Biodiversity Development Assessment Report

120-134 Farm Road, Mulgoa NSW 2745

By Ecological Consultants Australia Pty Ltd TA

Kingfisher Urban Ecology and Wetlands

October 2021

About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia at Studio 1/33 Avalon Parade, Avalon. The author of the report is Geraldene Dalby-Ball with qualifications BSc. majoring in Ecology and Botany with over 20 years' experience in this field and Luke Johnson with qualifications B EnvSc.

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

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Executive Summary

Introduction

Ecological Consultants Australia (ECA) has been contracted by The Planning Hub to provide a **Biodiversity Development Assessment Report** for a proposal at 120-134 Farm Road, Mulgoa NSW 2745 within the Penrith City Council Local Government Area (LGA).

Trigger for a formal BDAR under the BC Act 2016:

The proposal triggers the area clearing threshold as per the BOS entry requirements as the site is identified by the Biodiversity Values map published by the Chief Executive of the NSW Office of Environment and Heritage.

The proposed development area does impact

Stage 1: Biodiversity Assessment

- On-ground survey took place in October 2021 by Senior Ecologist Geraldene Dalby-Ball.
- Data was gathered across three BAM plots located in each vegetation zone at the site.
- Flora and fauna observations were recorded on-site using binoculars and physical examination. Notes, photos and samples of flora species were taken to assess ecological health and value of the site.
- Bionet searches were performed for flora, fauna and endangered populations to identify if there were previous records of threatened species occurring within the local area using a 10km radius around the site.

Results

Stage 2: Impact Assessment

- The impact calculations were made based on there being direct impacts to vegetation from the proposed development. The impact area and/or areas of modification has been calculated as 0.29ha within the 3.82ha site.
- Survey plots were within a vegetation community identified as Cumberland Plains Woodland (CPW) (PCT849).
- CPW is listed as an Endangered Ecological Community (EEC) under the NSW BC Act (2016) and Critically Endangered Ecological Community (CEEC) under the Commonwealth EPBC Act (1999).
- Vegetation onsite has been significantly altered such that the site does not reflect the natural structural attributes of the CPW.
- Vegetation is structurally and functionally poor due to previous clearing onsite. Thus, the proposed development assessed in this BDAR is not expected to significantly contribute to loss of CPW.
- No threatened species were recorded during the site surveys.

Stage 3: Improving Biodiversity values

- Fauna refuge zone
- Delineation of work areas
- Vegetation clearing control measures

- Weed Management and removal
- Native seed collection
- Preservation of habitat
- Nest boxes
- Native species landscaping

See recommendations section for a detailed explanation as to how these recommendations improve biodiversity values.

Conclusions and Recommendations

- The proposed development will have an approximate impact area of 0.29ha on previously mapped Cumberland Plains Woodland (CPW) (PCT849). This vegetation has been significantly altered and degraded from its natural state.
- The site has been managed for agricultural and horticultural purposes since the 1800's. The site has a long history of vegetation clearing, habitat fragmentation and on-going disturbance, via agricultural practices. A majority of vegetation on site is regrowth. There is little to no remnant vegetation left on the property.
- The development and associated works generated zero ecosystem or species credits for the site. This is a reflection of the very poor vegetation integrity at the site.
- The grand total cost to offset both ecosystem credits and species credits generated by this development is $0.00 (including GST).
- Measures including but not limited to; nest boxes, native species landscaping, delineation of works zones, weed removal, tree protection and fauna refuge zones should all be used to mitigate any impacts associated with the proposal and increase habitat opportunities in the area.

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Stage 1: Biodiversity Assessment

1 Introduction

Ecological Consultants Australia (ECA) has been contracted by The Planning Hub to provide a **Biodiversity Development Assessment Report** for a proposal at 120-134 Farm Road, Mulgoa NSW 2745 within the Penrith City Council Local Government Area (LGA).

1.1 Site information and general description

The Subject Site (the "Site") is the area of direct and likely indirect impacts and is defined as the whole of the property.

This area has been assessed in the Biodiversity Assessment Method Calculator (BAM-C) from which offset credits have been generated.

Table 1 - Site Administrative Information

Category	Details
Title Reference (Lot/DP)	8/-/DP229785
Area (ha)	3.82Ha
Street Address	120-134 Farm Road, Mulgoa NSW 2745
LGA	Penrith City Council
Land Zoning	E3: Environmental Management.

*A small section located on the eastern boundary within the lot associated with the development is mapped as E2: environmental conservation due to its proximity of Mulgoa Creek. This area subsequently overlaps with the riparian zone. This E2 area is outside of the construction and building footprint and will not be directly or indirectly impacted by the proposed development.

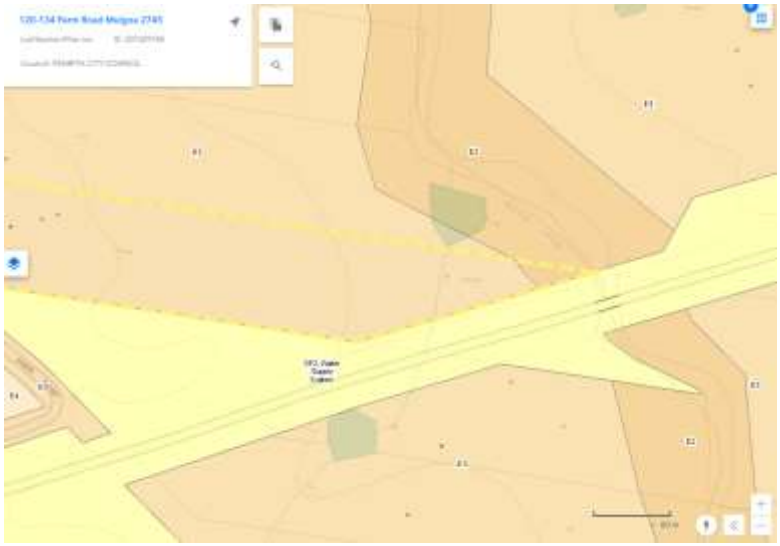


Figure 1.1 - Land zoning map of the site. NSW Government ePlanning Portal, 2020.

Figure 1.2 - Site of the proposed development. Source: NSW Government SixMaps, 2021.

1.2 Site history

The site has been managed for agricultural purposes for the previous 200 years. Native vegetation would have once covered the area although due to modification and disturbance, the site has lost many natural attributes. The site has been significantly altered and degraded from its natural state due to a long history of vegetation clearing, habitat fragmentation and on-going disturbance, via agricultural practices.

A majority of vegetation on site is regrowth or has been planted by the property owner. Potential remnant vegetation within the site is evident on the western border of the lot. Exotic species are dominant across the site and are preventing the recruitment of the original vegetation community.

Figure 1.3 - Historical imagery of the site 1975. NSW Government, Historical Imagery Portal 2021.

1.3 Proposed actions

The proposed development involves the construction of a new dwelling on a site with an existing dwelling creating a detached dual occupancy.

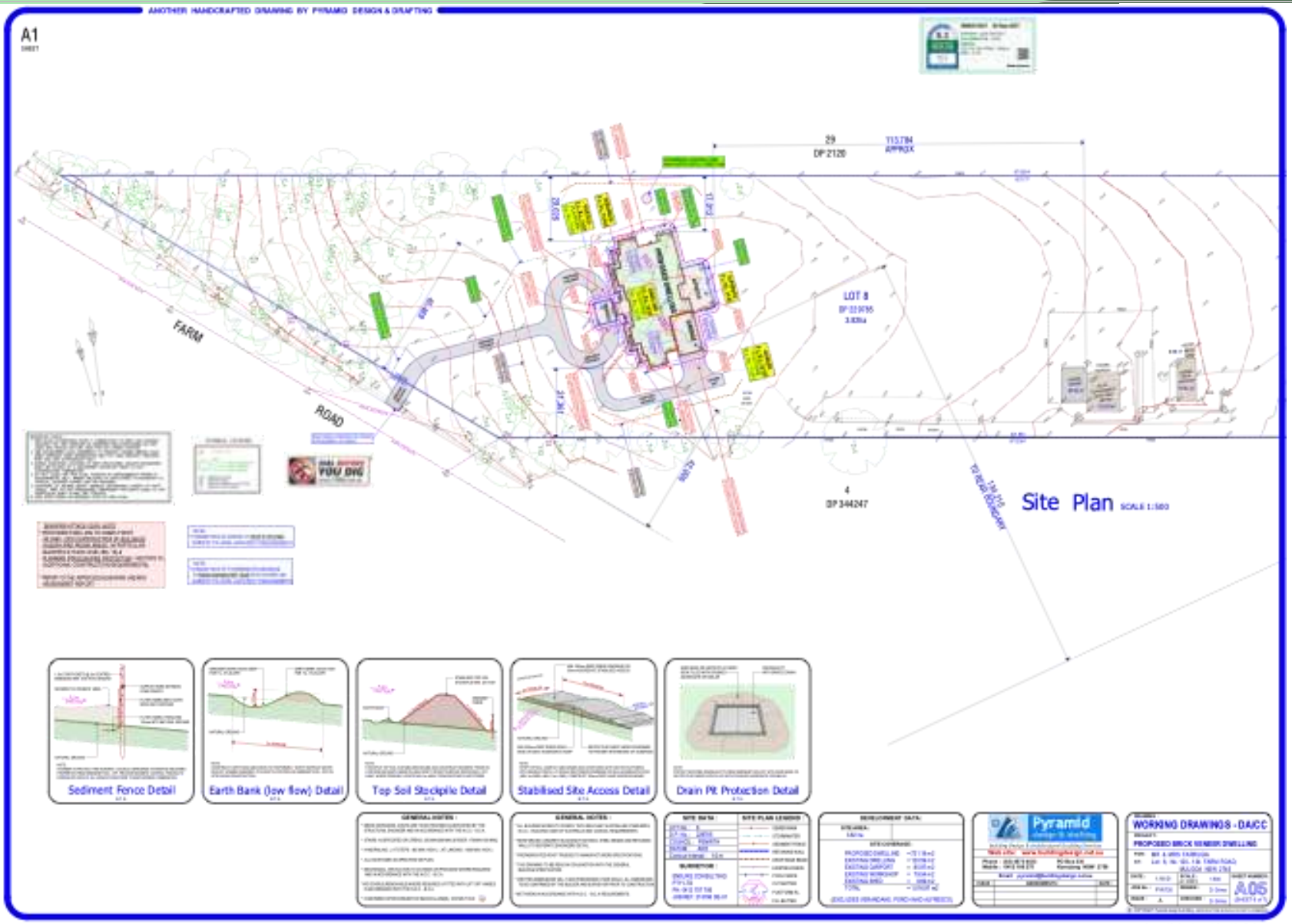


Figure 1.4 - Site Plan. Pyramid Design & Drafting. 1/04/21.

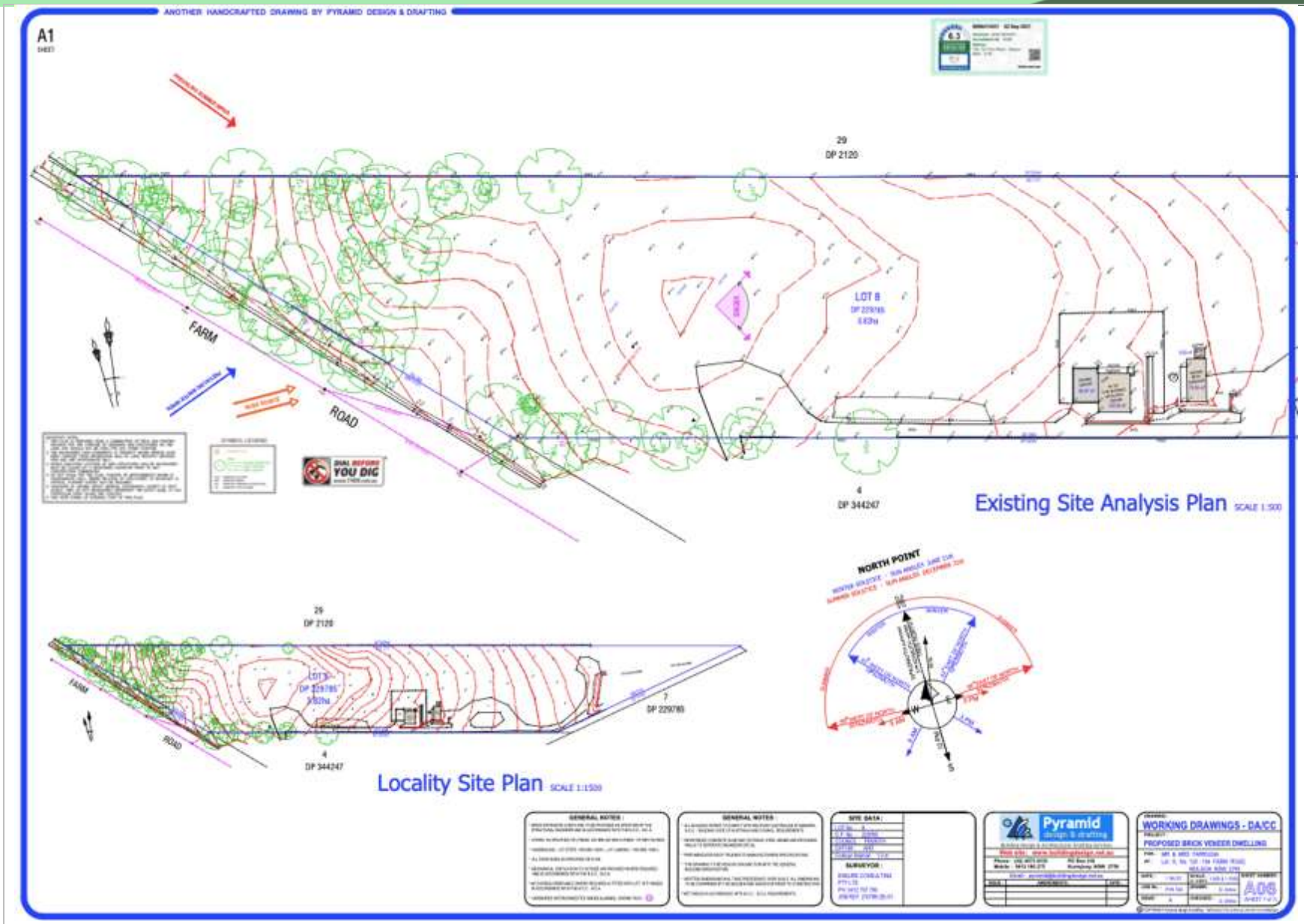


Figure 1.5 - Site Analysis Plan. Pyramid Design & Drafting. 1/04/21.

1.4 Sources of information used in the assessment

The following sources of information were used for this assessment:

- SeedMaps 2021
- CumberlandPlainWest_VIS__4207 OEH (2016)
- BioNet DPIE (2021)
- Planning for Bush Fire Protection (PBP) NSW RFS 2019.
- PYR726 Farrugia Final Drawing - Issue A. Pyramid Design & Drafting 1/04/21.
- Waste Water & Management Report. Blue Mountains Geological and Environmental Service Pty Ltd, July 2021.

1.5 Legislative context and statutory requirements

1.5.1 NSW Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2000* institutes and sets out a system for environmental planning and assessment in NSW, and includes Part 4 which deals with development applications on private land.

This proposal falls under a Part 4 development and requires development consent, and associated environmental assessment.

1.5.2 NSW Biodiversity Conservation Act 2016 and associated documents

The *Biodiversity Conservation Act 2016* (BC Act 2016) is the key legislation that enables the conservation of biodiversity within the state of New South Wales. The BC Act 2016 facilitates the assessment and on-going protection of flora and fauna, including threatened species and ecological communities. The BC Act 2016 outlines assessment and offsetting requirements for activities with the potential to impact on threatened species and ecological communities in NSW, and the clearing of native vegetation which exceeds the threshold.

The BC Act also:

- Outlines the licences required under the BC Act to harm protected flora and fauna;
- Lists Threatened species and ecological communities in Schedules 1 and 2;
- Sets out monetary and imprisonment penalties for offences relating to the harming of protected flora and fauna;
- Under Part 7 (s7.4), introduces a list of activities/proposal that exceeds the biodiversity offsets scheme threshold.

The NSW *Biodiversity Conservation Regulation 2017* sets out the Biodiversity Offsets Scheme entry threshold for Part 4 developments under the EP&A Act 1979. If the development triggers as least one (1) entry threshold, the development must be assessment under The BC Act using the Biodiversity Assessment Method (BAM) (OEH 2017). See also https://www.environment.nsw.gov.au/biodiversity/entryrequirements.htm

The development triggers the Biodiversity Offsets Scheme entry threshold. The assessment type used in the BAM-C is Part 4 Developments (Small Area). The paddock tree assessment tool (appendix I – BAM (2017) was not used in this assessment. Vegetation zones have annexed the appropriate areas of native vegetation which will be modified or removed. Thus, an adequate BDAR has is provided to the consent authority.

1.5.3 Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is applicable if it was considered that an impact on a 'matter of National Environmental Significance (NES)' were likely, thus providing a trigger for referral of the proposal to the Department of Environment and Heritage.

Matters of national environmental significance identified in the Act are:

- world heritage properties;
- national heritage places;
- Ramsar wetlands;
- nationally threatened species and communities;
- migratory species protected under international agreements;
- the Commonwealth marine environment; and
- nuclear actions.

The Commonwealth Government has published Significant Impact Guidelines (DE 2013) to assist in the determination of whether an action is likely to have a significant impact on a matter of NES. The proposal is not expected to significantly impact any MNES.

1.5.4 Penrith Local Environmental Plan 2010 (PLEP)

The site is identified as E3: Environmental Management under the PLEP.

As identified in PLEP the objectives of part 2, is—

- To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.
- To provide for a limited range of development that does not have an adverse effect on those values.
- To minimise conflict between land uses within the zone and land uses within adjoining zones.
- To ensure development is compatible with the environmental capabilities of the land and does not unreasonably increase the demand for public services or public facilities.
- To preserve and improve natural resources through appropriate land management practices.

The location and design of the proposed new dwelling has taken into account the surrounding native vegetation and aims to replace the existing dwelling at the site. As such no trees are required or proposed to be removed as a result of the dwellings deisgn or location. The objectives of the PLEP as they relate to the development will be satisfied. Mitigation measures are outlined in section 10 of this report.

1.6 Biodiversity Offsets Scheme threshold

The Biodiversity Offsets Scheme applies to:

local development (assessed under Part 4 of the Environmental Planning and Assessment Act 1979) that triggers the Biodiversity Offsets Scheme threshold (see section 1.6) or is likely to significantly affect threatened species based on the test of significance in section 7.3 of the Biodiversity Conservation Act 2016.

1.6.1 BOS Area Clearing Threshold

The proposal does not trigger the area clearing threshold as per the BOS entry requirements as the impact area is less than the clearing area threshold. Area clearing thresholds are determined by minimum lot size and guidelines outlined in BAM (OEH 2017) (figure 1.6).

Table 1.1 - Minimum lot size and clearing threshold area trigger.

Minimum lot size	**20Ha**
Threshold for clearing, above which the BAM and offsets scheme apply	**0.5ha**
Impact area	**0.29ha**

Area clearing threshold

The area threshold varies depending on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan (LEP)), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
1 ha to less than 40 ha	0.5 ha or more
40 ha to less than 1000 ha	1 ha or more
1000 ha or more	2 ha or more

Figure 1.6 - Area clearing threshold as per the BOS entry requirements.

1.6.2 Biodiversity Values Map

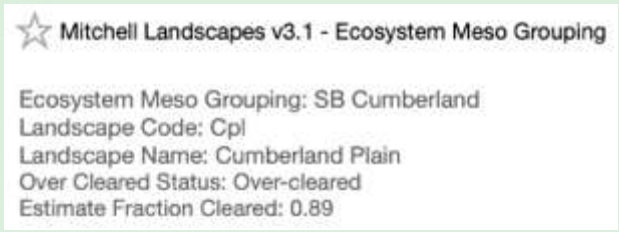
The proposed development area does impact areas identified by the Biodiversity Values map published by the Chief Executive of the NSW Office of Environment and Heritage.

Figure 1.7 - Biodiversity Map – Site in red. Source: https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

2 Landscape features and site context

The site is located within agricultural/rural/light industrial setting. The surrounding properties are made up of agricultural (Cropping) rural (grazing and pasture paddocks) and patches of native bushland.

Table 2.1 - Site Biodiversity Information

Category	Details
Interim Biogeographic Regionalisation for Australia (IBRA)	Sydney Basin
IBRA Sub Region	Cumberland
NSW Landscape 	Cumberland Plain Cpl 
% Native vegetation cover	35% in the 1500m radius circle See Figure 2.1
Landscape features	
Rivers and streams	A drainage gully exists within the eastern portion of the lot, although it is not considered a waterway and should not be classified as such. The drainage gully does not contain an observable channel, banks or fluvial bed forms. The drainage gully has been formed from storm water spill over connecting two dams; one onsite and one off site; to Mulgoa Creek approximately 60m north of the lot boundary. Mulgoa Creek runs north until it reaches the Nepean River.
Wetlands	No wetlands are located within the site or adjacent land.

Connectivity features	Vegetation on site is connected to adjoining bushland via paddock trees and inconsistent structural layers. Connectivity within the assessment area is generally isolated along riparian corridors.
Areas of geological significance and soil hazard features	No
Areas of Outstanding Biodiversity Value identified under the BC Act	No
Geology and Soil	"Luddenham" is the identified soil landscape for the site as per eSpade2.0 (DPIE, 2020). Luddenham is characterised by Hills and low hills on Wianamatta Group Bringelly Shale (shale, sandstone-lithic and siltstone/mudstone) in the Cumberland Plain and Blue Mountains Plateau

Figure 2.1 - Assessment Area Red circle showing the 1500m buffer around the site.

3 Native vegetation

3.1 Desktop and Survey results – Plant Community Types (PCTs)

A review of the most up-to-date vegetation mapping, CumberlandPlainWest_VIS__4207 DPIE (2016), identified three (3) plant community types (PCT) within site. The PCT is identified as; *Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion* (PCT835); *Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion* (PCT849) and; *Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion* (PCT850).

Table 3.1 – Table of vegetation community synonyms as per NSW and Commonwealth legislation.

NSW PCT Code	NSW PCT Name	BC Act 2016	EPBC Act 1999
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions State Conservation: Endangered Ecological Community (EEC)	No associated TEC
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion State Conservation: Critically Endangered Ecological Community (CEEC)	Cumberland Plain Woodland in the Sydney Basin Bioregion Commonwealth Conservation: Critically Endangered (CE)
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion State Conservation: Critically Endangered Ecological Community (CEEC)	Cumberland Plain Woodland in the Sydney Basin Bioregion Commonwealth Conservation: Critically Endangered (CE)

3.1.1 Field Survey

The field survey assisted in verifying the distribution and quality of vegetation at the site. Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (PCT849/850) is mapped across the site via *Cumberland Plain West_VIS__4207 OEH (2016).*

Approximately 90% of the vegetation onsite has been previously disturbed. The canopy is discontinuous onsite, with scattered canopy trees consisting of a mix of *E. teriticornis* and *E. moluccana*. The mid stratum is primarily absent within site boundaries. The ground stratum has been highly disturbed, with much of the site dominated by exotic pasture/turf grass species. Small patches of vegetation onsite are displaying signs

of natural regeneration through the occurrence of *Wahlenbergia gracillis*, although this is being hindered by current land use practices.

Vegetation has been assessed as Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (CPW) (PCT849) in the BAM-C. This finding was concluded following desktop investigations and field assessments. See section 5 for a description of vegetation zones and the impact assessment.

Stratification and plot dimensions

Plots were as per the BAM Method with 20x20 plots (400m^2) for assessing structure and composition with a center line extending 50m to great a 20 x 50 plot (1000m^2) to assess function. See Biodiversity Assessment Method Operational Manual – Stage 1 (OEH 2018) page 26-28 for methods used.

https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-operational-manual-stage-1-180276.pdf

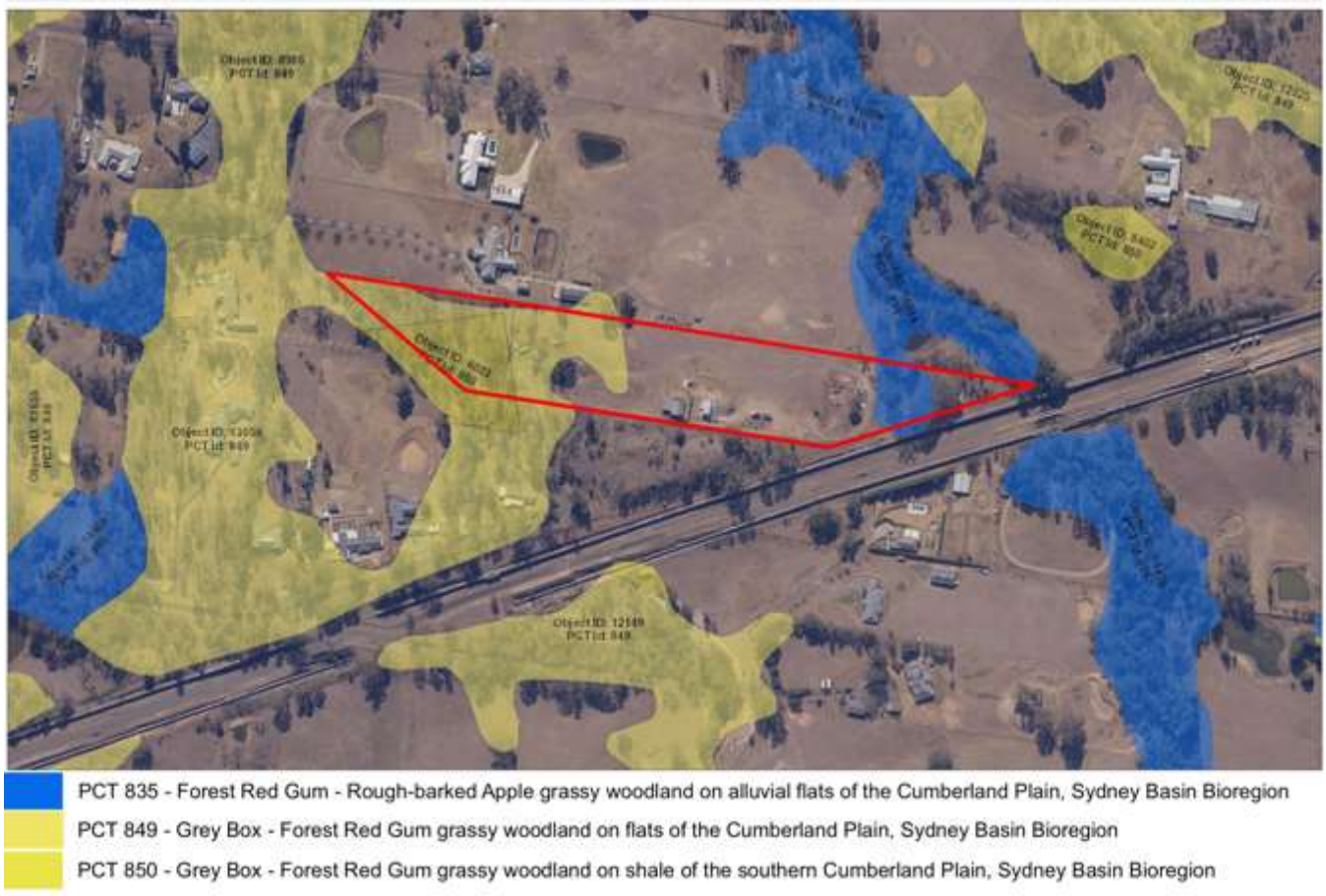


Figure 3.1 - Subject site within mapped vegetation surrounding the property CumberlandPlainWest_VIS__4207 OEH (2016). Source: SEED 2021.

3.1.2 Site Photos

Included are photos of vegetation zones and the general condition of vegetation at the site.

Plate 1. APZ area - no works needed

Plate 2. Ground cover consists of exotic grass species

Plate 3. Dead tree – being retained

Plate 4. Litter cover within the site

Plate 5. Ground cover vegetation

Plate 6. Bare ground within the site

Plate 7. Vegetation plot and location information

4 Threatened Species

4.1 Flora and Flora Field Survey

No threatened flora or fauna species were identified during Kingfisher 2021 field surveys.

4.1.1 Opportunistic Flora and Fauna survey methods

During opportunistic surveys, notes and photos were taken of the vegetation types and flora and fauna present onsite were recorded. Surveys were general and opportunistic in nature and were performed by traversing the site.

4.1.2 Diurnal Bird Surveys

Diurnal bird surveys occurred during mid-afternoon. Opportunistic observations of birds were made during vegetation surveys. Several species which are known to nest in hollows were predicted at the site and a dedicated effort was made to traverse the impact area to understand if hollows are present and if they are suitable for predicted bird species.

The site survey for birds primarily focused on their breeding habitat requirements such as hollows, waterways onsite, nests that are present and other features which BAM identified bird species may use for breeding purposes. It was concluded that the impact area hosts potential foraging habitat for all birds species listed in the BAM calculator. Therefore, all bird species identified in the BAM calculator were retained in the assessment for foraging purposes.

However, it is unlikely that threatened avifauna would use the impact area for breeding purposes, due to lack of optimal breeding habitat (suitable hollows, suitable waterways). Justification for species exclusion in the BAM-C can be found in appendix I. Searches were conducted for forest owls, no individuals were recorded on site however call playback was not used.

4.1.3 Microbats

The impact area hosts marginal foraging habitat for threatened microbat species which are identified in the BAM calculator for the site. All microbat species have been retained in the BAM calculator for foraging purposes. The site survey for microbats primarily focused on their breeding habitat requirements such as caves, outcrops, hollows and other features which microbat species may use for breeding purposes.

It has been concluded that while microbat species may use the site for foraging purposes they are unlikely to use the site for breeding purposes due to lack of optimal breeding opportunities within the impact area. Therefore, impact assessment on microbat breeding habitat has been excluded from the BAM assessment.

4.1.4 Mammal Surveys

Mammal surveys occurred during the mid-afternoon. The proposed development is not expected to significantly impact upon breeding or foraging purposes for any mammal species identified in the BAM Calculator as there are no optional habitat features within the development area.

4.1.5 Amphibian Surveys

Amphibian surveys occurred during the mid-afternoon. Opportunistic observations of amphibians were made during vegetation surveys. Any potential habitat features were investigated however no threatened

amphibian species identified in the BAM calculator were identified onsite. Habitat requirements for all threatened amphibian species identified in the BAM calculator are marginal within the impact area.

4.1.6 Reptile and Snail surveys

Reptile and Snail surveys were undertaken by thorough investigation of potential habitat including:

- Leaf litter
- Bark litter
- Stick piles
- Native ground cover vegetation
- Rocks
- Rubbish

Targeted searches were conducted for the Dural Land Snail (*Pommerhelix duralensis*) and Cumberland Plain Land Snail (*Meridolum corneovirens*). Although no threatened Reptile or Snail species were identified during site investigations.

4.2 Threatened Flora - Desktop

A total of 6 threatened flora species have been recorded within 10km of the study site according to BioNet records. These species are currently listed as vulnerable or endangered under state and/or commonwealth legislation (see Table 4.1). The vulnerable and endangered species to focus on-site searches for can be seen in Table 4.1 below highlighted in bold. This is based on likelihood of occurrence.

Table 4.1 - Threatened flora observed in previous ecological surveys within a 10km radius of the study site. NSW DPIE Bionet 2021.

Family	Scientific Name	Common Name	NSW status	Comm. status	Records
Fabaceae	*Dillwynia tenuifolia*		V		7
Myrtaceae	*Eucalyptus benthamii*	Camden White Gum	V	V	24
Proteaceae	*Grevillea juniperina* subsp. *juniperina*	Juniper-leaved Grevillea	V		5
Thymelaeaceae	*Pimelea spicata*	Spiked Rice-flower	E1	E	9
Fabaceae	*Pultenaea parviflora*		E1	V	47
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	E4A		3

Note: E = Endangered, V = Vulnerable, P = Protected.

4.3 Threatened Fauna - Desktop

A total of 36 threatened fauna species have been recorded within 10km of the study site according to BioNet records. These species are currently listed as vulnerable or endangered under state and/or

commonwealth legislation (see Table 4.2). The vulnerable and endangered species to focus on-site searches for can be seen in Table 4.2 below highlighted in bold. This is based on likelihood of occurrence.

Table 4.2 - Threatened fauna observed in previous ecological surveys within a 10km radius of the study site. NSW DPIE Bionet 2021.

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Amphibia	*Litoria aurea*	Green and Golden Bell Frog	E1,P	V	2
Amphibia	*Pseudophryne australis*	Red-crowned Toadlet	V,P		1
Aves	*Anthochaera phrygia*	Regent Honeyeater	E4A,P	CE	8
Aves	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		10
Aves	*Botaurus poiciloptilus*	Australasian Bittern	E1,P	E	1
Aves	*Burhinus grallarius*	Bush Stone-curlew	E1,P		2
Aves	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V,P,3		4
Aves	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V,P,2		7
Aves	*Chthonicola sagittata*	Speckled Warbler	V,P		5
Aves	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V,P		1
Aves	*Daphoenositta chrysoptera*	Varied Sittella	V,P		17
Aves	*Ephippiorhynchus asiaticus*	Black-necked Stork	E1,P		3
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V,P		8
Aves	*Hieraaetus morphnoides*	Little Eagle	V,P		2
Aves	*Lathamus discolor*	Swift Parrot	E1,P,3	CE	14
Aves	*Limosa limosa*	Black-tailed Godwit	V,P	C,J,K	1
Aves	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	V,P		1
Aves	*Ninox connivens*	Barking Owl	V,P,3		2
Aves	*Ninox strenua*	Powerful Owl	V,P,3		4
Aves	*Petroica boodang*	Scarlet Robin	V,P		1
Aves	*Petroica phoenicea*	Flame Robin	V,P		2
Aves	*Stagonopleura guttata*	Diamond Firetail	V,P		2
Aves	*Tyto novaehollandiae*	Masked Owl	V,P,3		10

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Aves	*Tyto tenebricosa*	Sooty Owl	V,P,3		3
Gastropoda	*Meridolum corneovirens*	Cumberland Plain Land Snail	E1		104
Mammalia	*Chalinolobus dwyeri*	Large-eared Pied Bat	V,P	V	5
Mammalia	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V,P		10
Mammalia	*Miniopterus australis*	Little Bent-winged Bat	V,P		1
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V,P		9
Mammalia	*Myotis macropus*	Southern Myotis	V,P		11
Mammalia	*Petauroides volans*	Greater Glider	P	V	1
Mammalia	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E1,P	V	1
Mammalia	*Phascolarctos cinereus*	Koala	V,P	V	5
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	V,P	V	29
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P		1
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		9

Note: E = Endangered, V = Vulnerable, P = Protected.

4.3 Endangered population

One endangered population have been recorded to occur within 10km of the site. Table 4.3 outlines these populations. It is unlikely that either of these populations would occur at the site due to habitat requirements and site accessibility. See Appendix I for rationale.

Table 4.3 - Endangered populations in the LGA. Source: NSW OEH Bionet 2021.

Scientific Name	Endangered Population	NSW Status	Comth. Status	No. of records
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora R. Br.* subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		221

Likelihood of occurrence

See Appendix I for a 'Rationale for Likelihood of Occurrence', which outlines why species have been retained or omitted from BAM calculations. Reasons for inclusion or removal are based on species habitat preferences, site investigations, species survey, Bionet records and expert opinion. During the survey, none of the above threatened species were observed on-site. Marginal foraging habitat for several species is present onsite. Thus, all predicted species were retained in the BAM-C and several candidate species generated species credit species due to the impact on foraging habitat.

Stage 2: Impact Assessment

5 BAM Calculator

5.1 Vegetation Zones and Integrity Scores

Vegetation zones were determined on species composition at the site. The vegetation zones cover areas in which native vegetation is proposed for removal and/or modification. The single vegetation zone has been divided into management zones.

Future vegetation integrity (F-VI) scores in the BAM-C, for APZ management zones are reflective of Inner Protection Area (IPA) maintenance practices as outlined in Planning for Bush Fire Protection (PBP) NSW RFS (2019). Within the APZ, species diversity is expected to remain as per current survey results. However, the structural attributes of the vegetation will be modified in the APZ, therefore F-VI scores were adjusted accordingly. The complete vegetation removal management zones have a F-VI score of 0.

Data for the BAM-C was gathered across a single BAM plot located in the construction footprint zone at the site.

Zone One - Construction Footprint (House)

The zone is located entirely within the construction footprint of the proposed dwelling. The vegetation is in a highly disturbed condition consisting of cleared open ground and exotic pasture/turf grasses. The dominant vegetation consists of *Bouteloua dactyloides* (Buffalo Grass) and exotic clover. Possible remnant, *E. tereticornis* and *E. moluccana* are present outside the boundary of this zone and will be retained. This zone has undergone historical disturbance for over 50 years through vegetation removal, grazing and previous development. As a result the vegetation in this zone does not reflect the natural attributes of remnant vegetation that would have once made up this area.

The combination of low native abundance and poor species composition hinder the ability to differentiate between a number of PCTs that could occur within this patch such as PCT 849 and PCT 850. Therefore, this vegetation has been assessed as Cumberland Shale Plains Woodland in Sydney Basin Bioregion (PCT849) in the BAM-C. This finding was concluded following desktop investigations and field plot-based assessments and the experience of the assessing ecologist with vegetation in this area of NSW. This patch of vegetation is highly disturbed, assessment of the associated TEC (CPW) is similarly hindered by the lack of native vegetation and previous site disturbances. As a result, a precautionary approach was taken and assumed that if managed correctly the seedbank of the original PCT would be likely to exist and vegetation was assessed as Cumberland Plain Woodland (CPW) TEC, in the BAM -C, albeit in poor condition.

Patch size assigned to the vegetation zone was concluded to be >100 ha. Vegetation on site is less than 100 m from native vegetation of the adjoining properties. Scattered remnant trees are common across the landscape within the assessment area and form connection to larger native vegetation throughout the assessment area.

The vegetation zone has been left as a single management zone within the BAM-C. This will reflect the future actions; Total vegetation removal (House) (0.29ha).

Table 5.1. Table of current vegetation integrity scores for vegetation zones on site.

PCT	Vegetation Zone	Area (Ha)	Vegetation Integrity(VI) Score	Change in VI
849 (CSPW)	One (House)	0.29	2.4	-2.4
Total		**0.29**		

Figure 5.1 – Vegetation zones

Figure 5.2 – Plot Location

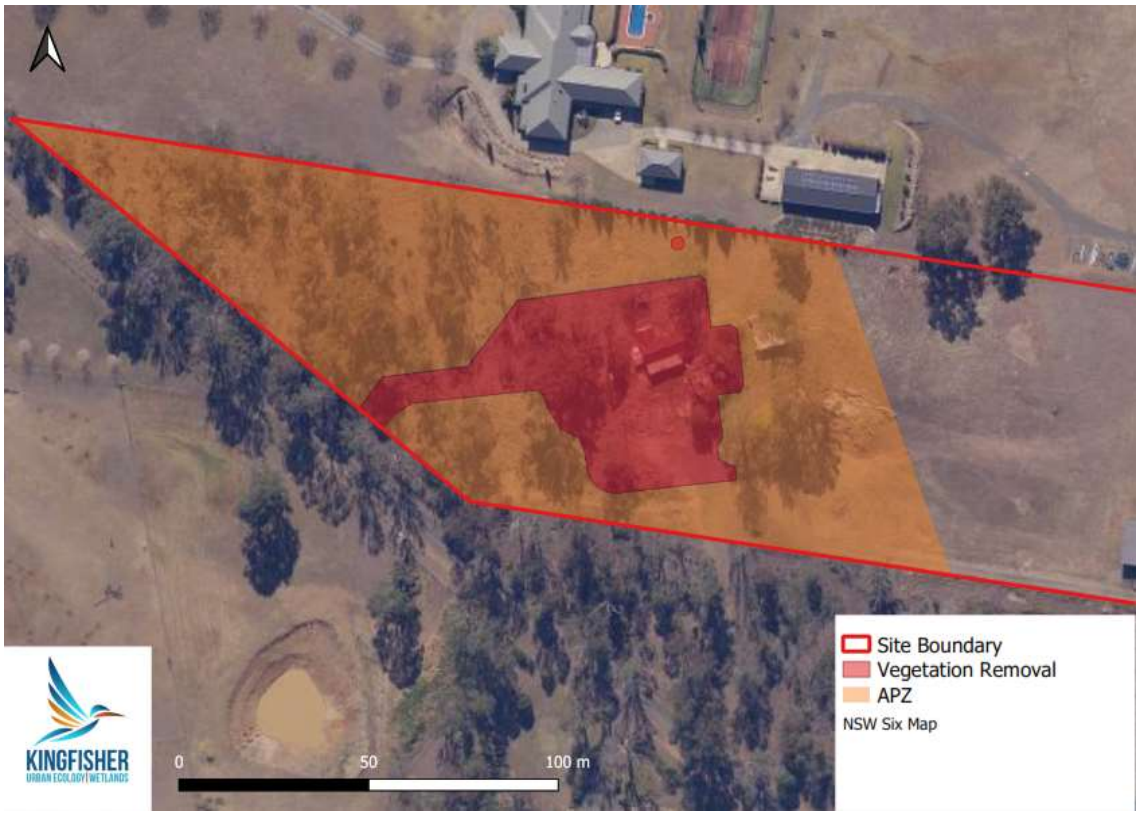


Figure 5.3 – Proposed Impacts and Management Zones

Plate 5 – Ground litter within plot

Plate 6 – Cleared ground within zone 1

Plate 7 – Vegetation plot location information

5.2 Species and Ecosystem Credits

The grand total cost to offset both ecosystem credits and species credits generated by this development is $0.00 (including GST). A credit is a unit used to measure the impact of a development. Credits have a price and are traded by the Biodiversity Conservation Trust (BCT) under the Biodiversity Conservation Scheme (BOS). A credit may be created due to a number of factors including but not limited to, amount of vegetation removed, critical habitat removed and alteration of the landscape.

5.2.1 Ecosystem Credit Species derived from BAM

The development and associated works generated zero ecosystem credits for the site. This is a reflection of the very poor vegetation integrity at the site. See below, figure 5.4 for the ecosystem credit summary.

Ecosystem credit classes

Ecosystem credit summary

PCT	TEC	Area	HBT Cr	No HBT Cr	Credits
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.29	0	0	0

Credit classes for 849

Like-for-like options

TEC	HBT	Credits	IBRA region
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	No	0	Cumberland , Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Figure 5.4 - Ecosystem credit summary from the BAM calculator.

5.2.2 Species Credit Species derived from BAM

The development and associated works generated ~~xx ecosystem~~ species credits for zero threatened species. This is also reflective of the poor habitat condition and minimal impacts to vegetation proposed.

In total the cost to offset the species credits generated was not supplied by the BAM and further communication with the BCT is required. The individual credit price for each species can be seen below in figure 5.5.

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
No species available							
					Grand total		**Contact BCT for pricing**

Figure 5.5 - Species credit summary from the BAM calculator.

It has been concluded that not all land within the impact area holds suitable habitat for threatened species. Thus, some species have been excluded due to severe habitat degradation. References used for the rationale table are species records from Bionet and information from the relevant DPIE species profile for each species and from the Threatened Biodiversity Data Collection.

Appendix I lists the species credit species predicted by the BAM Calculator and details whether the species have been further assessed based on site suitability (I.e. Habitat constraints and/or habitat degradation within the development site). Under Section 6.4.1.13 of the BAM, further species credit species can be excluded from further assessment if an assessment of habitat constraints and microhabitats determines that the habitat within the development site is substantially degraded such that the species credit species is unlikely to occur. See section "6.1.2 BAM Candidate Species for Further Assessment".

The species credits generated in this BDAR were generated in the areas of "complete vegetation removal" and not Asset Protection Zones (APZ). The single vegetation zone was used as the activities within the APZ area are not expected to significantly degrade or remove breeding habitat features (including hollows) for the species credit species. This method is in accordance with the BAM Section 6.4 (steps 3 - 6).

6 Direct Impacts

Figure 6.1 – Proposed Impacts and Management Zones

6.1.1 Vegetation disturbance and Loss

Exotic vegetation will be removed to accommodate for the proposed development. However, the development site is substantially degraded such that the original vegetation community is unlikely to

recover. Areas of potential habitat for CPW will be lost, although the site has been subject to vegetation removal and modification for the previous 200 years.

Vegetation within the APZ area will not be modified. The vegetation surrounding the development is currently being managed as APZ (IPA) for the preexisting dwelling that the development is to replace. Species diversity, composition and structure is expected to remain post development.

7 Indirect Impacts

7.1.1 Weed growth and invasion

Weed species are present and must be properly managed so they do not spread.

At the direct works zone weeds are to be managed by stopping seed spread on machinery, tools, equipment and worker clothes (e.g. boots). Additionally, after weed removal around the perimeter area of the construction, there must be continuous maintenance of the site otherwise it may result in increased weed growth, exacerbated by the high abundance of weeds present pre-works.

Weeds will colonize and pioneer on any cleared grounds so must be managed throughout the duration of the project as well as on-going post works

7.1.2 Introduction of pathogens

The introduction of pathogens may occur into the site, and surrounding remnant bushland, via machinery, tools, equipment and worker clothing (e.g. boots). Diseases to watch out for include Phytophthora (also known as Root Rot – type of water mold) and Myrtle Rust (*Puccinia psidii* – type of fungus). See Appendix for Bushland Hygiene Protocols for Phytophora.

7.1.3 Soil disturbance and erosion

The removal of vegetation and trees can result in soil disturbance. The soil appears to be sodic thus erosion can occur at a faster rate. Soil compaction could occur from machinery use. It is recommended that soil compaction in non-built upon areas is to be avoided and not to occur within the trees to be retained. Replacement of woody debris and a covering of organic matter over the cleared site will prevent erosion and thus is highly recommended.

7.1.4 Water Quality

There are no streams present onsite however the proposed actions may result in transport of sediment from the work zones because of increased storm water runoff to areas downhill. Which may impact water quality, riparian vegetation and aquatic fauna. Recommendations to maintain and improve water quality on site have been listed in section 10 below.

8 Serious and Irreversible Impact Assessment (SAII)

The following section provides details which address section 10.2 of the Biodiversity Assessment Method (BAM) and thus has referenced the guiding document *Guidance to assist a decision-maker to determine a serious and irreversible impact* in order to satisfy BAM requirements.

The document *Guidance to assist a decision-maker to determine a serious and irreversible impact* outlines the steps taken determine serious and irreversible impacts in section 3.2. The steps are as follows;

1. Step one: Identify relevant entities at risk of a SAII
2. Step two: Evaluate the extinction risk of the entity to be impacted
3. Step three: Detail measures taken to avoid, minimise and mitigate impacts on the entity
4. Step four: Evaluate a serious and irreversible impact
5. Step five decision making

8.1.1 Step one - Identify relevant entities at risk of a SAII

Following 3.2.1 in *Guidance to assist a decision-maker to determine a serious and irreversible impact;*

> *The Biodiversity Assessment Report (BAR) will identify species or ecological communities at risk of a SAII that are likely to be affected by the proposal. These entities are identified in the BAM Calculator (BAM-C). The front page of the credit report provided by the BAM-C will also identify all the entities that are considered to be at risk of a SAII and are impacted on by the proposal.*

The BAM-C Credit report can be found in appendix IV.

The following section identifies SAII entities recognised by the BAM Calculator as being at risk of a serious and irreversible impact. Description of the principles for the Listed entities are available in the *Guidance to assist a decision-maker to determine a serious and irreversible impact* and are summarised as:

- Principle 1 – species or ecological community currently in a rapid rate of decline
- Principle 2 – species or ecological communities with a very small population size
- Principle 3 – species or area of ecological community with very limited geographic distribution
- Principle 4 – species or ecological community that is unlikely to respond to management and is therefore irreplaceable

The list of SAII entities identified by the document was accessed via;

https://www.environment.nsw.gov.au/topics/animals-and plants/biodiversity/biodiversity-offsets-scheme/serious-and-irreversible-impacts

Table 8 - All SAII entity recognised by the BAM Calculator for the site.

Scientific Name	Common Name	Principles			
		1	2	3	4
Cumberland Shale Plain Woodland (CPW) (PCT849).	Cumberland Shale Plain Woodland (CPW) (PCT849).	X	X		

8.1.2 Step two - Evaluate the extinction risk of the entity to be impacted

- **Cumberland Shale Plains Woodland (CPW)**

Cumberland shale plains woodland (CPW) satisfies Principle 1 and 2 of SAII criteria;

- Principle 1 – species or ecological community currently in a rapid rate of decline
- Principle 2 – species or ecological communities with a very small population size

The proposed development will have an approximate impact area of 0.29ha within the 8ha patch of CPW. Vegetation on site has been significantly altered such that the site does not reflect the natural structural attributes of CPW. Many areas are dominated by exotic grasses. The canopy vegetation adjacent to Farm Road marginally reflects attributes of the CPW community. The majority of vegetation in this area is likely to constitute regrowth and is not remnant. The patch is also dominated by exotic species. The primary impact will be vegetation removal of an area that would otherwise be cleared ground or turf. It is expected that approximately 0.92 ha of potential CPW vegetation will be impacted by the construction footprint. The remaining CPW vegetation is currently being managed as APZ for the existing dwelling and will not undergo further impacts from the proposal. The current estimated extant of CPW is 6800ha. The removal of potential CPW within the site comprises <0.05% of the current estimated extent. The proposed development is not expected to significantly contribute to loss of CPW due to the degraded nature and current APZ requirements of the site.

8.1.3 Step three - Detail measures taken to avoid, minimise and mitigate impacts on the entity

- **Cumberland Shale Plains Woodland (CPW)**

The proposal is expected to have a negligible impact upon CPW as core habitat for CPW will not be removed. The vegetation proposed for removal is not considered to form part of the original plant community and the vegetation in Zone 1 is in poor condition and it is unlikely that the original vegetation community would recover without assistance.

Delineation of works areas and exclusion zones for all vegetation to remain have been recommended.

8.1.4 Step four - Evaluate a serious and irreversible impact

- **Cumberland Shale Plains Woodland (CPW)**

The proposed development assessed in this BDAR is not expected to significantly contribute to loss of CPW due to the poor condition of vegetation onsite. Vegetation is both structurally and functionally poor due to historical actions on site. It is unlikely that this proposal would place CPW at risk of extinction or cause a serious or irreversible impact.

Stage 3: Improving Biodiversity Values

9 Avoid and minimise impacts

The development will not significantly impact features outlined in table 9 below. The proposed actions will not affect water quality as there will be erosion and silt management controls onsite to prevent runoff. Below is a table showing the potential impact the development would have on features that threatened species or communities can be dependent on.

Table 9 - Expected impact on potential habitat onsite.

Feature	Present	Description of feature characteristics and location	Potential Impact	Threatened species or community using or dependent on feature	Section of the BAR where prescribed impact is addressed.
Karst, caves, crevices, cliffs or other geologically significant feature	No	N/A	N/A	N/A	N/A
Rocks	No	N/A	N/A	N/A	N/A
Human made structure	Yes	House within the development site	House will be demolished Negligible	N/A	N/A
Non-native vegetation	Yes	Scattered throughout	Negligible	N/A	N/A

10 Recommendations

10.1.1 Wildlife corridor/ Revegetation

Cumberland Plain Woodland (CPW) species community list. Species plantings should aim to restore maximum diversity at the site. This will provide greater foraging and nesting habitat for native species and will deliver greater biodiversity gain outcomes. These species should be selected in consultation with an ecologist for the greatest ecological outcome.

The drainage line and stretches of bare ground should be revegetated with Koala feed and browse trees. This can be implemented whilst also ensuring the areas satisfy bushfire protection requirements. Such measures will also increase habitat connectivity of the surrounding landscape. Shrub and ground covers will also increase the habitat area for other wildlife including small insectivorous and insectivorous birds. Planting of threated flora species within revegetation areas is also recommended.

10.1.2 Weed management

Low impact bushland regeneration methods should be utilised to meet weed control performance criteria in all areas of remnant native vegetation, to prevent unnecessary impacts to native vegetation and disturbance to soil. Low impact bush regeneration methods include the manual removal of herbaceous weeds and their propagules by hand and with hand tools. All bush regeneration activities requiring the use of chemicals must be performed in accordance with the NSW *Pesticides Act 1999.* Herbicides must not be applied whilst exotic plants are setting seeds.

10.1.3 Delineation of work areas

During construction, impacts to the site and adjacent vegetation should be minimised by the delineation of works zones. Access to the site would be best restricted to the development footprint only. An environmental exclusion zone is proposed for vegetation outside work areas.

10.1.4 Vegetation clearing control measures

No clearing is currently proposed that would require clearing control measures. However should there be a need to remove canopy vegetation, an ecologist should be present onsite during vegetation clearing to ensure no fauna are harmed as a result of clearing.

10.1.5 Tree Protection

Tree protection will be consistent with the Tree Survey. Main trees to be managed are trees within close proximity to building works NB: see final tree survey for details and tree numbers.

10.1.6 Weed Removal Techniques

Weed removal proposed for the site will consist of hand removal techniques, manual/mechanical removal using bush regenerator tools and winter thermal (flame) weeding. This approach will reduce the amount of herbicide used and reduce the amount of off-target damage through spot on application.

Woody perennial weeds less than 2 metres in height will require cut and paint or scrape and paint bush regenerator techniques based on the germinating/epicormic behaviour of the plant (especially plants that tend to coppice or sucker).

It is recommended that seed heads are removed prior to commencement of primary works. This would be best performed carefully by hand with secateurs with the aim of avoiding the spread flowers or seeds into disturbed zones.

See Appendix II for further details.

10.1.7 Native Seed Collection

Any future works that require native trees or shrubs being removed for the construction works should be checked for seeds during removal works. If seeds are present, they should be collected and used off-site, location to be determined with council.

10.1.8 Nest boxes

Installation of a 2 nest boxes designed for microbats should be added to the site to increase roosting opportunities in the area.

Image from: nestboxes.com.au

10.1.9 Pathogen prevention

To prevent the introduction of pathogens, Bushland Hygiene Protocols outlined in Appendix III should be followed. The site is considered to be an area which may promote the spread of Phytophthora (a group of fungus-like diseases affecting plants) due to its moist soil and proximity to water. It is recommended that Bushland Hygiene Protocols be followed closely.

11 Conclusions

The proposed development will have an approximate impact area of 0.29ha on previously mapped Cumberland Plains Woodland (CPW) (PCT845). This vegetation has been significantly altered and degraded from its natural state as reflected by the VI score. Vegetation onsite has been significantly altered such that the site does not reflect the natural structural attributes of CPW. The grand total cost to offset both ecosystem credits and species credits generated by this development is $0.00 (including GST).

12 Appendices

12.1 Appendix I – Rationale for Likelihood of Occurrence

Rationale for Likelihood of Occurrence all Species Credit Species (candidate species) predicted by the BAM Calculator (BAM-C) and details whether the species have been retained or omitted from the calculator.

Where a species has a specific habitat constraint, which is not present within the subject land, or if the species is a vagrant within the IBRA subregion, the species is considered unlikely to occur and no further assessment is required. Additionally. in accordance with section 6.4.1.17 of the BAM, a candidate species credit species can be considered unlikely to occur within the subject land (or specific vegetation zones) where habitat is substantially degraded such that the species is unlikely to utilise area. As discussed in Sections 2 and 3, much of the vegetation within the subject land and 1,500 m buffer has been previously cleared, fragmented and is subject to ongoing disturbance.

A predicted candidate species credit species that is not considered to have suitable habitat on the subject land (or specific vegetation zones) in accordance with section 6.4.1.17 of the BAM does not require further assessment on the subject land (or specific vegetation zones). The reasons for determining that a predicted species credit species is unlikely to have suitable habitat on the subject land (or specific vegetation zones) has been included below for each Candidate Species for the BDAR.

Table 12.1. Potential Species Credit Species generated by the BAM-C, all the following species were candidate threatened species for the site. All BAM-C predicated species were retained.

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
Flora				
Caladenia tessellata	Thick Lip Spider Orchid	The Thick Lip Spider Orchid is from a group of orchids characterised by five long spreading petals and sepals around a broad down-curled labellum ('lip'). It has cream-coloured petals with reddish stripes, and the yellowish labellum is broad with a few darker stripes. The long, sparsely-hairy, narrow	No	Likelihood of occurrence for the species is low. Habitat is substantially degraded such that the species is unlikely to utilise area.

		leaf is about 6 cm long and 5 mm wide. Column base with two prominent yellow glands. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations). Within NSW, *Caladenia tessellata* is currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. The total population size is estimated to be less than 50 individuals.		Areas of suitable habitat are not present within the site boundaries as the site has been significantly altered and degraded from its original state. A dense coverage of exotic grasses is prohibiting growth of native vegetation. Further decreasing the chances of the species being present within the site boundaries. Additionally, targeted surveys were conducted during ideal flowering time of year and conditions. The species was not recorded during site surveys and no recording on Bionet within 10 Km radius. Species is not present and is unlikely to be present on the subject land. No further assessment required.
Fauna				
Chalinolobus dwyeri	Large-eared Pied Bat	Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.	No	There is a low likelihood of occurrence for the species. Previously recorded sightings on Bionet atlas have been sighted within 10km's of the site, However, these tend to be located to the west of the 10km buffer within closer proximity to the Nepean River where it is likely the main location of

				caves and roosts occur. The site presents marginal habitat for the species in the form of foraging opportunities from eucalyptus and other flowering natives. Whilst no hollows recorded on site. Species utilise cracks and caves in cliff faces for roosting habitat. These features are unlikely to exist within 2km of the site. Species not recorded during site survey. No further assessment required.
Lathamus discolor	Swift Parrot	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta,* Spotted Gum *Corymbia maculata,* Red Bloodwood *C. gummifera,* Mugga Ironbark *E. sideroxylon,* and White Box ˆ. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*. Return to home foraging sites on a cyclic basis depending on food availability.	Foraging – Yes Breeding - No	There is a moderate likelihood of occurrence. It is expected that the species may use the site for foraging and thus the species was retained as a Predicted threatened species (Ecosystem credits) in the BAM-C. The site presents marginal foraging habitat for the species in the form of canopy vegetation. The development site does not contain areas of important breeding habitat for the species, as per the DPIE BV map. Habitat constraints in BAM-C are based on this BV map and as such, Habitat

				constraints are N/A. Species not recorded during site survey. No further assessment or consideration is required.
Miniopterus australis	Little Bent-winged Bat	Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats (*M. schreibersii*) and appears to depend on the large colony to provide the high temperatures needed to rear its young.	Foraging – Yes Breeding - No	There is a moderate likelihood of occurrence. It is expected that the species may use the site for foraging and thus the species was retained as a Predicted threatened species (Ecosystem credits) in the BAM-C. The site presents foraging habitat for the species. The development site would not be considered breeding habitat for the species. The impact area lacks key Habitat constraints including; Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding, as per the BAM-C. No further assessment or consideration is required.
Miniopterus orianae oceanensis	Large Bent-winged Bat	Primarily roosts in caves but will utilise mine shafts, storm-water tunnels, buildings and other man-made structures. Forms colonies within a maternity cave and disperse within a 300km range. Forage in forested areas in the tree canopy.	Foraging – Yes Breeding - No	There is a moderate likelihood of occurrence. It is expected that the species may use the site for foraging and thus the species was retained as a Predicted threatened species (Ecosystem credits) in the BAM-C. The

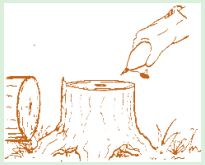
				site presents foraging habitat for the species. The development site would not be considered breeding habitat for the species. The impact area lacks key Habitat constraints including; Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding, as per the BAM-C. No further assessment or consideration is required.
Anthochaera phrygia	Regent Honeyeater	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. This species has been seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests.	Foraging – Yes Breeding - No	There is a moderate likelihood of occurrence. It is expected that the species may use the site for foraging and thus the species was retained as a Predicted threatened species (Ecosystem credits) in the BAM-C. The site presents marginal foraging habitat for the species in the form of canopy vegetation. The development site does not contain areas of important breeding habitat for the species, as per the DPIE BV map. Habitat constraints in BAM-C are based on this BV map and as such, Habitat constraints are N/A. Species not recorded during site survey. No further

				assessment or consideration is required.

12.2 Appendix II– Key Weed Removal Methods

Physical removal

Technique	Method	Equipment
Hand Removal 	Seedlings and smaller weed species where appropriate will be pulled out by hand, without risk of injury to workers. The size that this can occur varies throughout the treatment area. Generally, it ranges from post seed to approximately 300mm in height. Rolling and raking is suitable for larger infestations of Wandering Jew. The weed can be raked and stems and plants parts rolled. The clump of weed material can then be bagged and removed from site.	Tools: Gloves, Rakes, Knife and Weed Bags
Crowning 	Plants that possess rhizomes or bulbs might not respond to various removal techniques and may need to be treated with crowning. A knife, mattock or trowel is to be driven into the soil surrounding the bulb or rhizome at an angle of approximately 45 degrees with surrounding soil, so as to cut any roots that may be running off. This is to occur in 360 degrees around the bulb/rhizome. The rhizome or bulb is to be bagged and removed from the site and disposed of at an appropriate waste recycling facility Soil disturbance is to be kept to a minimum when using this technique.	Tools: Knife, mattock, trowel, impervious gloves, and all other required P.P.E.
Cut and Paint Stems 	Weed species deemed unsuitable for hand removal shall be cut. Those that have persistent of vigorous growth will be cut and painted with Roundup® Biactive Herbicide or equivalent. Juvenile and smaller weed species will be cut with secateurs at base of plant, and herbicide applied via applicator bottle. Stem to be cut horizontally as close to the ground as possible, using secateurs, loppers or a pruning saw. Horizontal cuts to be made on top of stem to prevent the herbicide running off the stump. Apply herbicide to the cut stem immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Herbicide is not to reach sediment or surrounding non-targeting plants.	Tools: loppers, secateurs, pruning saw, herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide and all other required P.P.E.

Technique	Method	Equipment
Scrape and Painting 	More resilient weed species, where other techniques are less reliable are to be scraped with a knife or chisel and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current herbicide license. Weed species will be scraped with a knife or chisel up the length of the trunk, and herbicide applied via applicator bottle. Scrape the trunk from as close to the ground as possible to approximately ¾ of the plants height. Where trunk diameters exceed approximately 5 cm a second scrape shall be made on the other side of the trunk. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants. Follow up treatment may be required. If plants resprout, scrape and paint the shoots using the same method after sufficient regrowth has occurred.	Tools: knife, chisel, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.
Cut with a Chainsaw and Paint 	Larger size weed species, too large for cutting with hand tools, shall be cut with a chainsaw and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current chainsaw and herbicide license. Larger weed species will be cut with a chainsaw at base of plant, and herbicide applied via applicator bottle. Cut the stem horizontally as close to the ground as possible, using the chainsaw. Remove upper branches to reduce bulk of plant. If cutting at the base is impractical, cut higher to get rid of the bulk of the weed, then cut again at the base and apply herbicide. Make cuts horizontal to prevent the herbicide running off the stump. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Ensure there is no runoff of poison. All care must be taken by the contractor not to spill herbicide into water, onto sediment, or surrounding non-targeting plants. Follow up treatment will be required. If plants resprout, cut and paint the shoots using the same method.	Tools: chainsaw, ear muffs, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.

Technique	Method	Equipment
Spot Spraying	Spot spraying involves spraying non-seeding annuals and grasses, and for regrowth of weeds once an area has been cleared or brushcut. Works to be carried out by a contractor with a current herbicide license. Herbicide will be mixed up according to the manufacturer's directions for the particular weed species being targeted. Mixed herbicide shall be applied to the targeted weed species with a backpack sprayer. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants.	Tools: protective clothing, safety glasses, herbicide sprayer, impervious gloves, Herbicide, and all other required P.P.E.

Flame Weeding

Thermal (flame) weeding is a method where high temperatures are applied to weeds, causing the plant to die. Thermal weeding is particularly useful in situations where conservation or health considerations are high and weed density is low such as waterways where herbicide use is not permitted.
While flame weeding is not suited to most streetscapes due to the fire hazard nor can it be used on materials such as soft fall and similar playground equipment it is noted that 'flame' weeding in waterways allows weed management in areas where herbicides are not permitted.
Also for native vegetation areas thermal weeding, with a flame weeder, has been shown to stimulate germination of native plants while killing the seeds of annual weeds such as Devils Pitchfork, *Bidens pilosa*. Flame weeding is also effective in killing persistent weeds like
Mother of Millions.
Best results are obtained when follow up weed control is undertaken 4-6 weeks after treatment. In addition, weed control should be conducted periodically after that for example to control weeds over a period of a year it is likely that between 3-5 applications will be necessary, depending on rainfall and the extent of the weed seed bank. This method is most effective on young annual weeds and least effective on older perennial weeds. In some cases, control of perennial weeds will be ineffective however this depends on the species present and its age.

Images provided by Dragonfly Environmental

Flame weeding should be undertaken outside of the fire seasons. Flame weeding allows for the mimicking of a burn in areas where a control burn could not be undertaken. See native plants regenerating after flame weeding.

12.3 Appendix III– Bushland Hygiene Protocols for Phytophthora (Hornsby Council Recommendations)

- Always assume that the area you are about to work in is free of the disease and therefore needs to be protected against infection.
- And, always assume that the activity you are about to undertake has the potential to introduce the disease.
- Arrive at site with clean shoes, i.e.: no dirt encrusted on them.
- If you arrive with shoes that are encrusted with dirt, they will have to be completely soaked in metho or disinfectant and allow a few minutes to completely soak in. NEVER scrape untreated dirt off your shoes onto the ground.
- Before you move onto the site spray the bottom of your shoes with 70 % metho. Bleach solution (1% strength) or household/commercial disinfectant (as per label) are also suitable.
- Check all tools and equipment that comes in contact with soil are clean before entering the area (they should have been cleaned on site at the end of the previous work session). If there is any dirt on them, spray them with 70% metho.
- Clean all tools at the end of each work session while still on site ensuring this is done away from drainage lines and adjacent work areas. Knock or brush off encrusted dirt and completely spray with 70 % metho. Replace in storage/transport containers.
- Preferably compost all weed material on site.
- Never drag vegetation with exposed roots and soil through bushland.
- When removing weeds from site, remove as much soil as possible from them in the immediate work area and carefully place vegetative material into plastic bags.
- Try not to get the bag itself dirty; don't put it on/in a muddy area.
- Always work from the lower part of a slope to the upper part.
- Always work in areas known to be free of the pathogen before working in infected areas.
- Minimise activities wherever possible when the soil is very wet.
- Vehicles should not be driven off track or into reserves (unless vehicle decontamination is carried out before and after entering a single work site)
- Only accredited supplies of plants/mulch to be used.

Kit should contain: 1 bucket, 1 scrubbing brush, 1 spray bottle (metho 70% solution), 1 bottle tap water, 1 bottle methylated spirits.

Contact Hornsby Bushcare if you require any refills or replacements of your Phytophthora Kits on 9484 3677 or bushcare@hornsby.nsw.gov.au

Facts about Phytophthora

Phytophthora cinnamomi (Phytophthora) is a microscopic, soil borne, water-mould that has been implicated in the death of remnant trees and other plants in Australian bushland. Phytophthora is not native to Australia. It is believed to have been introduced sometime after European settlement. Phytophthora is a national problem and is listed as a key threatening process under the Commonwealth's Environmental Protection and Biodiversity Conservation Act 1999.

Symptoms including Dieback

"Dieback" simply means dying or dead plants. There are many causes of dieback; Phytophthora is just one of them. Often dieback is the result of a combination of factors such as; changed drainage patterns and nutrient loads (e.g.: increased stormwater run-off) or changed soil conditions (e.g.: dumped fill or excavation of/near root zone). Plants that are stressed are more vulnerable to Phytophthora.

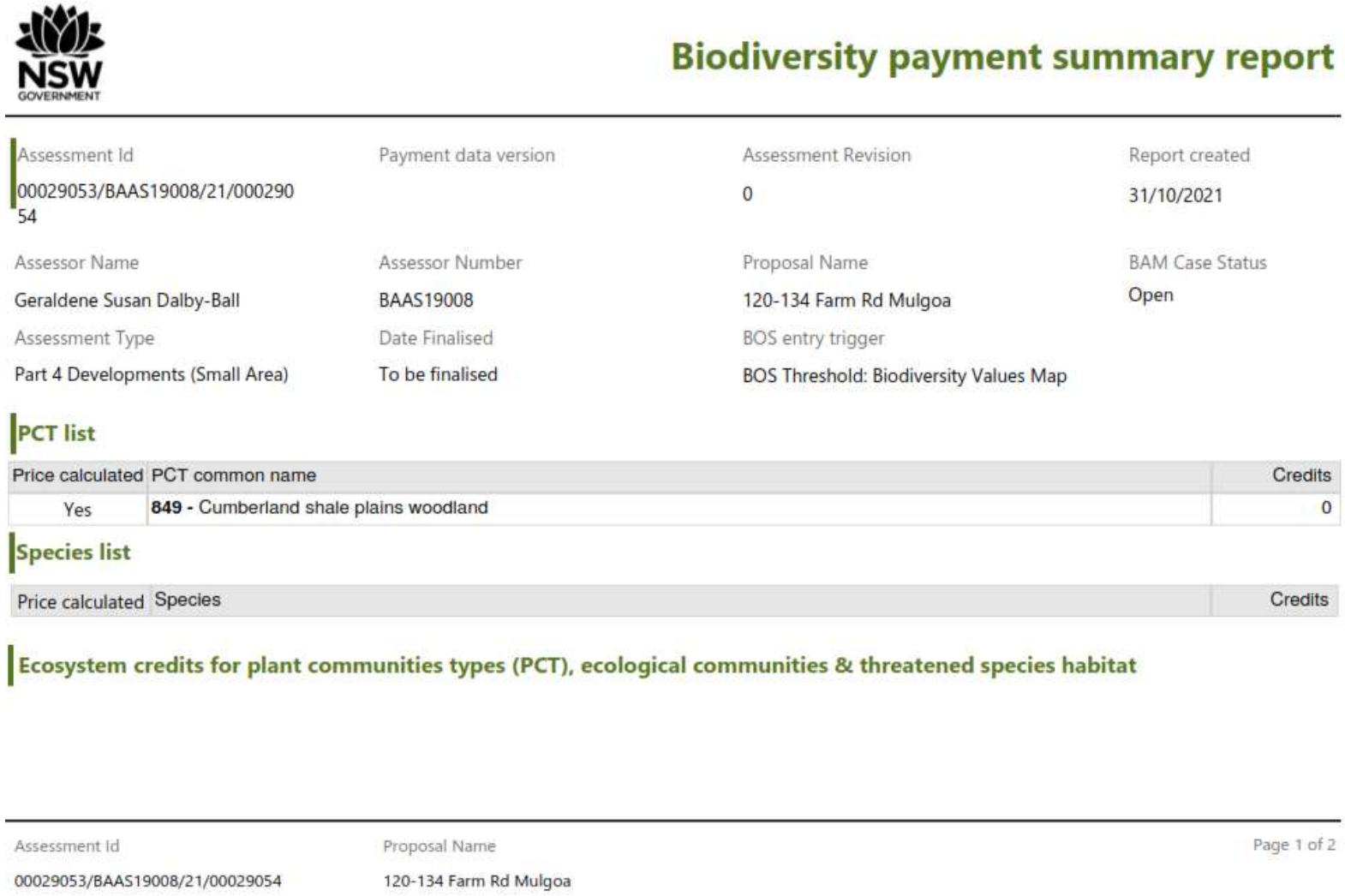
Initial symptoms of Phytophthora include; wilting, yellowing and retention of dried foliage, loss of canopy and dieback. Infected roots blacken and rot and are therefore unable to take-up water and nutrients. Severely infected plants will eventually die. Symptoms can be more obvious in summer when plants may be stressed by drought. If you suspect that Phytophthora is on your site, please contact the Bushcare team to collect a soil sample to be lab tested. This is usually done in the warmer months where conditions are optimum for the disease.

Infection

There is no way of visually telling if Phytophthora is present in the soil as its structures and spores are microscopic (invisible to the naked eye). Phytophthora requires moist soil conditions and warm temperatures for infection, growth and reproduction. Spores travel through moist soil and attach to plant roots. Once Phytophthora has infected a host plant it can grow inside plant root tissue independent of external soil moisture conditions. After infection, Phytophthora grows through the root destroying the tissue which is then unable to absorb water and nutrients.

12.4 Appendix IV– BAM –C; Reports and Data

12.4.1 Payment Report.



NSW GOVERNMENT

Biodiversity payment summary report

Assessment Id	Payment data version	Assessment Revision	Report created
00029053/BAAS19008/21/00029054		0	31/10/2021

Assessor Name	Assessor Number	Proposal Name	BAM Case Status
Geraldene Susan Dalby-Ball	BAAS19008	120-134 Farm Rd Mulgoa	Open

Assessment Type	Date Finalised	BOS entry trigger
Part 4 Developments (Small Area)	To be finalised	BOS Threshold: Biodiversity Values Map

PCT list

Price calculated	PCT common name	Credits
Yes	**849** - Cumberland shale plains woodland	0

Species list

Price calculated	Species	Credits

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

Assessment Id	Proposal Name	Page 1 of 2
00029053/BAAS19008/21/00029054	120-134 Farm Rd Mulgoa	

NSW GOVERNMENT

Biodiversity payment summary report

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Cumberland	**849** - Cumberland shale plains woodland	Yes	Cumberland Plain Woodland in the Sydney Basin Bioregion	18.83%	$ 1,097.37	1.6350	$ 33,697.42	0	$0.00

Subtotal (excl. GST)	**$0.00**
GST	**$0.00**
Total ecosystem credits (incl. GST)	**$0.00**

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

No species available

Grand total	**Contact BCT for pricing**

Assessment Id: 00029053/BAAS19008/21/00029054

Proposal Name: 120-134 Farm Rd Mulgoa

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12.4.2 Credit Summary Report.

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00029053/BAAS19008/21/00029054	120-134 Farm Rd Mulgoa	10/06/2021
Assessor Name	Report Created	BAM Data version *
Geraldene Susan Dalby-Ball	31/10/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS19008	Open	To be finalised
Assessment Revision	Assessment Type	BOS entry trigger
0	Part 4 Developments (Small Area)	BOS Threshold: Biodiversity Values Map

* 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.

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

NSW GOVERNMENT

BAM Credit Summary Report

Cumberland shale plains woodland											
1	849_Poor	Cumberland Plain Woodland in the Sydney Basin Bioregion	2.4	2.4	0.29	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	0
										Subtotal	**0**
										Total	**0**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

Assessment Id
00029053/BAAS19008/21/00029054

Proposal Name
120-134 Farm Rd Mulgoa

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12.4.3 Predicted species report.

NSW GOVERNMENT

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00029053/BAAS19008/21/00029054	120-134 Farm Rd Mulgoa	10/06/2021
Assessor Name	**Report Created**	**BAM Data version ***
Geraldene Susan Dalby-Ball	31/10/2021	45
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS19008	Part 4 Developments (Small Area)	Open
Assessment Revision	**BOS entry trigger**	**Date Finalised**
0	BOS Threshold: Biodiversity Values Map	To be finalised

* 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.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	849-Cumberland shale plains woodland
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	849-Cumberland shale plains woodland
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	849-Cumberland shale plains woodland
Diamond Firetail	Stagonopleura guttata	849-Cumberland shale plains woodland
Dusky Woodswallow	Artamus cyanopterus cyanopterus	849-Cumberland shale plains woodland
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	849-Cumberland shale plains woodland
Eastern False Pipistrelle	Falsistrellus tasmaniensis	849-Cumberland shale plains woodland
Flame Robin	Petroica phoenicea	849-Cumberland shale plains woodland
Gang-gang Cockatoo	Callocephalon fimbriatum	849-Cumberland shale plains woodland
Greater Broad-nosed Bat	Scoteanax rueppellii	849-Cumberland shale plains woodland

NSW GOVERNMENT

BAM Predicted Species Report

Grey-headed Flying-fox	Pteropus poliocephalus	849-Cumberland shale plains woodland
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	849-Cumberland shale plains woodland
Koala	Phascolarctos cinereus	849-Cumberland shale plains woodland
Large Bent-winged Bat	Miniopterus orianae oceanensis	849-Cumberland shale plains woodland
Little Bent-winged Bat	Miniopterus australis	849-Cumberland shale plains woodland
Little Eagle	Hieraaetus morphnoides	849-Cumberland shale plains woodland
Little Lorikeet	Glossopsitta pusilla	849-Cumberland shale plains woodland
Masked Owl	Tyto novaehollandiae	849-Cumberland shale plains woodland
Painted Honeyeater	Grantiella picta	849-Cumberland shale plains woodland
Powerful Owl	Ninox strenua	849-Cumberland shale plains woodland
Regent Honeyeater	Anthochaera phrygia	849-Cumberland shale plains woodland
Scarlet Robin	Petroica boodang	849-Cumberland shale plains woodland
Speckled Warbler	Chthonicola sagittata	849-Cumberland shale plains woodland
Spotted Harrier	Circus assimilis	849-Cumberland shale plains woodland
Spotted-tailed Quoll	Dasyurus maculatus	849-Cumberland shale plains woodland
Square-tailed Kite	Lophoictinia isura	849-Cumberland shale plains woodland
Swift Parrot	Lathamus discolor	849-Cumberland shale plains woodland
Turquoise Parrot	Neophema pulchella	849-Cumberland shale plains woodland
Varied Sittella	Daphoenositta chrysoptera	849-Cumberland shale plains woodland
White-bellied Sea-Eagle	Haliaeetus leucogaster	849-Cumberland shale plains woodland
White-throated Needletail	Hirundapus caudacutus	849-Cumberland shale plains woodland
Yellow-bellied Glider	Petaurus australis	849-Cumberland shale plains woodland
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	849-Cumberland shale plains woodland

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Assessment Id	Proposal Name	Page 2 of 3
00029053/BAAS19008/21/00029054	120-134 Farm Rd Mulgoa	

NSW GOVERNMENT

BAM Predicted Species Report

Common Name	Scientific Name	Justification in the BAM-C

12.4.4 Candidate species report

NSW GOVERNMENT

BAM Candidate Species Report

Proposal Details

Assessment Id 00029053/BAAS19008/21/00029054	Proposal Name 120-134 Farm Rd Mulgoa	BAM data last updated * 10/06/2021
Assessor Name Geraldene Susan Dalby-Ball	Report Created 31/10/2021	BAM Data version * 45
Assessor Number BAAS19008	Assessment Type Part 4 Developments (Small Area)	BAM Case Status Open
Assessment Revision 0	Date Finalised To be finalised	BOS entry trigger BOS Threshold: Biodiversity Values Map

* 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.

List of Species Requiring Survey

Name	Presence	Survey Months
Caladenia tessellata Thick Lip Spider Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat degraded Habitat constraints
Large-eared Pied Bat	Chalinolobus dwyeri	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Habitat degraded Habitat constraints
Regent Honeyeater	Anthochaera phrygia	Habitat degraded
Swift Parrot	Lathamus discolor	Habitat degraded Habitat constraints

12.4.5 Biodiversity Credit Report (Like for Like)

NSW GOVERNMENT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00029053/BAAS19008/21/00029054	Proposal Name 120-134 Farm Rd Mulgoa	BAM data last updated * 10/06/2021
Assessor Name Geraldene Susan Dalby-Ball	Assessor Number BAAS19008	BAM Data version * 45
Proponent Names	Report Created 31/10/2021	BAM Case Status Open
Assessment Revision 0	Assessment Type Part 4 Developments (Small Area)	Date Finalised To be finalised
BOS entry trigger BOS Threshold: Biodiversity Values Map	* 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.	

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland
Species		
Nil		

Additional Information for Approval

BAM Biodiversity Credit Report (Like for like)

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.3	0	0	0

849-Cumberland shale plains woodland

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	849_Poor	No	0	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

NSW GOVERNMENT

BAM Biodiversity Credit Report (Like for like)

Species Credit Summary

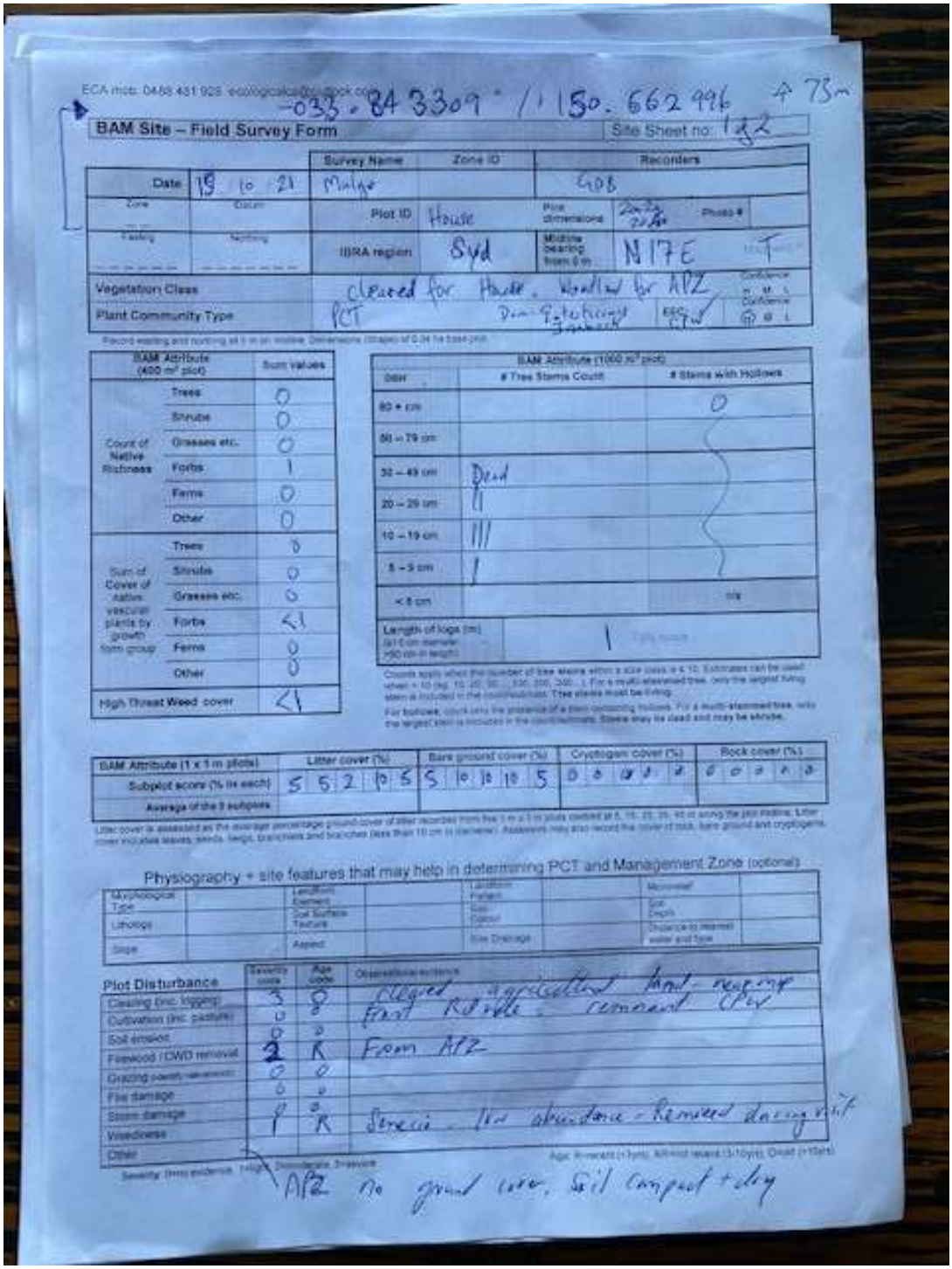
Species	Vegetation Zone/s	Area / Count	Credits
Chalinolobus dwyeri / Large-eared Pied Bat	**849_Poor**	0.3	1.00

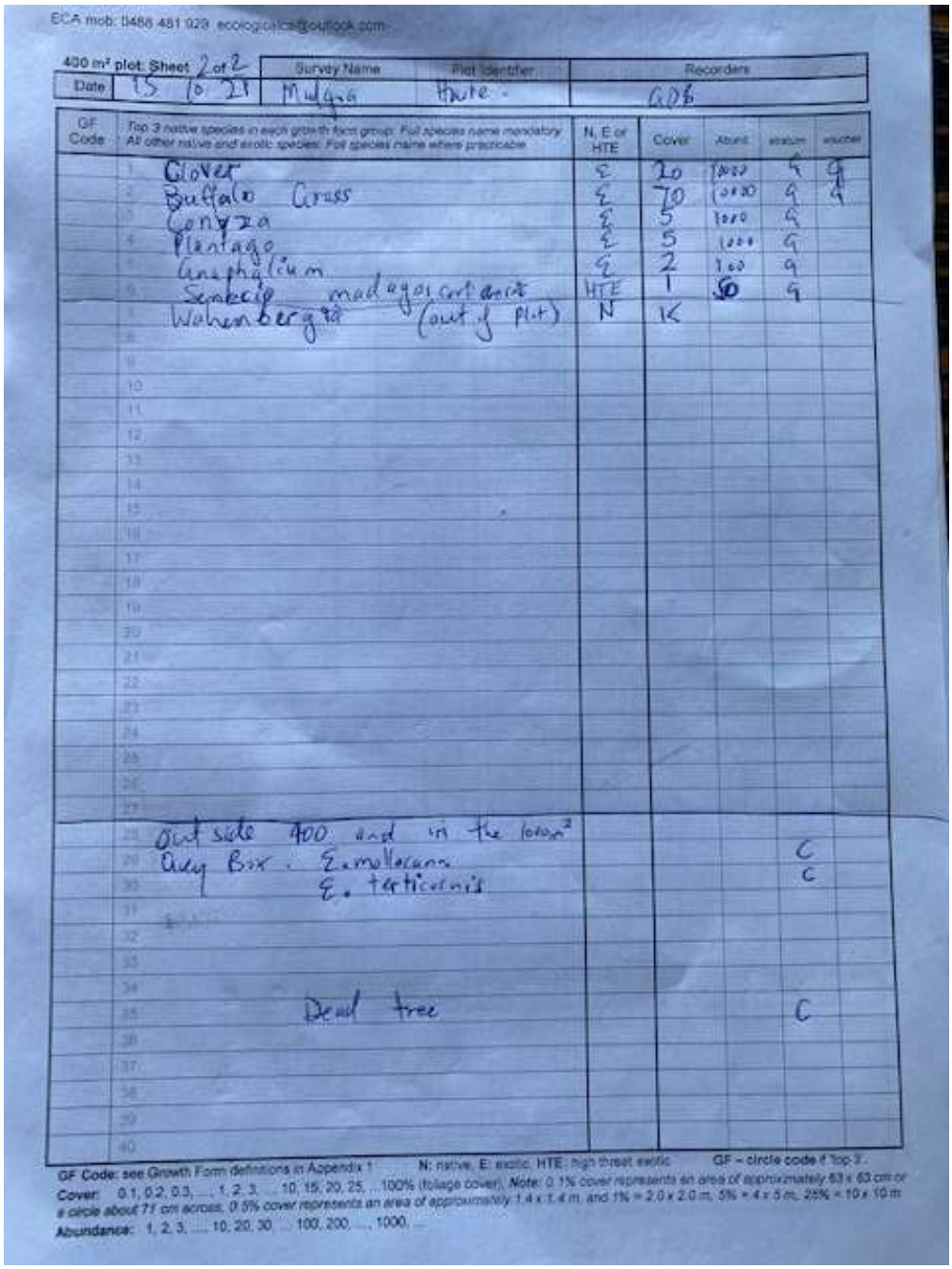
Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Chalinolobus dwyeri / Large-eared Pied Bat	**Chalinolobus dwyeri** / Large-eared Pied Bat	Any in NSW

12.4.6 Data sheets





Species	Native / Exotic	Growth code	Cover	Abund
Clover	Exotic	n/a	20	10000
Bouteloua dactyloides (Buffalo Grass)	Exotic	n/a	70	10000
Conyza	Exotic	n/a	5	1000
Plantago lanceolata	Exotic	n/a	5	1000
Gnaphalium (Cudweed)	Exotic	n/a	2	100
Senecio madagascariensis	HTE	n/a	1	50
Wahlenbergia spp.	*Native* *(Outside Plot)*	n/a	n/a	n/a
E. mollucana	*Native* *(Outside Plot)*	n/a	n/a	n/a

E. teriticornis	*Native* *(Outside Plot)	n/a	n/a	n/a

Code	Sum Value	Cover
Tree	0	0
Shrub	0	0
Grass	0	0
Forb	0	0
Fern	0	0
Other	0	0
HTW	1	<1%

13 Expertise of authors

Geraldene Dalby-Ball
DIRECTOR

With over 20 years wetland and urban ecology experience, a great passion for what she does, and extensive technical and on-ground knowledge make Geraldene a valuable contribution to any project.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference, Sydney CMA and Hawkesbury Nepean forums. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Geraldene was a key contributor to the recent set of Guidelines commissioned by South East Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to many community and professional workshops on ecological matters particularly relating to environmental management. She is an excellent Project Manager.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013). Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Urban waterway management – assessing, designing and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.
- **Practicing member and vice president** Ecological Consultants Association of NSW

Luke Johnson

ECOLOGIST

Luke is a passionate ecologist who has experience across both the government and private sectors to deliver sustainable environmental outcomes. He has contributed to projects with major construction contractors and has been able to deliver creative environmental solutions on time and within budget.

Luke's passion for fauna was discovered though volunteer work handling microbats in Victoria. Those skills have been honed through the work with ECA as a fauna spotter during vegetation clearing activities in NSW.

As an undergraduate student, he interned with the Bureau of Meteorology to conduct research identifying traditional ecological knowledge of severe weather events in communities in the Pacific.

He has exceptional customer communication skills and builds long lasting professional relationships with his clients. He has a working knowledge of current NSW and Commonwealth environmental legislation. He is also competent in the practical application of flora and fauna surveying and monitoring techniques.

Key Projects Include:

- Monitoring of Endangered Species, various locations of NSW and VIC
- Fauna spotter during vegetation clearing
- Conducted environmental impact assessments for state infrastructure projects and Department of Defence
- Passion for traditional ecological knowledge including researching for the Bureau of Meteorology's COSPAC program

SPECIALISATIONS

- Urban and landscape ecology
- Environmental Impact Assessments (EIA)
- Flora and Fauna Assessments
- Habitat tree assessment, marking and mapping
- GIS mapping
- Fauna spotting

CAREER SUMMARY

- **Ecologist**, Ecological Consultants Australia. *2020-present*
- **Environmental Consultant,** Hibbs & Associates. *2019-2020*
- **Field Ecologist,** Biosis 2018-2019
- **Volunteer,** Microbat box monitoring and handling including assisting in tagging

QUALIFICATIONS AND MEMBERSHIPS

- Bachelor of Environmental Management and Ecology, Victoria University
- First aid certificate
- Asbestos awareness training
- WHS General Induction of Construction Industry NSW White Card