturdee Avenue Bulli. Prepared for Anglican Retirement Villages. Cumberland Ecology, Carlingford Court, NSW.

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

NPWS. 2002. Native Vegetation of the Illawarra Escarpment and Coastal Plain - Bioregional Assessment Part 1. National Parks and Wildlife Services.

OEH. 2014. BioBanking Assessment Methodology 2014. Office of Environment and Heritage, Sydney.

OEH. 2017a. Biodiversity Assessment Method. Office of the Environment and Heritage, Sydney.

OEH. 2017b. BioNet Vegetation Classification.

OEH. 2018. Biodiversity Assessment Calculator.

Peterson Bushfire. 2018. Bushfire Assessment - Sandon Point Concept Plan MO06 - 0094 MOD5.

Appendix A

Plot Data

Table A.1 BAM plot data (2018)

Family	Scientific Name	Common Name	Native	Exotic	High Threat Weed	BAM Growth Form Group	Q1 (Zone 1)		Q2 (Zone 2)	
							C	*A*	*C*	*A*
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	YES			FG	0.1	10		
Apiaceae	*Centella asiatica*	Indian Pennywort	YES			FG	0.1	20		
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush		YES					0.3	5
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern		YES	YES		0.1	5	0.1	4
Asteraceae	*Ageratina adenophora*	Crofton Weed		YES	YES		0.1	1	0.2	3
Asteraceae	*Cirsium vulgare*	Spear Thistle		YES			0.1	1		
Asteraceae	*Conyza sumatrensis*	Tall fleabane		YES			0.1	2		
Asteraceae	*Hypochaeris radicata*	Catsear		YES			0.1	30		
Caryophyllaceae	*Paronychia brasiliana*	Chilean Whitlow Wort		YES			0.1	20		
Convolvulaceae	*Dichondra repens*	Kidney Weed	YES			FG	0.2	200	0.1	50
Cyperaceae	*Carex inversa*	Knob Sedge	YES			GG	0.1	20		
Cyperaceae	*Carex longebrachiata*		YES			GG	0.1	20	10	200
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	YES			EG			0.1	1
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower	YES			OG	0.1	1	0.2	5

Table A.1 BAM plot data (2018)

Family	Scientific Name	Common Name	Native	Exotic	High Threat Weed	BAM Growth Form Group	Q1 (Zone 1)		Q2 (Zone 2)	
Euphorbiaceae	*Euphorbia peplus*	Petty Spurge		YES			0.25	50		
Fabaceae (Caesalpinioideae)	*Senna pendula var. glabrata*			YES			0.1	1	0.5	10
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil	YES			OG	0.1	3		
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine	YES			OG	0.1	10	0.1	5
Fabaceae (Mimosoideae)	*Acacia longifolia subsp. sophorae*	Coastal Wattle	YES			SG			50	50
Fabaceae (Mimosoideae)	*Acacia maidenii*	Maiden's Wattle	YES			TG	0.1	2	1	3
Gentianaceae	*Centaurium tenuiflorum*	Branched Centaury		YES			0.1	50		
Iridaceae	*Aristea ecklonii*			YES					0.5	3
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	YES			OG	0.1	1		
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow		YES			0.1	10		
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne		YES			0.1	10	0.1	5
Myrsinaceae	*Lysimachia arvensis*	Scarlet Pimpernel		YES			0.1	100	0.1	5
Myrsinaceae	*Myrsine variabilis*		YES			SG	0.1	3	0.1	2
Myrtaceae	*Eucalyptus punctata*	Grey Gum	YES			TG	2	0		
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	YES			TG	5	1		
Myrtaceae	*Syncarpia glomulifera*	Turpentine	YES			TG	30	3		

Table A.1 BAM plot data (2018)

Family	Scientific Name	Common Name	Native	Exotic	High Threat Weed	BAM Growth Form Group	Q1 (Zone 1)		Q2 (Zone 2)	
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant		YES	YES		0.2	10	10	50
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet		YES	YES		0.1	50		
Oleaceae	*Ligustrum sinense*	Small-leaved Privet		YES	YES				0.1	2
Oleaceae	*Notelaea longifolia*	Large Mock-olive	YES			TG	0.1	1		
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive		YES			0.1	5	0.3	1
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis		YES			0.1	20		
Oxalidaceae	*Oxalis perennans*		YES			FG	0.1	100		
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	YES			SG	0.1	2	0.2	2
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	YES			TG			0.1	2
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	YES			SG	0.1	2	4	2
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues		YES			0.1	20		
Plantaginaceae	*Veronica arvensis*	Wall Speedwell		YES			0.1	5		
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell	YES			FG	0.1	2		
Poaceae	*Andropogon virginicus*	Whisky Grass		YES	YES				0.2	10
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass		YES	YES		2	200		
Poaceae	*Briza subaristata*			YES	YES		1	100		
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass		YES	YES		10	1000		

Table A.1 BAM plot data (2018)

Family	Scientific Name	Common Name	Native	Exotic	High Threat Weed	BAM Growth Form Group	Q1 (Zone 1)		Q2 (Zone 2)	
Poaceae	*Cynodon dactylon*	Common Couch	YES			GG	0.5	50	3	300
Poaceae	*Ehrharta erecta*	Panic Veldtgrass		YES	YES		5	500		
Poaceae	*Eleusine indica*	Crowsfoot Grass		YES			0.1	20		
Poaceae	*Imperata cylindrica*	Blady Grass	YES			GG			10	1000
Poaceae	*Microlaena stipoides*	Weeping Grass	YES			GG	20	2000	10	100
Poaceae	*Oplismenus aemulus*		YES			GG	0.1	20	0.25	50
Poaceae	*Paspalum dilatatum*	Paspalum		YES	YES		5	500		
Poaceae	*Stenotaphrum secundatum*	Buffalo Grass		YES	YES		50	5000		
Rubiaceae	*Galium leiocarpum*		YES				0.1	1		
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo	YES			TG			0.1	2
Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein		YES			0.1	3		
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush		YES			0.1	3	1	4
Solanaceae	*Solanum nigrum*	Black-berry Nightshade		YES			0.1	3	0.1	3
Verbenaceae	*Lantana camara*	Lantana		YES	YES		1	7	15	20
Verbenaceae	*Verbena bonariensis*	Purpletop		YES			0.1	2		

Table A.2 BBAM plot data (2017)

Stratum	Family	Status	Scientific Name	Common Name	Q1		Q2	
					Cover	*Abundance*	*Cover*	*Abundance*
Dicots	Acanthaceae		*Pseuderanthemum variabile*	Pastel Flower	0.5	50	0.25	10
Climbers/Vines	Apocynaceae		*Marsdenia rostrata*	Milk Vine			1	10
Climbers/Vines	Apocynaceae		*Tylophora barbata*	Bearded Tylophora	5	1000	0.5	50
Monocots (Other)	Araceae		*Gymnostachys anceps*	Settler's Twine	0.5	3	5	20
Monocots (Other)	Asparagaceae	*	*Asparagus aethiopicus*	Asparagus Fern	1	20	5	100
Climbers/Vines	Bignoniaceae		*Pandorea pandorana*	Wonga Vine			0.25	2
Ferns and Allies	Blechnaceae		*Doodia aspera*	Prickly Rasp Fern			1	50
Climbers/Vines	Caprifoliaceae	*	*Lonicera japonica*	Japanese Honeysuckle	0.25	10		
Dicots	Convolvulaceae		*Dichondra repens*	Kidney Weed	0.25	100		
Monocots (Other)	Cyperaceae		*Carex longebrachiata*		15	500	1	20
Climbers/Vines	Dilleniaceae		*Hibbertia scandens*	Climbing Guinea Flower	0.25	1		
Shrubs	Fabaceae (Caesalpinioideae)	*	*Senna pendula var. glabrata*		0.5	2	0.25	2
Shrubs	Fabaceae (Mimosoideae)		*Acacia maidenii*	Maiden's Wattle			0.25	1
Shrubs	Lamiaceae		*Clerodendrum tomentosum*	Hairy Clerodendrum			1	3
Sub-canopy	Lauraceae	*	*Cinnamomum camphora*	Camphor Laurel	1	2	15	10

Table A.2 BBAM plot data (2017)

Stratum	Family	Status	Scientific Name	Common Name	Q1		Q2	
Shrubs	Lauraceae	*	*Cinnamomum camphora*	Camphor Laurel	0.25	1		
Monocots (Other)	Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush	0.5	2	2	5
Climbers/Vines	Luzuriagaceae		*Eustrephus latifolius*	Wombat Berry	0.5	20	0.5	10
Climbers/Vines	Luzuriagaceae		*Geitonoplesium cymosum*	Scrambling Lily	0.5	20	0.25	5
Shrubs	Monimiaceae		*Wilkiea huegeliana*	Veiny Wilkiea	0.5	1	0.5	1
Shrubs	Myrsinaceae		*Myrsine variabilis*		0.25	1	0.5	5
Canopy	Myrtaceae		*Eucalyptus pilularis*	Blackbutt	20	2	20	1
Sub-canopy	Myrtaceae		*Eucalyptus pilularis*	Blackbutt	4	2		
Canopy	Myrtaceae		*Syncarpia glomulifera*	Turpentine	10	2	20	3
Sub-canopy	Myrtaceae		*Syncarpia glomulifera*	Turpentine	25	11	20	5
Shrubs	Ochnaceae	*	*Ochna serrulata*	Mickey Mouse Plant	15	50	50	500
Dicots	Ochnaceae	*	*Ochna serrulata*	Mickey Mouse Plant			5	1000
Sub-canopy	Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet			1	2
Shrubs	Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet	0.5	4	2	5
Shrubs	Oleaceae	*	*Ligustrum sinense*	Small-leaved Privet	0.5	3	1	5
Sub-canopy	Oleaceae		*Notelaea venosa*	Veined Mock-olive	5	5	1	1
Shrubs	Oleaceae		*Notelaea venosa*	Veined Mock-olive	20	50	2	10
Sub-canopy	Oleaceae	*	*Olea europaea*	Common Olive			2	2
Shrubs	Oleaceae	*	*Olea europaea*	Common Olive			1	3
Monocots (Other)	Phormiaceae		*Dianella caerulea var. producta*		0.25	2	0.5	5

Table A.2 BBAM plot data (2017)

Stratum	Family	Status	Scientific Name	Common Name	Q1		Q2	
Shrubs	Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush	1	3		
Sub-canopy	Phyllanthaceae		*Glochidion ferdinandi*	Cheese Tree	1	1		
Shrubs	Pittosporaceae		*Pittosporum revolutum*	Rough Fruit Pittosporum			2	10
Sub-canopy	Pittosporaceae		*Pittosporum undulatum*	Sweet Pittosporum	3	2	4	5
Shrubs	Pittosporaceae		*Pittosporum undulatum*	Sweet Pittosporum	3	25	5	3
Monocots (Grasses)	Poaceae		*Oplismenus imbecillis*		1	20	1	100
Climbers/Vines	Ranunculaceae		*Clematis aristata*	Old Man's Beard			0.25	1
Sub-canopy	Rutaceae		*Acronychia oblongifolia*	White Aspen			0.5	1
Shrubs	Rutaceae		*Acronychia oblongifolia*	White Aspen	0.5	1		
Sub-canopy	Rutaceae	*	*Citrus x taitensis*	Rough Lemon	2	1		
Shrubs	Sapindaceae		*Cupaniopsis anacardioides*	Tuckeroo	0.25	3		
Shrubs	Sapindaceae		*Guioa semiglauca*	Guioa	1	1		
Shrubs	Verbenaceae	*	*Lantana camara*	Lantana	5	20	2	10
Dicots	Violaceae		*Viola hederacea*	Ivy-leaved Violet	0.25	20		
Monocots (Other)	Zingiberaceae	*	*Hedychium gardnerianum*	Ginger Lily	0.25	1		

* denotes exotic species

Appendix B

Scanned Field Data Sheets

17145.

400 m² plot: Sheet 1 of 2	Survey Name	Plot Identifier	Recorders
Date 29/06/18	Bulli	Q1	20/20 → B.F, G.K.

Zone	Datum	IBRA region		Photo #	Zone ID
025 →	024			464 – 467	
Easting	Northing	Dimensions 20 x 20		Orientation of midline from the 0 m point.	Magnetic °

Vegetation Class	Wet sclerophyll	Confidence: H M L
Plant Community Type	Planted Eucs + Blackbutt escarp. remnant trees (ironbark/tereticornis)	EEC:	Confidence: H M L

GF Code	Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
• T	Syncarpia glomulifera	N	30	3	C	
N/A	Euphorbia peplus	E	0.25	50	G	
N/A	Verbascum virgatum	E	0.1	3	G	
N/A	Modiola caroliniana	E	0.1	10	G	
• S	Breynia oblongifolia	N	0.1	2	S	
N/A	Lysimachia arvensis	E	0.1	100	G	
N/A	Eleusine indica	E	0.1	20	G	
N/A	Centaurium tenuiflorum	E	0.1	50	G	
F	Galium ~~sp~~ leiocarpum	N	0.1	1	G	601
T	Eucalyptus ~~sp. tereticornis?~~ tereticornis	(P) N	5	1	C	602
F	Oxalis perennans	N	0.1	100	G	
F	Veronica arvensis	E	0.1	5	G	
• F	Dichondra repens	N	0.2	200	G	
N/A	Paspalum dilatatum	HTE	5	500	G	
N/A	Conyza sumatrensis	E	0.1	2	G	
G	Microlaena stipoides	N	20	2000	G	
N/A	Paronychia brasilensis	E	0.1	20	G	
V	Carex inversa	N	0.1	20	G	
N/A	Lantana camara	HTE	1	7	S,G	
N/A	Olea europaea subsp. cuspidata	HTE	0.1	5	G	
N/A	Ochna serrulata	HTE	0.2	10	G	
N/A	Ehrharta erecta	HTE	5	500	G	
N/A	Asparagus aethiopicus	HTE	0.1	5	G	
• S	Myrsine variabilis	N	0.1	3	G	
• S	Pittosporum undulatum	N	0.1	2	G	
• T	Notelaea longifolia	N	0.1	1	G	
L	Glycine microphylla	N	0.1	10	G	
N/A	Briza subaristata	HTE	1	100	G	
N/A	Axonopus fissifolius	HTE	2	200	G	
N/A	Plantago lanceolata	E	0.1	20	G	
N/A	Ligustrum lucidum	HTE	0.1	50	G	
L	Desmodium varians	N	0.1	3	G	
F	Veronica plebeia	N	0.1	2	G	
D	Oplismenus aemulus	N	0.1	20	G	
D	Cynodon dactylon	N	0.5	50	G	

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Ids B.F. 2/7/18

400 m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date 29/6/18	Bulli.	Q1	B.F, C.K.
Zone 0[illegible] Datum [illegible]47	IBRA region	Photo #	Zone ID
Easting ------ Northing -------	Dimensions	in	Orientation of midline from the 0 m point. Magnetic °
Vegetation Class	Wet. sclerophyll.		Confidence: H M L
Plant Community Type	Blackbutt Escarp regrowth + Planted	EEC: N	Confidence: H M L

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
N/A	~~Banksia integrifolia~~ Stenotaphrum secund.	HT E	~~30~~ 50	~~300~~ 5000		
N/A	~~Ochna serrulata~~ Sida rhombifolia	E	0.1	10		
L	~~Lantana camara~~ Hibbertia scandens	N	0.1	1		
N/A	~~Glob. ferdinandi~~ Hypochaeris radicata	E	0.1	30		
N/A	Oxalis corniculata	E	~~0.2~~ 0.1	~~200~~ 20		
N/A	Cenchrus clandestinus	HT E	10	1000		
N/A	Solanum mauritianum	E	0.1	3	G	
T	Eucalyptus punctata	(P) N	2	0		
V	Carex longebrachiata	N	0.1	20		
F	Centella asiatica	N.	0.1	20		
N/A	Cirsium vulgare	E	0.1	1		
N/A	Ageratina adenophora	HT E	0.1	1		
L	Geitonoplesium cymosum	N	0.1	1		
N/A	Senna pendula ~~subsp.~~ var. glab.	HT E	0.1	1	G	
F	Pseuderanthemum variabile	N.	0.1	10		
T	Acacia maidenii	N	0.1	2	G	
N/A	Solanum nigrum	E	0.1	3		
N/A	Verbena bonariensis	E	0.1	2		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no: 1 of

Date	29/06/18	Survey Name	Zone ID	Recorders
		Bulli		GK / BF
Zone	Datum	Plot ID	Q1	Plot dimensions 20x50 Photo # 464 (end) 467 (start)
Easting (End) WP 024	Northing (Start) WP 025	IBRA region		Midline bearing from 0 m
Vegetation Class		Wet Sclerophyll		Confidence: H M L
Plant Community Type		Escarpment Blackbutt	EEC:	Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	None in office
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH (large tree - 80+ only)	# Tree Stems Count	# Stems with Hollows
80 + cm	~	
50 – 79 cm	1 (57cm)	
30 – 49 cm	✓	
20 – 29 cm	~	
10 – 19 cm	✓	
5 – 9 cm	—	
< 5 cm	— (Regen)	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	1m Fune fallen logs	Tally space

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	40	45	25	10	45	35	5	5	—	10	5	5	—	—	—	—	—	—	—	—
Average of the 5 subplots	33					7					2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet 1 of 1	Survey Name	Plot Identifier	Recorders
Date: 29/06/18	Bulli	Q2	B.F, G.K.
Zone: 56 → 57 / Datum	IBRA region	Photo #: 468 → 471	Zone ID
Easting / Northing	Dimensions	Orientation of midline from the 0 m point.	Magnetic °
Vegetation Class			Confidence: H M L
Plant Community Type	Acacia regrowth	EEC:	Confidence: H M L

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
N/A	Lonicera japonica	HTE	50	2000	G	
N/A	Lantana camara	HTE	15	20	G	
• G	Imperata cylindrica	N	10	1000	G	
N/A	Gomphocarpus fruticosus	E	0.3	5	S	
S	Acacia longifolia subsp. sophorae	N	50	50	C, S	
• E	Pteridium esculentum	N	0.1	1	G	
L	Hibbertia scandens	N	0.2	5	G	
N/A	Ochna serrulata	HTE	10	50	S, G	
N/A	Asparagus aethiopicus	HTE	0.1	4	G	
N/A	Solanum mauritianum	E	1	4	S	
N/A	Senna pendula var. glabrata	HTE	0.5	10	S	
N/A	Ageratina adenophora	HTE	0.2	3	G	
• S	Breynia oblongifolia	N	0.2	2	G	
N/A	Andropogon virginicus	HTE	0.2	10	G	
N/A	Sida rhombifolia	E	0.1	5	G	
N/A	Solanum nigrum	E	0.1	3	G	
• F	Dichondra repens	N	0.1	50	G	
L	Glycine microphylla	N	0.1	5	G	
G	Microlaena stipoides	N	10	100	G	
T	Cupaniopsis anacardioides	N	0.1	2	G	
T	Acacia maidenii	N	1	3	S	
V	Carex longebrachiata	N	10	$200	G	
• S	Pittosporum undulatum	N	4	2	(E) C	
~~N/A~~	~~Olea europaea subsp. cuspidata~~	~~HTE~~	~~1~~	~~0.25~~	~~S~~	
N/A	"Blue lily" – Aristea ecklonii	E	0.5	3	G	B03
D	Oplismenus aemulus	N	0.25	50	G	
• S	Myrsine variabilis	N	0.1	2	G	
N/A	Lysimachia arvensis	E	0.1	5	G	
D	Cynodon dactylon	N	3	3000	G	
N/A	Ligustrum sinense	HTE	0.1	2	G	
• T	Glochidion ferdinandi	N	0.2	1	S	

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders			
Date	29/6/2018	Bulli		GK/BF			
Zone	Datum	Plot ID	Q2	Plot dimensions	20x50	Photo #	S: 468-469 E-470-471
Easting	Northing	IBRA region		Midline bearing from 0 m			
Vegetation Class						Confidence:	H M L
Plant Community Type	Native/Exotic mix (Acacia regrowth)			EEC:		Confidence:	H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	10cm
	Grasses etc.	5cm
	Forbs	difficult
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm	✓	
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0.5m, 0.5m	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	75	80	90	15	85	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–
Average of the 5 subplots	69					1														

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Date: 16/1/17 | Waypoint: 278 – 279 | Job #: | Site: [illegible] | Q: 1

Personnel: K.T | Easting: | Quadrat size: ☐ 20x20m ☐ 20x50m

Photo ID: 1474 – 1476 | Northing: | Aspect: | Slope:

Community: Blackbutt [illegible] 2770 | Soil:

Canopy	C	A
Euc. pil	20	1
Syn. glom	10	2

Sub canopy	C	A
Syn. glom	25	1
[illegible]	3	2
[illegible]	1	2
[illegible]	2	1
[illegible]	1	1
[illegible]	1	1
[illegible]	6	6
[illegible]	4	2

Ferns and Allies	C	A

Climbers/Vines	C	A
[illegible]	0.5	20
[illegible]	5	100
[illegible]	0.5	20
[illegible]	0.25	1

Shrubs	C	A
*Ochna serrulata	15	50
*Ligustrum sinense	0.5	3
~~[illegible]~~		
[illegible]	0.25	3
[illegible]	5	20
[illegible]	0.5	1
[illegible]	5	0.5
*Cinnamomum camphora	0.25	1
[illegible]	0.5	4
[illegible]	0.5	1
Myrsine variabilis	0.25	1
[illegible]	1	1
[illegible]	1	1
[illegible]	0.5	2
[illegible]	1	5

[illegible] — *Citrus x limon

Weeds	C	A
[illegible]	0.5	50
Viola hederacea	0.25	50
Dichondra rep.	0.25	100
[illegible]	0.5	50

*Lonicera japonica

[illegible] oblong (f.)

[illegible]

Monocots (Grasses)	C	A
Oplis. imb.	1	20

Monocots (Other)	C	A
[illegible]	0.5	20
[illegible]	0.5	5
[illegible]	15	100
[illegible]	0.25	2
[illegible]	0.5	2
[illegible]	0.25	1

Parameter	Tree	Small tree	Shrub	Groundcover	
Height (m)	25-30	16 – 20	0.5 – 7	0.1 – 0.7	Bare (%): 5
FPC (%)	30	40	65	76	Litter (%): 6
Weeds (%)	–	–	50	30	Rock (%): 2
					Moss (%): –

[illegible]

C score	A measure or estimate of the appropriate cover measure for each recorded species recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover should be entered (e.g. 0.4)
A score	A relative measure of the number of individuals or shoots of a species within the plot. Use the following intervals; numbers above about 20 are estimates only 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required

ID:

CUMBERLAND ECOLOGY

Date: 16.8.17	Personnel: GR, PF, RM	Project #: 17145	Site: Sandon .1	Plot: Q1

Presence/Absence (1m interval)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
NGCG Native Grasses																									
NGCS Native Shrubs																									
NGCO Other Natives																									
EPC(a) Exotics groundcover/annuals																									

Projective Foliage Cover (5m interval)	5	10	15	20	25
NCS Canopy Cover Native	60 %	40 %	%	40 %	10 %
NMS Mid-Storey Cover Native	%	%	70 %	%	40 %
EPC(c) Exotics canopy	%	%	%	%	%
EPC(b) Exotics mid-storey	%	%	%	%	%

Presence/Absence (1m interval)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
NGCG Native Grasses																									
NGCS Native Shrubs																									
NGCO Other Natives																									
EPC(a) Exotics groundcover/annuals																									

Projective Foliage Cover (5m interval)	30	35	40	45	50
NCS Canopy Cover Native	%	%	20 %	%	%
NMS Mid-Storey Cover Native	50 %	80 %	50 %	70 %	70 %
EPC(c) Exotics canopy	%	%	%	%	%
EPC(b) Exotics mid-storey	%	%	%	%	%

Class	Value	Calculation
NGCG Native Grasses		Add total NGCG 'hits' and multiply by 2
NGCS Native Shrubs		Add total NGCS 'hits' and multiply by 2
NGCO Other Natives		Add total NGCO 'hits' and multiply by 2
EPC Exotics		[illegible]
NCS Canopy Cover Native		Add NCS values and divide by 10
NMS Mid-Storey Cover Native		Add NMS values and divide by 10

Date: 16/8/17 Waypoint: 257 + 217 | Job #: | Site: [illegible] | Q: 2

Personnel: [illegible] Easting: Quadrat size: ☐ 20x20m ☐ 20x50m

Photo ID: [illegible] Northing: Aspect: Slope:

Community: [illegible] Soil:

Canopy	C	A	Shrubs	C	A	Forbs	C	A	Monocots (Grasses)	C	A
Euc. pil	20	1	*Ochna serrulata	50	50	*Sten. pseudo	5	1000	Oplis. imbecillis	1	100
Syn. glom.	20	3	*Lant. cam.	2	10	Pseuderanthemum	0.5	10			
			Pitt. undulatum	5	5						
			*Lig. sin.	1	3						
			Pitt. revol.	1	4						
			*Olea euro. cusp.	1	3						
			Myrsine howit.	0.5	5						
			Acacia impl.	0.25	1						
			*Lig. luc.	2	5						
			Not. longifolia	2	10						
			[illegible]	0.5	1						
			*Senna pendula	0.25	2						
			Clerodendrum tom.	1	3						

Sub-canopy	C	A
*Cinn. camph.	15	10
*Olea euro. cusp.	2	2
Syn. glom.	20	5
*Lig. lucid.	1	2
Pitt. undul.	10	5
Acronychia oblongifolia	0.5	1
*Schefflera actinophylla	1	1

<- Notelaea [illegible]

Ferns and Allies	C	A
Adiantum sp.	1	50

Monocots (Other)	C	A
*Aspar. aethiopicus	5	100
Dianella longif.	1	20
Lomandra longif.	5	20
*Asparagus [illegible]	0.5	5
Lom. [illegible]	5	5

Climbers/Vines	C	A
Parsonsia str.	1	20
Eustreph. latif.	0.5	50
Clematis arist.	0.5	1
*Ipomoea [illegible]	0.25	3
Pandorea pan.	0.5	10
Geitonoplesium cym.	0.25	5

+ [illegible]

Parameter	Tree	Small tree	Shrub	Groundcover	
Height (m)	15-30	3-10	0.1-2	0.1-0.5	Bare (%): 1
PFC (%)	40	40	65	35	Litter (%): 70
Weeds (%)	–	[illegible]	50	15	Rock (%):
					Moss (%):

C score	A measure or estimate of the appropriate cover measure for each recorded species; recorded from 1-5% and then to the nearest 5%. If the cover of a species is less than 5% and the species is considered important, then the estimated cover should be entered (e.g. 0.1)
A score	A relative measure of the number of individuals or shoots of a species within the plot. Use the following intervals: numbers above about 20 are estimates only. 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required.

ID:

CUMBERLAND ECOLOGY

[illegible]

Date: 16.3.17	Personnel: SX, BS, KM, HHS	Project #: 1745	Site: Saundon PT	Plot: 02

Presence/Absence (1m interval)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
NGCG Native Grasses										✓		✓	✓	✓	✓	✓	✓		✓	✓					✓
NGCS Native shrubs																									
NGCO Other Natives																			✓						
EPC(a) Exotic groundcover/annuals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓	✓	✓	✓	✓	

Projective Foliage Cover (5m interval)	5	10	15	20	25
NCS Canopy Cover Native	20 %	10 %	20 %	10 %	%
NMS Mid-Storey Cover Native	%	10 %	%	%	20 %
EPC(c) Exotic canopy	%	%	%	%	%
EPC(d) Exotic (not annual)	%	%	%	%	%

Presence/Absence (1m interval)	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
NGCG Native Grasses				✓																					
NGCS Native shrubs			✓																						
NGCO Other Natives																									
EPC(a) Exotic groundcover/annuals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

↓ V7

Projective Foliage Cover (5m interval)	30	35	40	45	50
NCS Canopy Cover Native	30 %	30 %	50 %	40 %	60 %
NMS Mid-Storey Cover Native	10 %	%	%	%	%
EPC(c) Exotic canopy	%	%	%	%	%
EPC(d) Exotic (not annual)	%	%	%	%	90 %

Class	Value	Calculations
NGCG Native Grasses		Add total NGCG 'hits' and multiply by 2
NGCS Native shrubs		Add total NGCS 'hits' and multiply by 2
NGCO Other Natives		Add total NGCO 'hits' and multiply by 2
EPC Exotics		[(Add EPC(a) 'hits' and multiply by 2)+(Add EPC(b) values/10)+(Add EPC(c) values/10)] and divide by 3
NCS Canopy Cover Native		Add NCS values and divide by 10
NMS Mid-Storey Cover Native		Add NMS values and divide by 10

Appendix C

BAM Credit Reports

C.1 Credit Report – Full Plot data

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011832/BAAS17027/18/00011833	17145 - Anglicare Bulli	24/02/2018
Assessor Name	Report Created	BAM Data version *
David Robertson	08/08/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17027		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion								
1	694_Moderate	28.0	0.4	0.25	High Sensitivity to Potential Gain	1.75		5
2	694_Low	32.1	1.8	0.25	High Sensitivity to Potential Gain	1.75		26
							Subtotal	**31**
							Total	**31**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Lophoictinia isura / Square-tailed Kite (Fauna)						
694_Moderate	28.0	0.37	0.25	1.5	N/A	4
					Subtotal	**4**
Petroica rodinogaster / Pink Robin (Fauna)						
694_Moderate	28.0	0.37	0.25	2	False	5
					Subtotal	**5**
Solanum celatum / Solanum celatum (Flora)						
694_Moderate	28.0	0.37	0.25	2	False	5
					Subtotal	**5**

C.2 Credit Report – *Acacia longifolia ssp sophorae* excluded for Zone 2

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011832/BAAS17027/18/00011833	17145 - Anglicare Bulli	24/02/2018
Assessor Name	Report Created	BAM Data version *
David Robertson	08/08/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17027		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion								
1	694_Moderate	28.0	0.4	0.25	High Sensitivity to Potential Gain	1.75		5
2	694_Low	14.0	1.8	0.25	High Sensitivity to Potential Gain	1.75		0
							Subtotal	**5**
							Total	**5**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Lophoictinia isura / Square-tailed Kite (Fauna)						
694_Moderate	28.0	0.37	0.25	1.5	N/A	4
					Subtotal	**4**
Petroica rodinogaster / Pink Robin (Fauna)						
694_Moderate	28.0	0.37	0.25	2	False	5
					Subtotal	**5**
Solanum celatum / Solanum celatum (Flora)						
694_Moderate	28.0	0.37	0.25	2	False	5
					Subtotal	**5**

Biodiversity payment summary report

Assessment Id	Payment data version	Revision number	Report created
00011832/BAAS17027/18/00011833	36	0	08/08/2018

PCT list

Include	PCT common name	Credits
Yes	**694 -** Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	31

Species list

Include	Species	Credits
Yes	***Lophoictinia isura*** (Square-tailed Kite)	4
Yes	***Petroica rodinogaster*** (Pink Robin)	5
Yes	***Solanum celatum*** (Solanum celatum)	5

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Biodiversity payment summary report

IBRA sub region	PCT common name	Baseline price	Dynamic coefficient	Market coefficient	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Illawarra	**694 -** Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion **Warning: This PCT has NO trades recorded**	$ 10,902.94			21.64%	$28.35	1.0000	$ 13,290.68	31	$412,011.20

Subtotal (excl. GST)	**$412,011.20**
GST	**$41,201.12**
Total ecosystem credits (incl. GST)	**$453,212.32**

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10495	***Lophoictinia isura*** (Square-tailed Kite)	Vulnerable	$485.58	20.8700%	$20.00	4	$2,427.68
10607	***Petroica rodinogaster*** (Pink Robin)	Vulnerable	$163.27	20.8700%	$20.00	5	$1,086.72
10761	***Solanum celatum*** (Solanum celatum)	Endangered	$1,632.65	20.8700%	$20.00	5	$9,966.92

Biodiversity payment summary report

	Subtotal (excl. GST)	**$13,481.32**
	GST	**$1,348.13**
Total species credits (incl. GST)		**$14,829.45**
	Grand total	**$468,041.77**

C.4 Payment Report – *Acacia longifolia ssp sophorae* excluded for Zone 2

Biodiversity payment summary report

Assessment Id	Payment data version	Revision number	Report created
00011832/BAAS17027/18/00011833	36	1	08/08/2018

PCT list

Include	PCT common name	Credits
Yes	**694 -** Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	5

Species list

Include	Species	Credits
Yes	***Lophoictinia isura*** (Square-tailed Kite)	4
Yes	***Petroica rodinogaster*** (Pink Robin)	5
Yes	***Solanum celatum*** (Solanum celatum)	5

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Biodiversity payment summary report

IBRA sub region	PCT common name	Baseline price	Dynamic coefficient	Market coefficient	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Illawarra	**694 -** Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion **Warning: This PCT has NO trades recorded**	$ 10,902.94			21.64%	$28.35	1.0000	$ 13,290.68	5	$66,453.42

Subtotal (excl. GST)	**$66,453.42**
GST	**$6,645.34**
Total ecosystem credits (incl. GST)	**$73,098.76**

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10495	***Lophoictinia isura*** (Square-tailed Kite)	Vulnerable	$485.58	20.8700%	$20.00	4	$2,427.68
10607	***Petroica rodinogaster*** (Pink Robin)	Vulnerable	$163.27	20.8700%	$20.00	5	$1,086.72
10761	***Solanum celatum*** (Solanum celatum)	Endangered	$1,632.65	20.8700%	$20.00	5	$9,966.92

Biodiversity payment summary report

	Subtotal (excl. GST)	**$13,481.32**
	GST	**$1,348.13**
Total species credits (incl. GST)		**$14,829.45**
	Grand total	**$87,928.21**

Appendix D

Recorded Flora Species

Table D.1 Flora Species recorded within subject land and Anglicare property

Family	Exotic	Scientific Name	Common Name
Acanthaceae		*Pseuderanthemum variabile*	Pastel Flower
Anthericaceae	*	*Chlorophytum comosum*	Spider Plant
Apiaceae		*Centella asiatica*	Indian Pennywort
Apocynaceae	*	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush
Apocynaceae		*Marsdenia rostrata*	Milk Vine
Apocynaceae		*Tylophora barbata*	Bearded Tylophora
Araceae		*Gymnostachys anceps*	Settler's Twine
Asparagaceae	*	*Asparagus aethiopicus*	Asparagus Fern
Asteraceae	*	*Ageratina adenophora*	Crofton Weed
Asteraceae	*	*Ageratina riparia*	Mistflower
Asteraceae	*	*Cirsium vulgare*	Spear Thistle
Asteraceae	*	*Conyza sumatrensis*	Tall fleabane
Asteraceae	*	*Hypochaeris radicata*	Catsear
Bignoniaceae		*Pandorea pandorana*	Wonga Wonga Vine
Blechnaceae		*Doodia aspera*	Prickly Rasp Fern
Caprifoliaceae	*	*Lonicera japonica*	Japanese Honeysuckle
Caryophyllaceae	*	*Paronychia brasiliana*	Chilean Whitlow Wort
Convolvulaceae		*Dichondra repens*	Kidney Weed
Convolvulaceae	*	*Ipomoea indica*	Morning Glory
Cyperaceae		*Carex inversa*	Knob Sedge
Cyperaceae		*Carex longebrachiata*	
Dennstaedtiaceae		*Pteridium esculentum*	Bracken
Dilleniaceae		*Hibbertia scandens*	Climbing Guinea Flower
Euphorbiaceae	*	*Euphorbia peplus*	Petty Spurge
Fabaceae (Caesalpinioideae)	*	*Senna pendula var. glabrata*	
Fabaceae (Faboideae)		*Desmodium varians*	Slender Tick-trefoil
Fabaceae (Faboideae)		*Glycine microphylla*	Small-leaf Glycine
Fabaceae (Faboideae)	*	*Ulex europaeus*	Gorse
Fabaceae (Mimosoideae)		*Acacia longifolia subsp. sophorae*	Coastal Wattle
Fabaceae (Mimosoideae)		*Acacia maidenii*	Maiden's Wattle
Gentianaceae	*	*Centaurium tenuiflorum*	Branched Centaury

Table D.1 Flora Species recorded within subject land and Anglicare property

Family	Exotic	Scientific Name	Common Name
Iridaceae	*	*Aristea ecklonii*	
Iridaceae	*	*Dietes spp.*	
Lamiaceae		*Clerodendrum tomentosum*	Hairy Clerodendrum
Lauraceae	*	*Cinnamomum camphora*	Camphor Laurel
Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush
Luzuriagaceae		*Eustrephus latifolius*	Wombat Berry
Luzuriagaceae		*Geitonoplesium cymosum*	Scrambling Lily
Malvaceae	*	*Modiola caroliniana*	Red-flowered Mallow
Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne
Monimiaceae		*Wilkiea huegeliana*	Veiny Wilkiea
Myrsinaceae	*	*Lysimachia arvensis*	Scarlet Pimpernel
Myrsinaceae		*Myrsine variabilis*	
Myrtaceae		*Eucalyptus pilularis*	Blackbutt
Myrtaceae		*Eucalyptus punctata*	Grey Gum
Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae		*Syncarpia glomulifera*	Turpentine
Ochnaceae	*	*Ochna serrulata*	Mickey Mouse Plant
Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet
Oleaceae	*	*Ligustrum sinense*	Small-leaved Privet
Oleaceae		*Notelaea longifolia*	Large Mock-olive
Oleaceae		*Notelaea venosa*	Veined Mock-olive
Oleaceae	*	*Olea europaea subsp. cuspidata*	African Olive
Oxalidaceae	*	*Oxalis corniculata*	Creeping Oxalis
Oxalidaceae		*Oxalis perennans*	
Passifloraceae	*	*Passiflora suberosa*	Cork Passionfruit
Phormiaceae		*Dianella caerulea var. producta*	
Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush
Phyllanthaceae		*Glochidion ferdinandi*	Cheese Tree
Pittosporaceae		*Pittosporum revolutum*	Rough Fruit Pittosporum
Pittosporaceae		*Pittosporum undulatum*	Sweet Pittosporum
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues
Plantaginaceae	*	*Veronica arvensis*	Wall Speedwell
Plantaginaceae		*Veronica plebeia*	Trailing Speedwell
Poaceae	*	*Andropogon virginicus*	Whisky Grass

Table D.1 Flora Species recorded within subject land and Anglicare property

Family	Exotic	Scientific Name	Common Name
Poaceae	*	*Axonopus fissifolius*	Narrow-leafed Carpet Grass
Poaceae	*	*Briza subaristata*	
Poaceae	*	*Cenchrus clandestinus*	Kikuyu Grass
Poaceae		*Cynodon dactylon*	Common Couch
Poaceae	*	*Ehrharta erecta*	Panic Veldtgrass
Poaceae	*	*Eleusine indica*	Crowsfoot Grass
Poaceae		*Imperata cylindrica*	Blady Grass
Poaceae		*Microlaena stipoides*	Weeping Grass
Poaceae		*Oplismenus aemulus*	
Poaceae		*Oplismenus imbecillis*	
Poaceae	*	*Paspalum dilatatum*	Paspalum
Poaceae	*	*Setaria parviflora*	-
Poaceae	*	*Stenotaphrum secundatum*	Buffalo Grass
Ranunculaceae		*Clematis aristata*	Old Man's Beard
Rosaceae	*	*Rubus fruticosus sp. agg.*	Blackberry complex
Rubiaceae		*Galium leiocarpum*	
Rutaceae		*Acronychia oblongifolia*	White Aspen
Rutaceae	*	*Citrus x taitensis*	Rough Lemon
Sapindaceae		*Cupaniopsis anacardioides*	Tuckeroo
Sapindaceae		*Guioa semiglauca*	Guioa
Scrophulariaceae	*	*Verbascum virgatum*	Twiggy Mullein
Solanaceae	*	*Solanum mauritianum*	Wild Tobacco Bush
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade
Verbenaceae	*	*Lantana camara*	Lantana
Verbenaceae	*	*Verbena bonariensis*	Purpletop
Violaceae		*Viola hederacea*	Ivy-leaved Violet
Zingiberaceae	*	*Hedychium gardnerianum*	Ginger Lily

* denotes exotic species

Appendix E

Correspondence with OEH

From: OEH ROD LMBC Support Mailbox
To: Gitanjali Katrak
Subject: FW: LMBC-1910 FW: Query re: planted/regrowth veg and PCT assignment
Date: Wednesday, July 11, 2018 1:07:23 PM
Attachments: image002.png

Hi Gintajali,

Thanks for your email. The concept of non-aligned/regrown PCTs is a known one that is currently being addressed. However, in the interim we must follow the options that are available to us.
The approach that you've taken to try and discount A. longifolia subsp. sophorae seems ecologically sensible but I don't think that a reduction to zero credits is justifiable based on the potential for the area to provide habitat etc. However ultimately, the consent authority is the one who has to make that decision. Given that the consent authority likely does not have much experience in benchmark modification there is obviously a risk of additional time/cost to your client versus the cost of offsetting the credits as is. I'm afraid you're going to have to make that call!

Please let me know if you have any follow up questions.

Land Management and Biodiversity Conservation
Contact Service Centre
Conservation Program
Office of Environment and Heritage
T: 1800 931 717
E:lmbc.support@environment.nsw.gov.au
Please ensure you keep all cc'ed parties included in any replies to this email.

NSW GOVERNMENT | Office of Environment & Heritage

From: Gitanjali Katrak [mailto:gitanjali.katrak@cumberlandecology.com.au]
Sent: Tuesday, 10 July 2018 1:24 PM
To: OEH ROD LMBC Support Mailbox <lmbc.support@environment.nsw.gov.au>
Subject: Query re: planted/regrowth veg and PCT assignment
Importance: High

Hello,

I am preparing a BDAR for a client for a development in the Illawarra region, specifically Bulli and require some urgent advice on PCT selection, benchmarks and credit outputs.

The subject site in question comprises a mix of remnant Turpentine Forest (best fit PCT 694) and areas of scrubby regrowth from past clearing (an assessment of a 2010 aerial of the site shows the

regrowth areas as cleared/grassland). The area of turpentine forest is to be retained but the scrubby regrowth is to be cleared. The regrowth areas largely match up to the description of Map Unit 56a: Acacia Scrub in the Native Vegetation of the Illawarra Escarpment and Coastal Plain and comprise a mix of natives and exotics. The three dominant species in this veg zone are *Acacia longifolia subsp sophorae* (50% cover), *Lonicera japonica* (50% cover) and *Lantana camara* (15% cover).

As there is no PCT that aligns well with the Illawarra's Acacia Scrub map unit, the veg zone has been aligned as a degraded form of PCT 694, based on the proximity of an area of PCT 694 and scattered occurrences of diagnostic shrub and understorey species for the PCT such as *Imperata cylindrica* (10% cover) , *Pittosporum undulatum* (4% cover), *Myrsine variablis* (<1% cover) and *Breynia oblongifolia* (<1% cover) within the regrowth areas.

I ran the field data collected (area <2ha so only 1 plot) and the veg zone has a final Integrity score of 28 and a credit liability of 22 credits. Given that *Acacia longifolia subsp sophorae* is not diagnostic of PCT 694, for comparison purposes I created a new veg zone utilising the same plot data but without the *Acacia longifolia subsp sophorae* data. This reduced the veg integrity score to 14 credits and did not generate any credit requirements. There was no reduction in function score and composition score only had a minor reduction due to the removal of 1 native shrub growth form. However the Structural score dropped from 34.9 to 5 with the removal of the 50% cover of *Acacia longifolia subsp sophorae*. Therefore it appears that the cover of *Acacia longifolia subsp sophorae* is driving the credit liability for this veg zone which is largely weedy regrowth (apart from *Imperata cylindrica* and *Pittosporum undulatum*, the % cover of all diagnostic species of PCT 694 within the veg zone is <1%).

Given the issues above, could you please advise:

1. If the benchmark values can be adjusted somehow to reduce credit liability for the veg zone given that it is largely regrowth of non-characteristic natives and weeds; or
2. If *Acacia longifolia subsp sophorae* can be removed (or cover scores for this species adjusted somehow) from the plot data with the justification that it is not characteristic of the PCT and is a known coloniser of disturbed areas?

As this project has a very tight deadline (including non-ecological matters), could we greatly appreciate some prompt advice on the above.

Regards,

Gitanjali Katrak
Senior Project Manager/Ecologist

cumberland ecology

Cumberland Ecology | Sydney - Brisbane
t 02 9868 1933
e gitanjali.katrak@cumberlandecology.com.au
w cumberlandecology.com.au