



Appendix F. Biodiversity development assessment report

Shoalhaven Hydro Expansion Project - Main Works Environmental Impact Statement

SSI-10033

Origin Energy Eraring Pty Ltd

November 2022

Shoalhaven Hydro Expansion Project - Main Works

Biodiversity development assessment report

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Origin Energy Eraring Pty Ltd

November 2022

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Jacobs Group (Australia) Pty Limited
Level 7, 177 Pacific Highway
North Sydney, NSW 2060
PO Box 632
North Sydney, NSW 2059
Australia

T +61 2 9928 2100
F +61 2 9928 2444
www.jacobs.com

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Certification under Section 6.15 of the *Biodiversity Conservation Act 2016*

I, Matthew Consterdine (BAAS20027) certify that this Biodiversity Development Assessment Report and the accompanying finalised credit report dated 7 November 2022 has been prepared in accordance with the requirements of (and information provided under) the Biodiversity Assessment Method.



Matt Consterdine – BAAS20027

7 November 2022

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Appendix A. Habitat Assessment

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A.1.1 Greater Glider (*Petauroides volans*)

A.1.2 Littlejohn's Tree Frog (*Litoria littlejohni*) (and *Litoria watsoni*)

A.1.3 Bauer's Midge Orchid (*Genoplesium baueri*)

Appendix D. Biodiversity credit report

Appendix E. Protected Matters Search Tool report

Appendix F. BDAR requirements compliance

Glossary of terms

Term	Definition
Biodiversity Assessment Method (BAM)	The Biodiversity Assessment Method (BAM) is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites and stewardship sites. It is a scientific document that provides: <ul style="list-style-type: none"> A consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site Guidance on how a proponent can avoid and minimise potential biodiversity impacts The number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.
Biodiversity credits	Ecosystem credits or species credits.
Biodiversity credit report	The report produced by the BAM Calculator (BAM-C) that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development.
Biodiversity Offsets Scheme	The framework for offsetting unavoidable impacts on biodiversity from development with biodiversity gains through landholder stewardship agreements.
Biodiversity Offset Strategy	A strategy for offsetting residual impacts associated with a development.
BAM Credit Calculator (BAM-C)	The computer program that provides decision support to assessors and proponents by applying the BAM, which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Bioregion	Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to the project Secretary's Environmental Assessment Requirements (SEARs) for cumulative impact assessment requirements.
Development site	The development site encompasses the extent of physical disturbance likely to be required to accommodate the construction and operation of the new pumped hydro power station. For the purpose of this assessment, the development site carries the same meaning as the 'development site' and 'subject land', as defined by the BAM. This is the same as the Project area in the environmental impact assessment (EIS)
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance and loss of habitat for a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development.
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique location. Ecological communities can be listed as threatened under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) and/or New South Wales <i>Biodiversity Conservation Act 2016</i> (BC Act).
Ecosystem credit	A measurement of the value of Threatened Ecological Communities (TECs) and threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type (PCT). Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	Threatened species that can be reliably predicted to occur with a PCT, for which species-specific biodiversity credits are not required.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by ecological community, including any biotic or abiotic component.

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Term	Definition
Indirect impact	<p>An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact.</p> <ul style="list-style-type: none"> Compared to direct impacts, indirect impacts often: <ul style="list-style-type: none"> occur over a wider area than just the site of the development have a lower intensity of impact in the extent to which they occur compared to direct impacts occur off site have a lower predictability of when the impact occurs have unclear boundaries of responsibility.
Locality	This is defined as the area within a 10-kilometre (km) radius surrounding the development site.
Local population	The population that occurs in the development site. In cases where multiple populations occur in the development site and/or a population occupies part of the development site, impacts on the entirety of each population must be assessed separately.
Matters of National Environmental Significance (MNES)	Matters of National Environmental Significance (MNES) are protected by a provision of Part 3 under the EPBC Act.
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils, and broad vegetation types, mapped at a scale of 1:250,000.
Patch	A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land. The patch may extend onto adjoining land beyond the development site of the subject land, and for woody ecosystems, includes native vegetation separated by ≤100 metres (m) from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to ≤30 m.
Plant community type	A NSW PCT identified using the plant community type (PCT) classification system. The PCT classification was created in 2011 by consolidating two existing community-level classifications: the NSW Vegetation Classification and Assessment database; and the Biometric Vegetation Types database used in NSW regulatory programs. The PCT classification is now maintained in the BioNet Vegetation Classification application. It is a way to classify vegetation types.
Population	A group of organisms, all of the same species, occupying a particular area.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection (BDC).
Species credit species	Threatened species that are assessed according to section 6.4 of the BAM which may generate species-specific biodiversity credit requirements.
Assessment area	The assessment area includes a 50-metre buffer surrounding the development site that may be subject to indirect impacts. This area represents the limits of where disturbance may occur during construction to allow for flexibility for the final siting of project infrastructure. Final siting of the infrastructure (the development site) can move within the assessed assessment area subject to recommended environmental management measures and provided it does not exceed the limits defined by the assessment area.
Target species	A species that is the focus of a project or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection	Part of the BioNet database, accessible from the BioNet website at www.bionet.nsw.gov.au .
Threatened species	A species listed under the BC Act, <i>Fisheries Management Act 1994</i> (FM Act) or EPBC Act.
Threatened ecological community	A community of different species associated with one another and sharing the same habitat, that is listed under the BC Act, FM Act and EPBC Act. TECs are listed as endangered or critically endangered under the BC Act, or may be listed as vulnerable, endangered or critically endangered under the EPBC Act.

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Term	Definition
500-metre landscape buffer	This is an area that includes a 500-metre landscape buffer surrounding the development site and encompasses the assessment area. The 500-metre landscape buffer is an assessment area used to identify landscape features surrounding the development site to provide site context and to inform the likely habitat suitability of the development site

Abbreviations

Abbreviation	Definition
AOBV	Areas of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BAM-C	BAM Calculator
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Strategy
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and the Environment
DEWHA	Department of the Environment, Water, Heritage and the Arts
DoE	Department of Environment
DoEE	Department of the Environment and Energy
DPE	Department of Planning and Environment (NSW)
DPIE	Department of Planning, Industry and Environment (NSW)
DPI	Department of Primary Industries (NSW)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
EESG	Environment, Energy and Science Group (NSW DPE)
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
HBT	Hollow Bearing Tree
IBRA	Interim Biogeographic Regionalisation for Australia
KFH	Key Fish Habitat
MNES	Matters of National Environmental Significance
REF	Review of Environmental Factors
OEH	Office of Environment and Heritage (replaced by EESG)
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
sp.	Species (singular)
spp.	Species (plural)
SSD	State Significant Development
subsp.	Subspecies
TBDC	Threatened Biodiversity Data Collection (BioNet)
TECs	Threatened Ecological Communities
VIS	Vegetation Information System (BioNet Vegetation Classification)

Executive Summary

Origin is seeking approval under Part 5 Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of the Shoalhaven Hydro Expansion Project (the project). The project has been declared State Significant Infrastructure (SSI) under State Environmental Planning Policy (State and Regional Development) 2011. The project will involve construction and operation a new pumped hydro power station on and under the land between the Fitzroy Falls Reservoir and Lake Yarrunga (the project). The project would draw on Origin's existing water allocations to pump water up from Lake Yarrunga consuming energy when it is in less demand. Energy would then be generated through the return of water from Fitzroy Falls Reservoir to Lake Yarrunga when demand for energy increases.

The NSW Biodiversity Offsets Scheme applies to SSI projects unless the Secretary of the Department of Planning and Environment (DPE) and the Chief Executive of Environment, Energy and Science Group (EESG) determine that the project is not likely to have a significant impact. This document is the Biodiversity Development Assessment Report (BDAR) for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the methods and results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR addresses Stage 1 and Stage 2 of the BAM (DPIE, 2020).

The project is located in the NSW Southern Highlands, approximately 150km south-east of Sydney. The project would be predominantly located within the Shoalhaven Local Government Area with access and water for the scheme drawn from and returned to the existing Fitzroy Falls canal and reservoir located within the Wingecarribee Local Government Area. The project's surface works would be largely limited to land owned by WaterNSW associated with the existing Kangaroo Valley and Bendeela Power Stations and water transfer operations. WaterNSW land includes land either side of the existing surface penstock and surge tank at the top of the plateau and land between Jacks Corner Road and Bendeela pondage. Access to the Fitzroy Falls Canal control structure, surface penstock, surge tank and vertical shaft on the plateau during construction would be required via upgrade of existing access tracks through Morton National Park. The surface penstock from the upper intake structure (i.e. the existing Fitzroy Falls intake structure) to the surge tank will run parallel to the existing KV surface penstock for a distance of 2000 metres.

Landscape

The project occupies a landscape that was previously disturbed and modified for construction of the original Shoalhaven hydro scheme in the early 1970s. The site is located within the Sydney Basin Bioregion and traverses three IBRA subregions; Ettrema, Illawarra and Moss Vale. The upper sections of the scheme are located on a steep plateau (c. 600 m asl) partially adjoining Morton National Park, while the lower sections of the scheme are in Kangaroo Valley around 100 m asl. The northern end of the Shoalhaven hydro expansion project on the plateau is accessed through and surrounded by Morton National Park. The existing 'Promised Land Trail' enters Morton National Park from near the end of the Fitzroy Canal and was the original access developed for the existing scheme.

Areas of geological significance have been identified within landscape buffer, however none will be directly impacted by the project. No areas of land that the Minister for Energy and Environment has declared as an area of outstanding biodiversity value in accordance with Section 3.1 of the *Biodiversity Conservation Act 2016* (BC Act) will be affected. There is approximately 911 ha of native vegetation (woody and non-woody vegetation) within a 500 m landscape buffer (total area of 1,046 ha) surrounding the assessment area, equating to a percent native vegetation cover in the landscape of 87%.

Assessment Methods

Extensive ecological surveys have been undertaken for this BDAR between 2019 and 2022 in accordance with the BAM including:

- Preliminary site visits and mapping
- Identification and detailed mapping of plant community types (PCTs) involving:
 - Stratification of PCTs in survey units (vegetation zones)
 - Plot based floristic vegetation survey and vegetation integrity assessment
- Threatened species habitat assessment

- Targeted threatened species surveys, including:
 - Parallel transects undertaken across suitable habitats within the assessment area for threatened flora species within prescribed survey periods (seasons)
 - Targeted fauna survey methods were employed including live trapping, baited remote sensor camera traps, call broadcasting, ultrasonic call recording (bats), spotlighting, timed area searches, nest tree survey and stagwatching.

Native vegetation and habitats

Seven Plant Community Types (PCTs) were identified within the disturbance area each in varied condition:

- PCT 1254: Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
- PCT 1156: Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion
- PCT 1082: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1283: Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion
- PCT 1245: Illawarra Escarpment Blue Gum Wet Forest
- PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion
- PCT 1108: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion.

PCT 1245 corresponds with a threatened ecological community listed as Endangered under the BC Act referred to 'Southern Highland Shale Woodland of the Sydney Basin Bioregion' which is also listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. (EPBC Act) referred to as 'Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion'.

Threatened species

Two threatened plant species, *Rhodamnia rubescens* (Scrub Turpentine) and *Hibbertia puberula*, were identified from targeted surveys and one additional threatened flora species was assumed to be present, *Genoplesium baueri* (Bauer's Midge Orchid).

Fauna surveys identified the following threatened species:

- Birds: Gang-gang Cockatoo (*Callocephalon fimbriatum*), and Glossy Black-cockatoo (*Calyptorhynchus lathamii*)
- Non-flying mammals: Greater Glider (*Petauroides volans*) and Eastern Pygmy Possum (*Cercartetus nanus*)
- Flying mammals: Large-eared Pied Bat (*Chalinolobus dwyeri*) and Southern Myotis (*Myotis macropus*).

Other species credit fauna assumed to occur and included in the impact assessment include:

- Giant Burrowing Frog (*Heleioporus australiacus*), and Littlejohn's Tree Frog (*Litoria littlejohni*).

Biodiversity Impacts

Impact calculations have been split between the three IBRA subregions over which the project is situated (Moss Vale, Illawarra and Ettrema) for the purpose of determining separate offsetting requirements in the Biodiversity Assessment Method BAM-C (BAM-C).

The project infrastructure has been intentionally placed adjacent to the original scheme and access will be along previously cleared tracks, within minimal clearing of regrowth required to upgrade. Additionally, previously cleared land (with current regrowth) will be used for spoil stockpile, and a significant portion of the project will be placed underground and involve tunnelling. As such, the project will result in minimal clearing of native vegetation of up to 29.5 ha, of which 25% is regrowth vegetation previously disturbed. This is required to allow the construction of, and ongoing operational maintenance of the asset for the life of the project.

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- The development site layout has been frequently adjusted since the preliminary design stages in 2018 to account for biodiversity values identified during the survey program. Importantly, the impacts to Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion CEEC have been significantly reduced at the intersection of Promised Lands fire trail and Nowra/Moss Vale Rd (in the north of the development site). The original design for major clearing and lane-widening at this location (for truck access and laydowns) has been refined to only 0.23 hectares (ha) of vegetation impacts (along road edges).
- The project will remove areas of seven PCTs as described in **Table ES-1**.

Table ES-1. Vegetation integrity impacts according to PCTs, and number of ecosystem credits required

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	TEC	VI Score (= loss)	Biodiversity risk weighting	No. of ecosystem credits required
Moss Vale subregion							
MV-1	1254	0.23	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Yes	69.7	2	8
MV-2	1156	1.31	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	No	68.3	1.5	34
MV-3		2.20			56.1	1.5	46
MV-4		1.06			40	1.5	16
MV-5	1082	2.26	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	No	65.2	1.5	55
MV-6		4.29			57.9	1.5	93
Illawarra subregion							
ILL-1	1156	0.57	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	No	68.3	1.5	15
ILL-2		0.32			56.1	1.5	7
ILL-3		0.09			40	1.5	1
ILL-4	1082	0.004	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	No	57.9	1.5	1
ILL-5	1283	0.34	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	No	45.7	1.5	6
ILL-6		0.08			40	1.5	1
ILL-7		0.03			60.5	1.5	1
ILL-8	1245	1.41	Illawarra Escarpment Blue Gum Wet Forest		46.3	1.5	24
Ettrema subregion							
ETT-1	1283	2.19	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	No	45.7	1.5	38
ETT-2		0.02			40	1.5	1
ETT-3	1083	2.98	Red Bloodwood - scribbly gum heathy woodland on sandstone	No	75.2	1.5	84
ETT-4		3.59			46.7	1.5	63

Biodiversity development assessment report

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	TEC	VI Score (= loss)	Biodiversity risk weighting	No. of ecosystem credits required
ETT-5		2.82	plateau of the Sydney Basin Bioregion		38.2	1.5	40
ETT-6	1108	1.14	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion	No	74.3	1.75	37
ETT-7		2.54			22.2	1.75	25
Total credits							596

The project will involve the loss of habitat within the disturbance area for the following species credit species:

- *Rhodamnia rubescens* - 2 individuals
- *Hibbertia puberula* - 0.55 ha accounting for a 30 m buffer around the identified individuals
- *Genoplesium baueri* - 9.39 ha (based on associated PCTs)
- Gang-gang Cockatoo - 1.01 ha of breeding habitat based on potential nest trees (over the Moss Vale and Illawarra subregions)
- Giant Burrowing Frog - 25.79 ha (over the Moss Vale and Ettrema subregions)
- Littlejohn's Tree Frog - 12.1 ha (over the Moss Vale and Ettrema subregions)
- Eastern Pygmy-possum - 25.79 ha (over three subregions)
- Greater Glider - 12.33 ha (confined to the Moss Vale and Illawarra subregions)
- Southern Myotis - 9.69 ha (based on impacts to stream habitat)
- Large-eared Pied Bat - 0.87 ha (over the Moss Vale and Ettrema subregions).

The assessment area contains four main waterbodies, Kangaroo River and Bendeela Pondage in the valley and Fitzroy Canal and Trimbles Creek on the plateau. The NSW Department of Primary Industries Key Fish Habitat mapping indicates that Fitzroy Canal, Bendeela Pondage and Kangaroo River are categorized as Key Fish Habitat - of the southern rivers. Kings Creek (which occurs to the west of the valley portions of the assessment area) is also mapped as KFH (under the NSW Fisheries Management Act 1994). All such habitats are already affected by the existing hydro scheme and the proposed action (which expands on the existing infrastructure) will require a range of mitigation measures to prevent further impacts or habitat degradation.

Fitzroy Falls Spiny Crayfish (Critically endangered FM Act) has been historically recorded above and below the Fitzroy Falls Reservoir. The species is restricted to 12km of waterway of Wildes Meadow Creek NSW. An aquatic survey targeted at identifying the Fitzroy Falls Spiny Crayfish within the Fitzroy Falls Reservoir was undertaken for this assessment. The purpose of the survey was to assess the aquatic habitat, flora, fauna and water quality at selected monitoring locations around Fitzroy Falls Reservoir and confirm the presence or absence of Fitzroy Falls Spiny Crayfish at these sites. No Fitzroy Falls Spiny Crayfish specimens were caught during the survey program. This is consistent with findings presented in the desktop review and therefore it is reasonable to suggest that the Fitzroy Falls Crayfish is unlikely to inhabit the Fitzroy Falls Reservoir. Given this and considering that impacts of the project on water quality, flow and water level would be avoided at Fitzroy Falls Reservoir, it is unlikely that the Fitzroy Falls Spiny Crayfish would be impacted by the project.

The project has potential to result in indirect and prescribed biodiversity impacts, namely potential transportation of weeds, potential impacts to water quality from receiving waterways and potential increase in vehicle strikes on resident fauna. Measures to minimise and mitigate these potential impacts have been presented in this BDAR.

Due to the creation of new edges through remnant vegetation, there is also expected to be indirect impacts which may impact on Morton National Park. While direct impacts are easily quantified and controlled by managing the extent of clearing within the disturbance area, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during project design, whereas indirect impacts are mitigated through effective environmental management during construction and associated with an adaptive management strategy.

Mitigation and implementation

The impacts described are addressed in a mitigation strategy to be formalised into a Construction Environmental Management Plan (CEMP) and applied during the construction and operational phases. Mitigation measures form the basis and framework for development of project specific Biodiversity Management Plan (BMP).

Offset obligation and strategy

A credit requirement has been generated by the BAM-C for the three subregions assessed and includes 596 ecosystem credits and 2,664 species credits. A strategy to meet the offset obligation will be developed post-approval and consider a range of options, including direct payment into the Biodiversity Conservation Trust Fund and seeking like-for like credits from the offset market.

Important note about your report

In preparing this report Jacobs has relied upon and presumed accurate any information, or confirmation of the absence thereof, provided by Origin Energy and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change. Jacobs derived the data in this report from information sourced from Origin Energy and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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1. Introduction

1.1 Project overview

Origin Energy Eraring Pty Ltd (Origin), proposes to develop the Shoalhaven Hydro Expansion Project, to construct and operate a new pumped hydro power station on and under the land between the Fitzroy Falls Reservoir and Lake Yarrunga (the project). The project draw on Origin's existing water allocations to pump water up from Lake Yarrunga consuming energy when it is in less demand. Energy would then be generated through the return of water from Fitzroy Falls Reservoir to Lake Yarrunga when demand for energy increases.

The project would involve almost doubling the electricity generation capacity of the existing scheme, providing an approximate additional 235 megawatts (MW). The operation of the scheme would respond to the needs of the National Energy Market (NEM) and involving up to one pumping and generation cycle per day. Each generation cycle is anticipated to involve up to eight hours of generation and 16 hours of pumping, each of which could be divided into shorter durations to best satisfy the needs of the NEM.

The project is located in the New South Wales (NSW) Southern Highlands, approximately 150 kilometres (km) southeast of Sydney. The indicative project layout consists of the construction and operation of:

- Upper scheme components (Upper Scheme) including:
 - Connection to the upper intake control structure at the southern end of the Fitzroy Canal
 - A surface penstock (water transfer pipeline and associated infrastructure) from the existing Fitzroy Canal control structure to the vicinity of the existing scheme surge tank
 - A new surge tank adjacent to the existing scheme surge tank
 - A further section of surface penstock, adjacent to the existing scheme, from the new surge tank to the high pressure shaft
- Underground works (Underground Works) including:
 - Vertical shaft and headrace tunnel connecting to the southern end of Upper Scheme surface penstock to an underground power station
 - An underground power station cavern housing a transformer, reversible motor generator and pump turbine capable of supplying a nominal 235 MW of hydroelectric power
 - Associated access tunnel and multipurpose (egress, ventilation and services) tunnel with an entrance in the vicinity of the existing Kangaroo Valley Power Station
 - A tailrace tunnel, including an underground surge chamber located just downstream of the underground power station, terminating west of the existing Bendeela Power Station on Lake Yarrunga
- Lower scheme surface components (Lower Scheme) including:
 - Lower intake /outlet structure west of the Bendeela Power Station connected to the tailrace tunnel
 - Spoil emplacement facility east of Bendeela Pondage
 - High voltage network connection to existing Kangaroo Valley substation
 - Operational surface infrastructure including administration building, water treatment infrastructure and ventilation building.

The project would also require ancillary works which may include the carrying out of works to upgrade or construct access roads, spoil disposal sites, utilities infrastructure, construction compounds and construction power and water supply.

Importantly, the project essentially duplicates the existing scheme and as such, does not propose any new water storages or connections between waterbodies that have not already been utilised for the existing scheme. In addition, no transmission line augmentations are required to receive or distribute electricity from the existing Kangaroo Valley Power Station substation.

Plant equipment and construction material will generally be containerised and transported with standard semi-trailers or flatbed trucks. Heavy vehicles and trucks (OSOM) making these deliveries to the site are assumed to travel from Port Kembla via Wilton and would access the site from the north. Lighter (non-OSOM) vehicles, including 28-seater buses and 20 tonne (t) dump trucks, would access the site via the township of Kangaroo Valley. The route for lighter vehicles would be via the Hampden Bridge at Kangaroo Valley, which has a weight limit of 42.5 t. A full project description is provided in Chapter 3 of the Environmental Impact Statement (EIS).

1.2 Purpose of this technical report

The NSW Biodiversity Offsets Scheme applies to SSL projects unless the Secretary of the Department of Planning and Environment (DPE) and the Chief Executive of Environment, Energy and Science Group (EESG) determine that the project is not likely to have a significant impact. This document is the Biodiversity Development Assessment Report (BDAR) for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the methods and results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR addresses Stage 1 and Stage 2 of the BAM (DPIE, 2020).

This BDAR has been prepared in accordance with the SEARs issued for the project on 12 July 2021 by the Planning Secretary of the DPE.

The SEARs relevant to this technical report are presented in **Table 1-1**.

Table 1-1 SEARS – Biodiversity

SEARs	Section addressed
Biodiversity – including: <ul style="list-style-type: none"> An assessment of the biodiversity values and the likely biodiversity impacts of the project (including consideration of the Morton National Park in accordance with the NSW <i>Biodiversity Conservation Act</i> 2016, the Biodiversity Assessment Method (BAM), and documented in a Biodiversity Development Assessment Report (BDAR); 	<p>This document is the Biodiversity Development Assessment Report (BDAR) and has been prepared for the purpose of documenting the biodiversity values and impacts of the Shoalhaven Hydro Expansion Project in accordance with the NSW <i>Biodiversity Conservation Act</i> 2016 and the Biodiversity Assessment Method (Department of Planning, Industry and Environment (DPIE), 2020. Identification of the biodiversity values is provided in Section 4, 5 and 6.</p> <p>An assessment of the biodiversity impacts of the project are detailed in Chapter 7 and 9. This BDAR includes consideration of impacts on Morton National Park.</p>
<ul style="list-style-type: none"> the BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM; and 	<p>A discussion and outline of proposed avoidance and minimisation measures is detailed in Section 8</p> <p>A detailed assessment of impacts according to the Biodiversity Assessment Method (BAM) is provided in Section 9, which includes an assessment of direct, indirect, and prescribed impacts.</p> <p>Identification of the biodiversity credit requirements of the project is detailed in Section 12.</p>
<ul style="list-style-type: none"> an assessment of the impacts of the project on aquatic ecology, key fish habitat and threatened aquatic species, and measures to rehabilitate or offset (if required) aquatic biodiversity values 	<p>Identification of the biodiversity values in relation to aquatic ecology, key fish habitat and threatened aquatic species is provided in Section 6.5.</p>
<ul style="list-style-type: none"> if an offset is required, details of the measures proposed to address the offset obligation 	<p>Details on the proposed Biodiversity Offset Strategy (BOS) for the project are detailed in Section 12.3.</p>

1.3 Personnel

This BDAR was undertaken and prepared by appropriately qualified and experienced ecologists (**Table 1-2**).

Table 1-2 Project personnel, role and qualifications

Name	Role	Qualifications
Matt Consterdine	Senior Ecologist – Technical Lead Reporting lead, Vegetation Integrity surveys, targeted flora searches, fauna surveys, BAM-C, GIS	<ul style="list-style-type: none"> Certificate III Conservation and Land Management Bachelor of Environmental Science and Management Accredited under section 6.10 of the BC Act as a BAM Assessor (No. BAAS20027)
Chris Thomson	Principal Ecologist – Technical review and finalising BDAR, fauna surveys, reporting	<ul style="list-style-type: none"> Graduate Certificate in Natural Resources Bachelor of Applied Science (Environmental Mgt) Accredited under section 6.10 of the BC Act as a BAM Assessor (No. BAAS18058)
Jon Carr	Senior Ecologist – Vegetation Integrity surveys, targeted flora searches, reporting	<ul style="list-style-type: none"> Bachelor of Environmental Science and Management Accredited under Section 6.10 of the BC Act as a BAM Assessor (No. BAAS18009)

Biodiversity development assessment report

Name	Role	Qualifications
Emma Weatherstone	Ecologist – Targeted flora and fauna surveys, reporting	<ul style="list-style-type: none">▪ Bachelor of Wildlife Conservation
Kirsty Raines	Ecologist – Targeted flora and fauna surveys	<ul style="list-style-type: none">▪ Master of Environmental Science and Management▪ Bachelor of Zoology▪ Accredited under section 6.10 of the BC Act as a BAM Assessor (No. BAAS22013)
Julia Bayada	Graduate Ecologist – Reporting	<ul style="list-style-type: none">▪ Bachelor of Environmental Science and Management
Tim Maher	Ecologist – Targeted flora surveys	<ul style="list-style-type: none">▪ Master of Research (Plant Ecology)▪ Bachelor of Advanced Science (Biology)
Evelyn Craigie	Principal Ecologist – Targeted flora surveys	<ul style="list-style-type: none">▪ Master of Environmental Management▪ Bachelor of Science (Zoology)▪ Accredited under section 6.10 of the BC Act as a BAM Assessor (No. BAAS180088)

1.4 Agency consultation

The EESG within DPE was consulted throughout the development of this BDAR. Discussion included the methods of assessing direct, indirect and prescribed impacts of the project to be consistent with the BAM. Consultation consisted of:

A phone call with BCD Senior Conservation Planning Officer (Monday 8th November 2021), discussed:

- Update on project re-commencing
- Current findings and threatened species recorded
- Threatened flora survey design including likely limitations to parallel transects (some vegetation too dense to pass through, steep terrain avoided for safety concerns)
- Offer for BCD staff to inspect areas if parallel transects are questioned
- Large list of candidate species taken from three subregions BAMC trial runs
- Potential contacts for threatened species experts.

Email correspondence with DPE threatened species officers during 2021 and 2022 included.

- Email from Senior Threatened Species Officer (10th November 2021) Subject: Seasonal flowering observations of *Calochilus pulchellus*
- Email from Senior Team Leader (2nd December 2021) Subject: List of threatened flora species contacts
- Email from Senior Regional Biodiversity Conservation Officer (4th February 2022) Subject: Seasonal conditions for *Cryptostylis hunteriana* and comments on species distribution
- Email from Senior Regional Biodiversity Conservation Officer (7th February 2022) Subject: *Prasophyllum fuscum* species distribution
- Email from Senior Threatened Species Officer (21st March 2022). Subject: Seasonal flowering observations of *Genoplesium baueri* and *Pterostylis ventricose*.

Pre-referral meeting with Department of Agriculture, Water and the Environment – Environment Approvals Division (19/05/2022) with Origin representatives.



- Legend**
- Development site
 - Locality (10km)
 - Road
 - Waterways
 - Waterbody
 - NPWS estate
 - State Forest
 - IBRA subregions

0 2 4 km
1:120,000 at A4
GDA2020 MGA Zone 56



Data sources

Jacobs 2022
Department of Planning and Environment 2022
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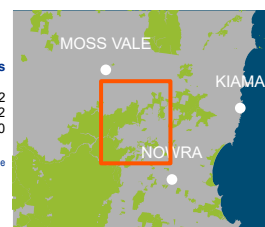


Figure 1-1 The locality

2. Project description

This chapter provides a description of the project including activities associated with construction and operation of each component of the project, based on the current available design information. Flexibility has been provided in the description of the project to allow for refinement during detailed design and in response to submissions received on this BDAR and/or if opportunities arise to minimise environmental impacts further. The final design may therefore vary from the concept design described in this section.

2.1 Project location and summary

Origin owns and operate the Kangaroo Valley pumped hydro scheme which includes the Kangaroo Valley Power Station, Bendeela Pondage and Bendeela Power Station. The Power Stations are constructed in series, capturing energy from a multi-stage head drop between the Fitzroy Canal control works and Lake Yarrunga. The Bendeela pondage allows some capacity for the power stations to operate independently. The proposed new Shoalhaven Pumped Hydro Energy Storage (PHES) Scheme will be constructed adjacent to the Kangaroo Valley pumped hydro scheme.

The project is located in the NSW Southern Highlands and Kangaroo Valley, approximately 150km south-east of Sydney. The project would be predominantly located within the Shoalhaven Local Government Area with access and water for the scheme drawn from and returned to the existing Fitzroy Falls canal and reservoir located within the Wingecarribee Local Government Area.

The project's surface works would be largely limited to land owned by WaterNSW associated with the existing Kangaroo Valley and Bendeela Power Stations and water transfer operations (Refer to **Figure 1-1**). WaterNSW land includes land either side of the existing surface pipeline and surge tank at the top of the plateau and land between Jacks Corner Road and Bendeela pondage.

Access to the Fitzroy Falls Canal control structure, surface pipeline, surge tank and vertical shaft on the plateau during construction would be required via upgrade of existing access tracks through Morton National Park. The surface pipeline from the upper intake structure (i.e. the existing Fitzroy Falls intake structure) to the surge tank will run parallel to the existing KV surface penstock for a distance of 2000 metres.

Below ground works for the high-pressure headrace tunnel would be required beneath a 100-metre-wide strip of Morton National Park located below the escarpment. These works would also be required beneath private freehold land located between the surge tank and Jacks Corner Road.

The major features of the area surrounding the project include:

- The existing scheme
- Morton National Park
- Shoalhaven Special Area
- Bendeela Recreation Area
- Forested escarpment and cliff lines
- Rural landholdings.

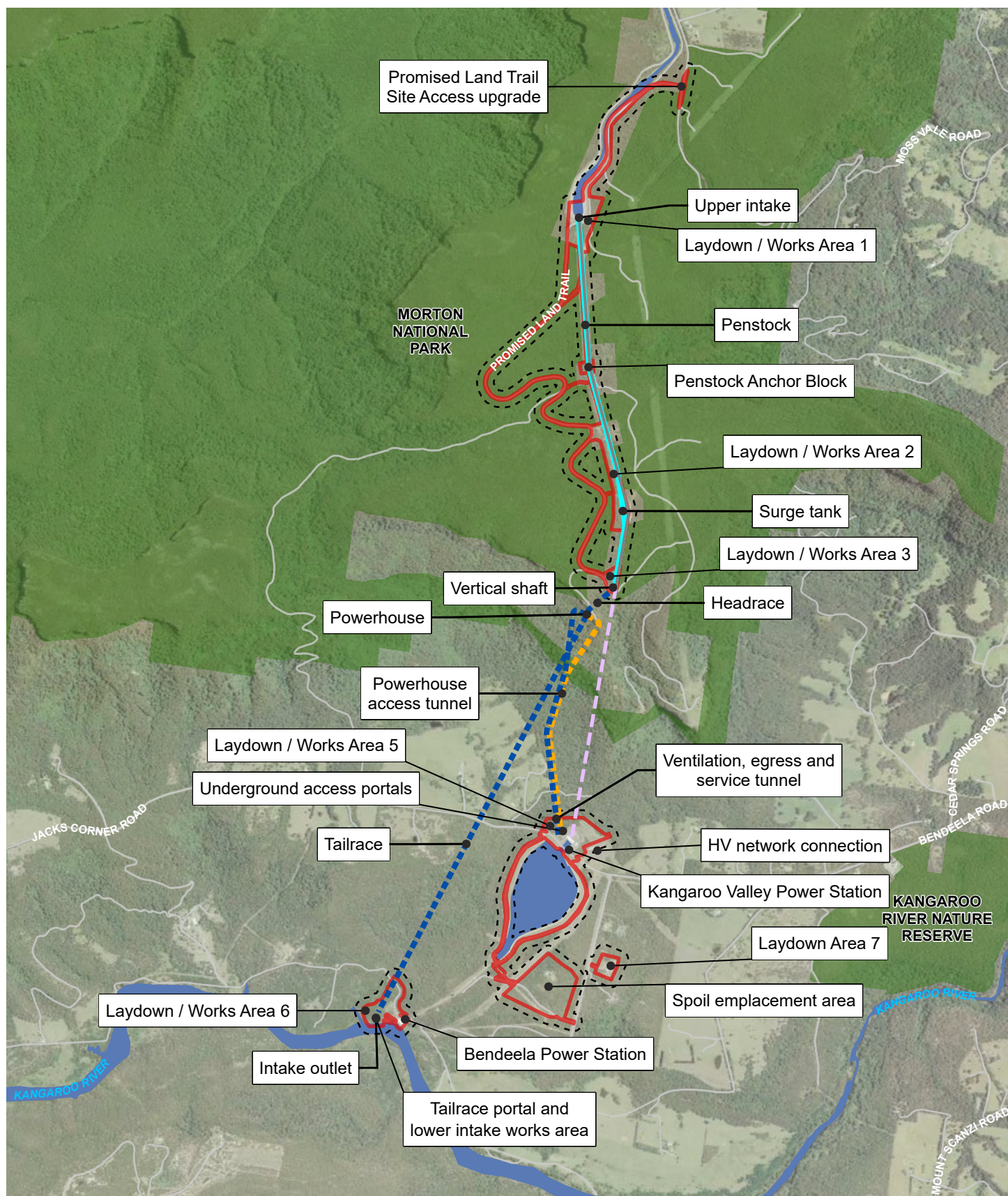


Figure 2-1 The Project

2.2 Key terms and definitions

The following areas are discussed throughout the report which aligns with terminology of the BAM and are defined as:

- **The Project:** Refers to the concept design for the Shoalhaven Hydro Expansion Project.
- **Development site:** The development site encompasses the extent of physical disturbance likely to be required to accommodate the construction and operation of the new pumped hydro power scheme (refer to **Figure 1-1**). For the purpose of this assessment, the development site carries the same meaning as the 'development site' and 'subject land', as defined by the BAM. This is the same as the Project area in the EIS.
- **Assessment area:** The assessment area includes a 50-metre buffer surrounding the development site that may be subject to indirect impacts (refer to **Figure 1-1**). This area represents the limits of where disturbance may occur during construction to allow for flexibility for the final siting of project infrastructure. Final siting of the infrastructure (the development site) can move within the assessed assessment area subject to recommended environmental management measures and provided it does not exceed the limits defined by the assessment area.
- **Locality:** This is defined as the area of land within a 10-km radius surrounding the development site (refer to **Figure 1-1**).
- **Bioregion:** The development site is located within the Sydney Basin IBRA bioregion (Department of Climate Change, Energy, the Environment and Water, 2020a), and traverses three IBRA sub-regions; Ettrema, Illawarra and Moss Vale (Department of Climate Change, Energy, the Environment and Water, 2020b). The largest portion of the development site lies within the Ettrema IBRA sub-region.
- **500-metre landscape buffer:** This is an area that includes a 500-metre landscape buffer surrounding the development site and encompasses the Assessment area. The 500-metre buffer has been applied as the majority of the project is linear. The 500-metre landscape buffer is an assessment area used to identify landscape features surrounding the development site to provide site context and to inform the likely habitat suitability of the development site (refer to **Figure 1-1**).

2.3 Construction methodology

A brief overview of the key features of the construction methodology for the Scheme systems is outlined below.

- **Surface pipeline:** A surface penstock pipeline will be constructed traversing approximately 2000m from the existing purpose-built pipeline cap on the upper intake control structure on the Fitzroy Falls Canal to a new surge tank and progress a distance of approximately 515m to an elbow at a newly constructed headrace shaft.
- From the intake structure to the surge tank, the penstock route runs adjacent to the existing operational surface penstock servicing the Kangaroo Valley Power Station. The new pipeline will be constructed adjacent to this pipeline along an existing easement corridor that was created for a future expansion of the scheme. The easement was substantially excavated with the original construction to the same level as the existing adjacent pipeline. The route traverses a valley with two main inclines, the steepest being approximately 36 per cent (%) slope. The surface penstock will be constructed using a cable crane along the alignment predominantly in the regions where alignment terrain is steep.
- Construction of the surface penstock will include erosion control structures for:
- Preventing erosion and controlling water flow from water drainage from the penstock to the natural water course adjacent to the penstock low point
- Preventing erosion of access ways and penstock civil infrastructure from water flows on steep inclines
- **Temporary construction areas:** All infrastructure for temporary works associated with the construction of the Scheme will be limited to locations identified as disturbance areas detailed within the BDAR. Notable temporary works include:
 - Underground works drainage infrastructure such as pumps, pipes, treatment plant and settling pond
 - Power and water supply
 - Construction ventilation systems
 - Conveyor systems
 - Temporary access roads and earthworks
 - Concrete batching plants
 - Construction laydown areas
 - Offices and cribbing facilities.

- **Construction access on the plateau:** The transport of materials to the southern end, including headrace liner and surge tank can be either along the alignment or the Promised Lands Trail. The Promised Lands Trail leading up to the Fitzroy canal control works is within WaterNSW land, but transitions to the Morton National Park soon after. The use of the Promised land trail will be conditional on not causing any material impact or clearing of vegetation along the track. Construction methods will be deployed to minimise disturbance within the Morton National Park and within constraints of the environmental approvals.
- The surface penstock, including the surge tank construction, requires the transport and positioning of large infrastructure components. As compared to the original penstock construction, accessibility is constrained by the vegetation growth along the promised land trail within the Morton National Park. Therefore, it is proposed to reinstate the original Promised Land track which will require clearing of regrowth from track edges and the base of cuttings.
- **Earthworks and spoil on the plateau area:** The construction methodology is predicated on generating as little spoil material on the plateau as possible and there will be no spoil disposal site established on the plateau. Rather a portion of the spoil will be beneficially utilised to level portions of the construction area between the Promised Lands Trail and the pipeline easement and for upgrading of the access tracks. An excess spoil will be transported to a spoil site located adjacent to the Bendeela Pondage.

3. Legislation and policy

3.1 Commonwealth government

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the primary Commonwealth legislation relating to the environment. Under Part 3 of the EPBC Act, approval from the Australian Minister for the Environment and Energy is required for a controlled action being an action that:

- Has, will have, or is likely to have a significant impact on a matter of national environmental significance
- Is undertaken on Commonwealth land and has, will have, or is likely to have a significant impact on the environment
- Is undertaken outside Commonwealth land and has, will have or is likely to have a significant impact on the environment of Commonwealth land
- Is undertaken by the Commonwealth and has, will have or is likely to have a significant impact on the environment.

A significant impact under the EPBC Act is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. Matters of national environmental significance (MNES) include:

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

It is generally the responsibility of the proponent of a proposed action to determine whether the Project, or action, has the potential to impact upon a MNES and constitute the need for a referral to the Commonwealth for determination. An action that is referred for consideration by the Australian Minister for the Environment and Energy cannot be undertaken until the outcome of the referral process is completed - either through the decision of the Minister that the action is not a controlled action or that the assessment and approval process has been completed.

An EPBC Act referral (2022/ 09293) was made to the Department of Agriculture, Water and the Environment (DAWE) on 29 June 2022 to assess whether the project would be considered to be a controlled action. On 28 September 2022, the department determined the project to be a 'controlled' action on the basis of potential impacts to the following MNES:

- Listed threatened species (section 18 & section 18A).

3.2 NSW state government

3.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the planning and approvals process in NSW. The EP&A Act provides for the making of Environmental Planning Instruments (EPIs) including Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs), which set out requirements for particular localities and/or particular types of development. The applicable EPIs and the Regulations made under the EP&A Act determine the relevant planning approval pathway and the associated environmental assessment requirements for proposed development activities.

3.2.2 Critical State significant infrastructure

Clause 16 of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) provides that:

Development specified in Schedule 5:

- a) *may be carried out without development consent under Part 4 of the Act, and*
- b) *is declared to be State significant infrastructure for the purposes of the Act if it is not otherwise so declared, and*
- c) *is declared to be critical State significant infrastructure for the purposes of the Act.*

Schedule 5 of the SRD SEPP lists:

- (1) *Development for the purposes of the Shoalhaven Hydro Expansion Project.*
- (2) *The Shoalhaven Hydro Expansion Project includes the following:*
 - a. *exploratory geotechnical works for the design of the project,*
 - b. *A new underground pumped hydro station,*
 - c. *tunnels and underground and overground water pipelines,*
 - d. *surge tanks and intake and outlet structures,*
 - e. *the decommissioning of the underground pumped hydro power station and rehabilitation of the site.*
- (3) *Development that is ancillary to other development in this clause (including the upgrading or construction of access roads, utilities infrastructure, construction accommodation, construction compounds).*
- (4) *The development is to be carried out on land in Kangaroo Valley, Barrengarry and Fitzroy Falls.*
- (5) *In this clause, development does not include the carrying out of surveys, sampling, environmental investigations, archaeological excavations or other tests or investigations for the assessment of the project.*

Accordingly, the project is Critical SSI which requires approval under Division 5.2 of the EP&A Act and the NSW Minister for Planning is the determining authority.

In accordance with Part 7.9 of the BC Act, an application for approval under Division 5.2 of the EP&A Act to carry out State Significant Infrastructure (SSI) must be accompanied by a BDAR unless the Planning Agency Head and the Environment Agency Head determine that the project is not likely to have any significant impact on biodiversity values. The SEARs issued for the project have determined the need for a BDAR in accordance with Section 5.16 of the EP&A Act.

The Biodiversity Offsets Scheme (BOS) applies to SSI projects unless the Secretary of DPE and the Chief Executive of the EESG determine that the project is not likely to have a significant impact. This document is the BDAR for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR has been prepared by the accredited assessors identified in **Table 1.1**, who are accredited under Section 6.10 of the BC Act to apply the Biodiversity Assessment Method (BAM) in connection with the BDAR pursuant to Part 6 of the BC Act.

The BDAR has been prepared in compliance with the BAM (DPIE 2020a) and is structured around two primary stages:

- Stage 1 – Biodiversity assessment
- Stage 2 – Impact assessment (biodiversity values, direct, indirect and prescribed impacts).

Biodiversity Assessment Method Calculator (BAM-C) parent case for this project is **00033614**. Given the three separate sub-regions traversed by the project, three child cases have been created in the BAM-C, this includes:

- 00033614/BAAS20027/22/00034904 for the Ettrema subregion,
- 00033614/BAAS20027/22/00035326 for the Moss Vale sub-region
- 00033614/BAAS20027/22/00035327 for the Illawarra sub-region.

This BDAR also addresses potential impacts to biodiversity listed under the Fisheries Management Act 1994 (FM Act) and Matters of National Environmental Significance (MNES) identified in the EPBC Act).

3.2.3 Biodiversity Conservation Act 2016

Part 7 of the *Biodiversity Conservation Act 2016* (BC Act) requires that an application for State significant infrastructure approval under Division 5.2 of the EP&A Act be accompanied by a "biodiversity development assessment report unless " the Secretary of the Department of Planning and the Chief Executive of the Office of Environment and Heritage" determine that the Project is not likely to have any significant impact on biodiversity values".

3.2.4 National Parks and Wildlife Act 1974

The objects of the National Parks and Wildlife Act 1974 Act (NPW Act) are as follows:

- (a) *the conservation of nature, including, but not limited to, the conservation of:*
 - (i) *habitat, ecosystems and ecosystem processes, and*
 - (ii) *biological diversity at the community, species and genetic levels, and*
 - (iii) *landforms of significance, including geological features and processes, and*
 - (iv) *landscapes and natural features of significance including wilderness and wild rivers,*
- (b) *the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to:*
 - (i) *places, objects and features of significance to Aboriginal people, and*
 - (ii) *places of social value to the people of New South Wales, and*
 - (iii) *places of historic, architectural or scientific significance,*
- (c) *fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,*
- (d) *providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.*

The Morton National Park is reserved under the NPW Act and the use of existing unsealed roads within the reserved lands is required to access the Project. No works or activities are proposed within the Morton National Park other than upgrade of existing tracks developed in 1974.

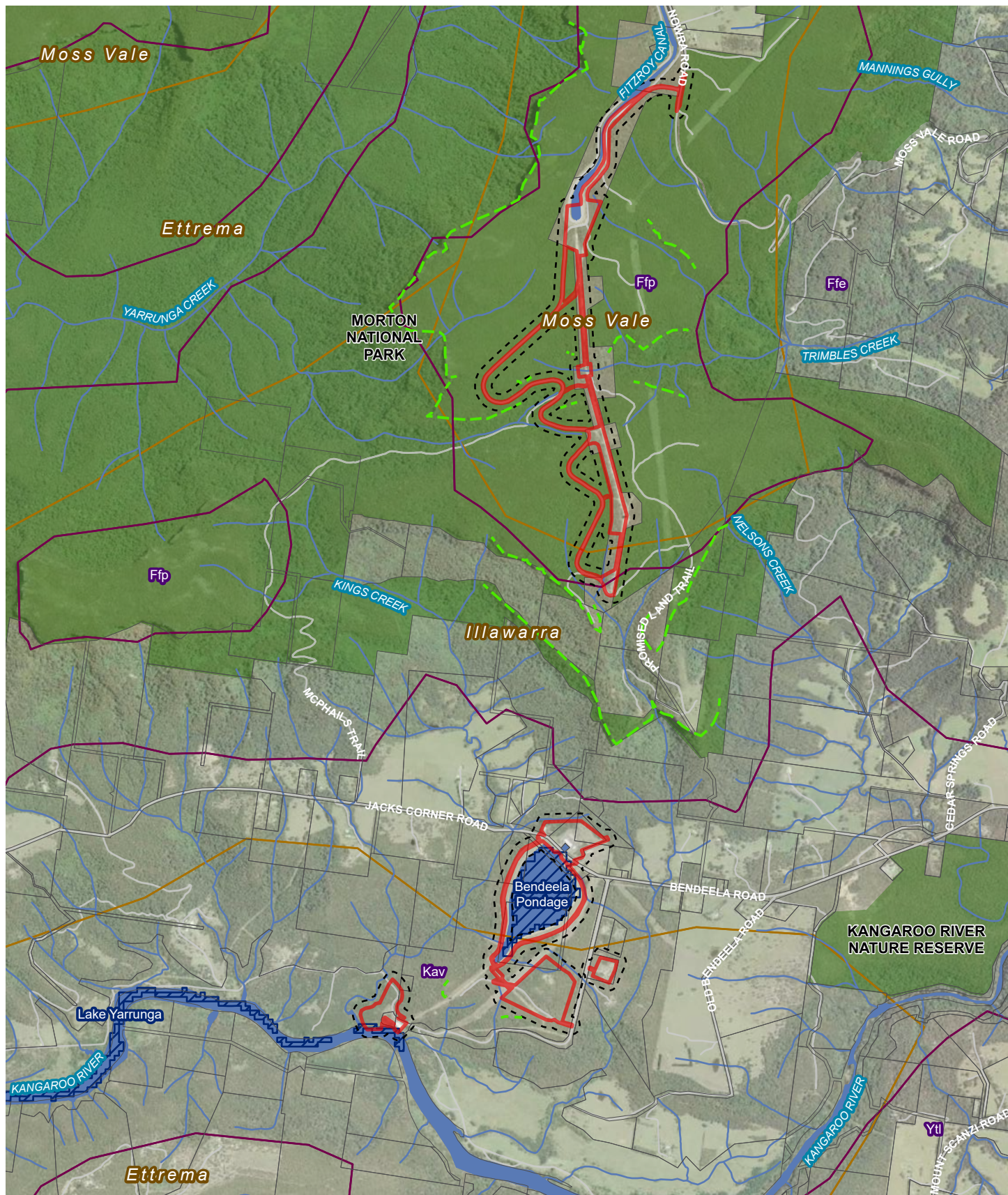
Part 12 of the NPW Act allows for the granting of leases, licences, easements and rights of way for activities within reserved lands. Origin has agreed formal access arrangements for the use of existing access track through the Morton National Park with National Parks and Wildlife services and no additional approvals are understood to be necessary.

4. Landscape Features

The Project occupies a landscape that was previously disturbed and modified for construction of the original Shoalhaven hydro scheme. **Photo 4.1** (left) shows an aerial image taken after construction in 1974. The image on the right taken in 2016 shows regeneration which has occurred along edges of tracks and the disturbance corridor for the pipeline. However, a review of aerial imagery indicates considerable regeneration, and the locality is known to retain biodiversity values including a number of threatened species and ecological communities listed under the State of New South Wales and Commonwealth legislation. The landscape features and site context relevant to the project are discussed in this section and shown on **Figure 4-1**.



Photo 4-1. Aerial imagery from 1974 (left) following the original project construction, and right showing recent image taken in 2016



- Cliff lines
- Development site
- Project area (50m buffer of Development site)
- Cadastre
- NPWS estate
- IBRA subregions
- NSW (Mitchell) Landscapes
- Wetlands
- Road
- Waterways
- Waterbody



1:35,000 at A4
GDA2020 MGA Zone 56

Data sources

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Figure 4-1 Landscape Features

4.1 IBRA bioregions and subregions

The development site is located within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion (Department of Climate Change, Energy, the Environment and Water, 2020a). The Project is unique from a biodiversity perspective in that it traverses three IBRA subregions; Ettrema, Illawarra and Moss Vale (Department of Climate Change, Energy, the Environment and Water, 2020b). The characteristic landforms and soils of these subregions include:

- **Moss Vale subregion:** occupies the plateau, where the characteristic landform of this subregion includes shale and basalt with rolling hills and shallow valleys. Soils typically consist of structured red and red-brown clay loams and loamy alluvium with high fertility (NPWS, 2003). The northern end of the project including the existing Fitzroy canal occurs in the Moss vale subregion
- **Illawarra subregion:** Occupies the slopes and cliff faces below the existing surge tank. Characteristic landforms of this subregion include vegetated cliff faces on coastal escarpment with waterfalls and steep streams and contain boulder debris slopes with sandy clay matrix and low hills and alluvial valleys on coastal ramp. Soils typically consist of structured red and red-brown loams and clay loams with some areas of mellow texture contrast soils (NPWS, 2003)
- **Ettrema subregion** occurs at the southern end of the project and encompasses land occupied by the Bendeela pondage, Kangaroo Valley and Kangaroo River. Characteristic landforms of this subregion include low stepped hills on plateau with deeply incised streams off plateau edge below waterfalls on the escarpment. Soils typically consist of alternating sandstone, shale create bare rock benches and soil benches with shallow, often saturated sand and structured red brown clay loams on basalt (NPWS, 2003).

4.2 BioNet NSW Landscapes (Mitchell landscapes)

The Project crosses three NSW landscapes (NPWS, 2002) and are described as follows from north to south:

- **Fitzroy Falls Plateau:** The primary features of this landscape include plateau and slightly undulating hills on horizontal Triassic quartz sandstone and conglomerate, general elevation 700-780 m, local relief 40 m, well-drained gradational yellow earth and uniform sands with some texture-contrast profiles on shale layers or colluvial clay (DECC, 2001)
- **Fitzroy Falls Escarpment:** The primary features of this landscape include high cliffs with waterfalls at the margin of the Fitzroy Falls Plateau landscape, on upper Permian and lower Triassic coal measures of shale, sandstone, tuff and quartz sandstone, general elevation 400-700 m, local relief 150 m, well-drained gradational yellow earth, and uniform sands on the plateau edge, considerable rock outcrop and rubbly debris slope at the base of the cliffs with a coarse sand matrix (DECC, 2001)
- **Kangaroo Valley:** The primary features of this landscape include an enclosed, narrow, western facing valley surrounded by sandstone escarpment features comparable to the Bulli coastal escarpment, the valley is incised into Permian pebbly siltstone and sandstone, valley floor elevation 80-100 m above sea level, local relief 180 m, and soils on the slopes are loamy sand matrix in a sandstone rubble beneath cliff lines then yellow texture-contrast profiles grading to deep loam on the valley floors (DECC, 2001).

4.3 Morton National Park

The Morton National Park is located of the eastern escarpment of the Southern Tablelands approximately 150 km southwest of Sydney. The park stretches from Bundanoon in the north to southeast of Braidwood and covers a diverse and rugged landscape. The northern end of Shoalhaven expansion project on the plateau is accessed through and surrounded by Morton National Park. The Promised Land Trail enters Morton National Park from near the end of the Fitzroy Canal.

The park consists mostly of a flat plateau dissected by steep gorges. Because of the varied geology and landform, altitude range and climatic location, the park contains a large range of vegetation types and native animal species. The vegetation includes a number of forest and woodland associations, extensive areas of heathland/sedgeland and several types of rainforests. The park provides important habitats for a large number of threatened plant and animal species including several endemic plants.

4.4 Rivers, streams, and estuaries

The Project is within the Shoalhaven River catchment (Kangaroo River sub-catchment). The assessment area contains the second order stream of Trimbles Creek in the north (on the plateau) that is fed by six mapped smaller ephemeral first order streams draining from the project. Trimbles Creek becomes a larger third order

as it flows to the east and joins Millers Creek, a fourth order stream that drains south to Barrengarry Creek (fifth order stream) and meets Kangaroo River (sixth order stream). In the south (in Kangaroo Valley), the third order stream Kings Creek flows south from the upper valley until it meets Kangaroo River (sixth order stream).

Trimbles Creek is mapped as Key Fish Habitat approximately 1.3 km downstream (to the east) of development site. Key Fish Habitat is also mapped in adjacent to or within the development site along Kings Creek (third order stream), Kangaroo River and Bendeela Pondage. First order streams on the western side of the development site in the north also indirectly flow into Yarrunga Creek (fourth order stream) mapped as Key Fish Habitat.

The southern extent of the Project is located at the foot of a valley in an area that was filled associated with the construction of the anchor block for the existing scheme surface pipeline. This valley is mapped as containing a first order creek up stream of Trimbles Creek which is mapped as Key Fish Habitat approximately 1.3 km downstream of the Assessment area.

Additionally, the Project is located within the catchment of Kings Creek which is also mapped as Key Fish Habitat. The Project is over 100 metres from the creek and no direct or indirect impacts to Kings Creek are likely.

Lake Yarrunga is also mapped as Key Fish Habitat, located to the south of the Project. No clearing or impact to key fish habitat is likely due to the nature of the works proposed and control measures to be employed.

4.5 Wetlands

There are no naturally occurring wetlands in the Assessment area. Bendeela Pondage and Kangaroo River (Lake Yarrunga) are adjacent to the project.

4.6 Connectivity of habitat

Vegetation connectivity in the assessment area is very high, particularly from the plateau in a west and southwest direction and associated the expansive Morton National Park that is connected to the south to other national parks and state conservation areas including Bugong National Park and Colymea State Conservation Area. From the Fitzroy Falls canal to the east there are extensive cleared lands associated with rural land, however connectivity remains high and continues to Budderoo National Park around 12 km to the east.

In the plateau portions of the assessment area there are no major barriers that break apart vegetation (apart from the existing hydro scheme pipeline, dams and tracks as well as the 40m wide Nowra/Moss Vale Road alignment). The vegetation in the plateau is largely contiguous and much of this is preserved within Morton National Park.

In contrast the Kangaroo Valley portions of the assessment area in the south and more fragmented and associated with clearing for the power station areas, dams, public roads and paddocks (private rural properties). However, based on aerial imagery and regional vegetation mapping, the valley areas still contains contiguous forest patches which are within close proximity to vegetation of the development site, particularly on the south side of the Kangaroo River.

4.7 Areas of geological significance and soil hazard features

Areas of geological significance generally include karst, caves, crevices and cliffs. Cliffs are a common feature of the Morton National Park landscape and within the assessment area occur predominately in a broad rim encircling below the southern end of the existing pipeline and surge tank (between the plateau and the existing power station (see **Photo 4.2**). This cliff landscape will not be directly or indirectly impacted by the project. In steep locations between the Promised Land track and the existing pipeline there are examples of exposed rocky habitats that contain many crevices and shallow overhangs (see **Photo 4.3**). The proposed project will not directly impact cliffs, caves or crevices.

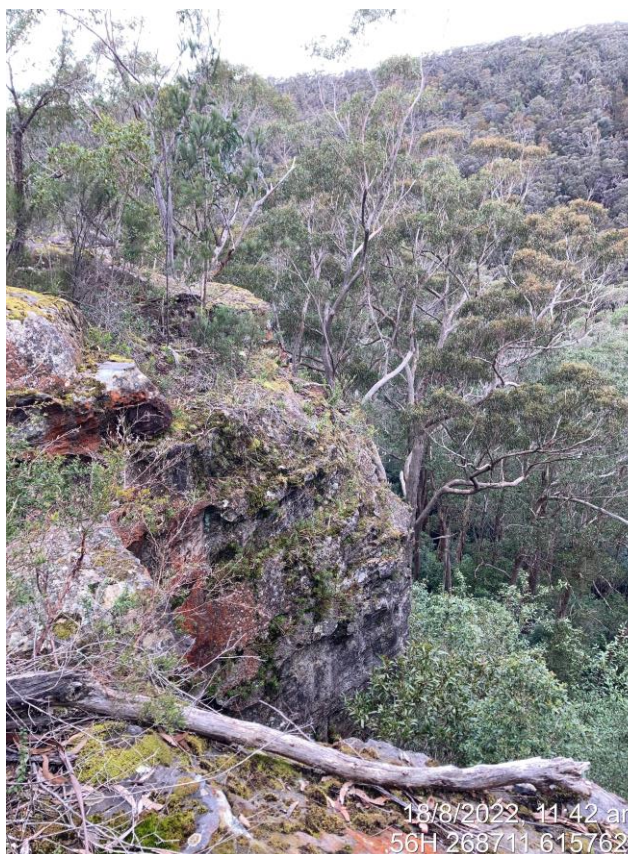


Photo 4-2 Photograph showing steep cliff landscape below the plateau encircling the southern end of the existing pipeline and surge tank

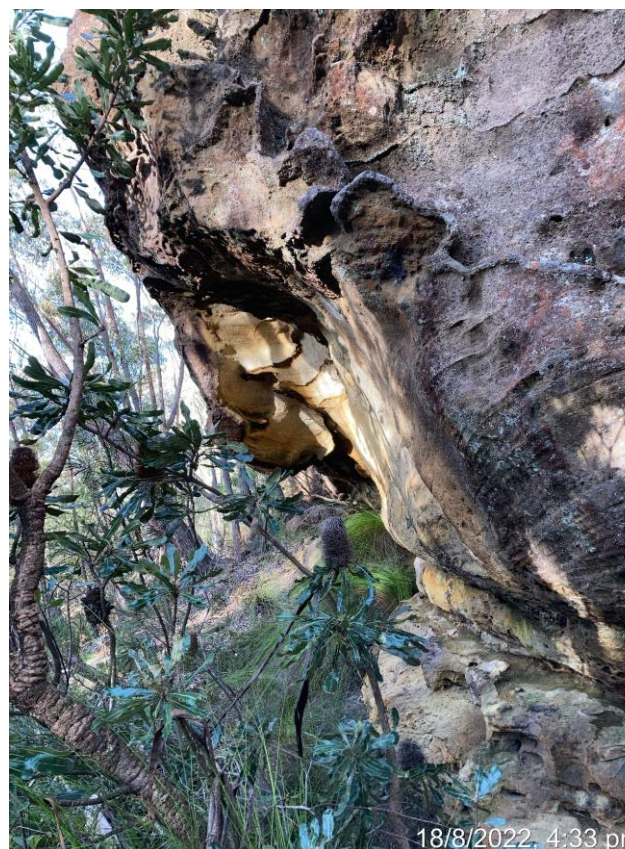


Photo 4-3 Example of shallow crevices and overhangs located on the plateau between the existing pipeline and the Promised Land trail

Soil hazard features such as dryland salinity, acidification, structural breakdown, sodicity and contamination were not noted during the field surveys. There were no apparent plant growth problems noted due to soil health. Soils at the site were generally sandy-loam, and drainage was good in all assessed areas. The acid sulfate soil risk has not been mapped for the assessment area. Based on surrounding topography, it is assumed to be low risk.

4.8 Areas of outstanding biodiversity value

Areas of declared critical habitat that were listed under the now repealed Threatened Species Conservation Act 1995 have become declared areas of outstanding biodiversity value (AOBVs) in NSW with the commencement of the BC Act. AOBVs are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. These are areas declared by the Minister for the Environment.

The assessment area does not contain any areas of outstanding biodiversity value listed on the register of declared areas of outstanding biodiversity value.

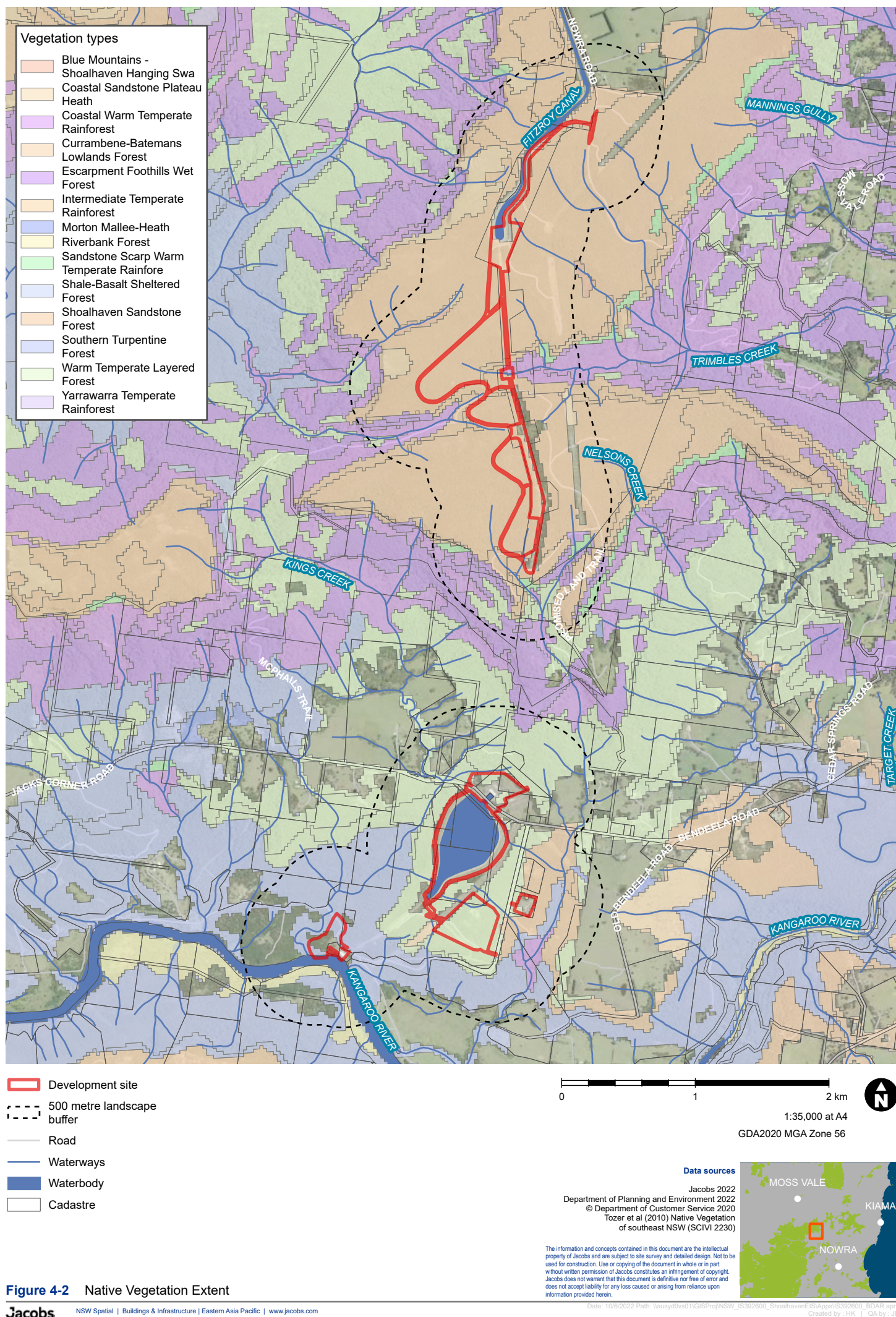
4.9 Native vegetation extent

To determine the extent of native vegetation the project has been assessed as a linear project, given the majority of the works are associated with a pipeline, and therefore a 500 m landscape buffer was applied.

To assess percent current extent of native vegetation, a landscape buffer of 500 metre was placed around the development site boundary. The 500-metre landscape buffer is approximately 1,046.97 hectares (ha) in size and contains approximately 911.26 has of native vegetation (refer **Figure 4-2**). This area was calculated using a combination of available resources including:

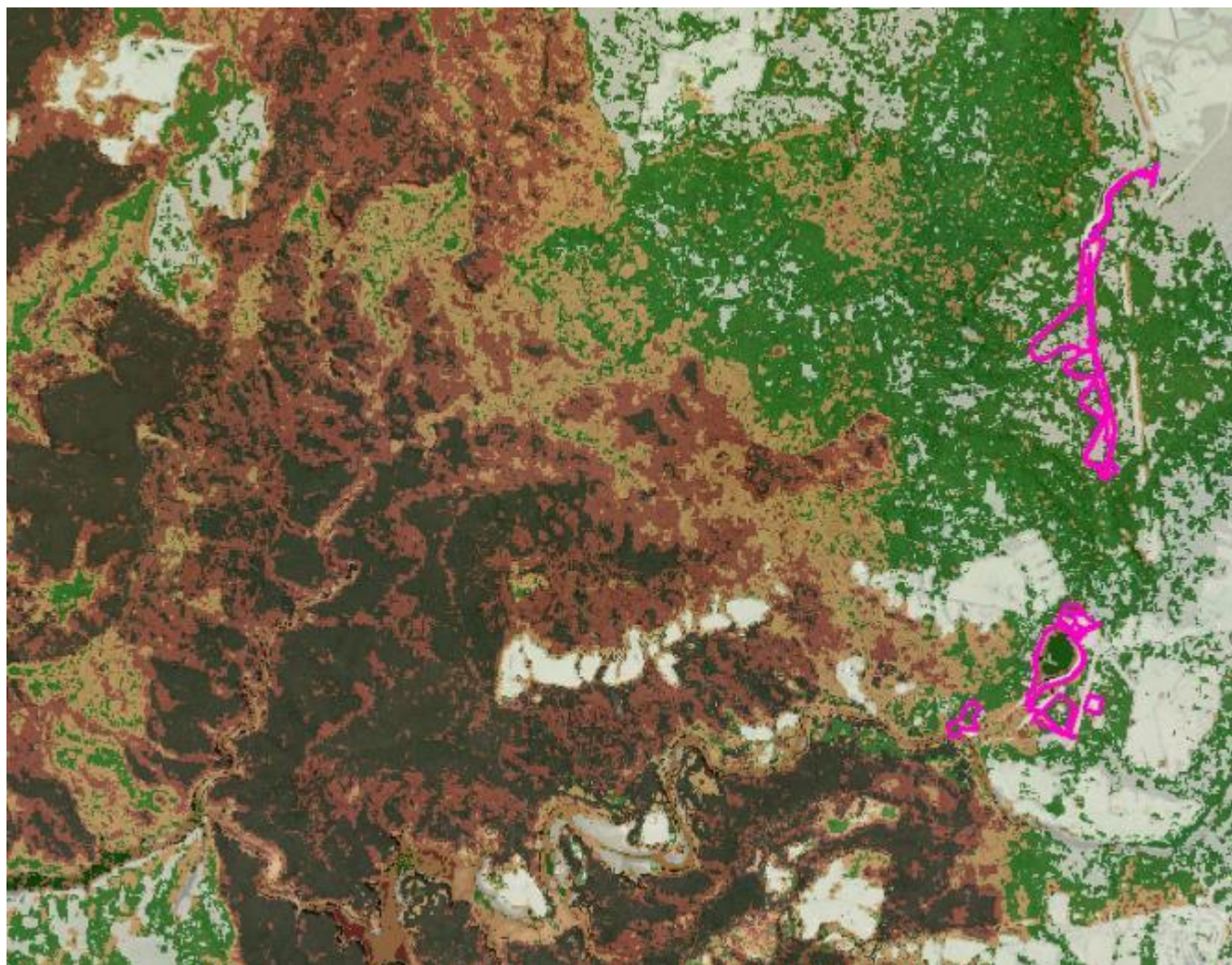
- Vegetation mapping prepared for this BDAR
- NSW State Vegetation Type Map (SVTM)
- High-definition aerial imagery taken of the site on 26 November 2020.

As much of the 500-metre landscape buffer was not verified during surveys, regional vegetation mapping and aerial imagery were the primary resources for mapping the extent of native vegetation. This results in a percent native vegetation cover in the landscape of approximately 87 %. Therefore, native vegetation cover in the landscape is in the >70 % cover class. These calculations are an approximation only and there are unsealed dirt roads and disturbed areas that exist throughout the 500m buffer that are included in the mapping as they have some level of native vegetation cover and could be assigned to a plant community type (PCT). The purpose of the percentage vegetation cover calculation is to create a figure of native vegetation cover that is used in the BAM-C to predict threatened species likely to occur or use habitat on a site. Minor adjustments to polygon boundaries will not affect the <70 % cover class present within the landscape buffer.



4.10 Bushfire 2019/20

A large bushfire affected parts of the Kangaroo Valley and Morton National Park to the west of the project in January 2020. The assessment area was not directly impacted by the fire. The severity of this fire is shown in the image below, which displays the spatial dataset 'Fire Extent and Severity Mapping' (FESM, Department of Planning, Industry and Environment, 2020) that identifies four burn area classes. This mapping is based on aerial and satellite image analysis and shows the assessment area (pink polygons) with some areas mapped as 'low burnt understory with unburnt canopy'. The assessment area was ground-truthed during the targeted flora and fauna surveys between October 2021 to May 2022 and confirm that the assessment area was not affected by the fire, and the broad-scale mapping showing patches of low burnt areas is incorrect.



- ☐ Unburnt
- ☐ Non-FESM burnt area
- ☐ Low - burnt understory with unburnt canopy
- ☐ Medium -partial canopy scorch
- ☐ High- full canopy scorch/partial consumption
- ☐ Extreme - full canopy consumption
- ☐ No data

The NSW government developed the 'Guideline for applying the Biodiversity Assessment Method at severely burnt sites' (Department of Planning, Industry and Environment, 2020c) following the 2019-2020 bushfires. The aim of the Guideline is to provide assessors with a reasonable, evidence-based and transparent process for identifying severely burnt native vegetation and provides a range of approaches for applying the BAM on land impacted by severe or catastrophic bushfire, i.e. bushfire of high to extreme intensity resulting in significant modification of vegetation structure and composition such that the original vegetation type and

condition is no longer identifiable. The Guideline states that the 'Fire Extent and Severity Mapping' can be used to assess a site. Based on this mapping the study area does not meet the definition of severely burnt and in fact based on ground-truthing, the assessment area was unburnt, so the Guideline (Department of Planning, Industry and Environment, 2020c) largely does not apply to this assessment.

5. Native vegetation and vegetation integrity

5.1 Background research and data sources

A database search and literature review were completed as part of the desktop assessment of the assessment area prior to the commencement of field surveys. The review focused on database searches, relevant ecological reports pertaining to the survey area and relevant Geographic Information System (GIS) layers. The review was used to prepare a list of PCTs and potential Threatened Ecological Communities (TECs), to inform survey effort required for both native vegetation and threatened species assessment.

The following databases and information sources were consulted:

- NSW BioNet Vegetation Classification database – last reviewed February and July 2022
- DoAWE Protected Matters Search Tool – searched 19 May 2022
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE) – searched April 2022.

Regional vegetation mapping, geology and soil mapping projects were reviewed including:

- South coast SCIVI VIS map 2230
- Biometric vegetation types of the Shoalhaven, Eurobodalla and Bega Valley local government areas. Version 2.1 VIS_ID 3900
- NSW State Vegetation Type Map (SVTM)
- Mitchell Landscapes Version V3.1 (NPWS 2002)
- NSW Soil and Land Information System (SALIS) espade
- Australian Soil Classification (ASC) Soil Type map of NSW (State Government of NSW and Office of Environment and Heritage (OEH), 2012).

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the EESG NSW Threatened Species Scientific Committee website. At the time of writing, there are no preliminary or provisional listings of relevance to the project (Public exhibition list last updated 14 June 2022).

5.2 Assessing native vegetation cover

The extent of native vegetation cover in the development site was ground-truthed and mapped using up to date aerial imagery. Polygons were digitised using ArcGIS 10.8 at a scale of between 1:1,000 and 1:5,000. The vegetation extent within the development site has been mapped as accurately as possible although some boundary errors may still exist.

An assessment of percent of current extent of native vegetation, within the landscape buffer of 500 metres around the boundary of the development site was made in accordance with Section 3.2 of the BAM. For details see **Section 4.9** and **Figure 4-2**.

5.2.1 Definition of native vegetation

Under the BAM, native vegetation has the same meaning as in Section 1.6 of the BC Act which states that native vegetation and clearing native vegetation have the same meanings as in Part 5A of the Local Land Services Act 2013. Section 60B of the Local Land Services Act 2013 defines the meaning of native vegetation as any of the following types of plants native to NSW:

- a) Trees (including any sapling or shrub or any scrub)
- b) Understorey plants
- c) Groundcover (being any type of herbaceous vegetation)
- d) Plants occurring in a wetland.

A plant is native to NSW if it was established in NSW before European settlement.

A large proportion of the assessment area has been historically cleared for the existing hydro scheme or for grazing land along the Kangaroo Valley foothills in the 1900s. Whilst significant regrowth of vegetation has

occurred in many areas, there are some areas remaining which are weedy or lack structural components of a plant community. Ongoing vegetation maintenance as part of the hydro scheme and power station infrastructure management has also modified some vegetation patches to the point where only one or two native species may be remaining. As such, these areas have been assigned to the most likely PCT, as the original PCT can be determined with reasonable confidence based on adjacent PCTs and position in the landscape.

5.3 Plant community type identification

5.3.1 Stratification of native vegetation into survey units

The extent of potential PCTs within the assessment area was firstly reviewed using regional vegetation mapping spatial layers in Shoalhaven Biometric VIS 3900 v2.1 (OEH, 2013) and SCIVI VIS_ID 2230 (Tozer et al, 2010). Prior to the fieldwork commencing, survey sites (plots/midlines) were randomly located within each area of mapped vegetation to provide a representative assessment of the vegetation. Plots were also positioned to provide a wide spatial coverage of the assessment area.

The field survey was able to provide good spatial coverage and survey effort for each PCT present on the site, meeting the requirements of the BAM. The vegetation within the development site has been assigned to a PCT as listed in the BioNet Vegetation Classification database based on the observed species composition, vegetation structure, landscape position, and underlying geology and soils. In most cases the vegetation on site does not perfectly align with any PCT listed in the BioNet Vegetation Classification database so the vegetation has been allocated to the PCT with which it most closely aligns. There is approximately 29.5 ha of native vegetation within the development site. As a result of historical vegetation clearing for the existing hydro scheme, as well as grazing land in the valley, this vegetation is comprised of approximately 22.2 ha of regrowth and 7.3 ha of potentially remnant native vegetation. Regrowth and remnant forms of native vegetation were surveyed. Plot locations were also chosen to avoid ecotones, tracks (their edges) and/or disturbed areas distinguishably different to the target vegetation zones.

Once the identification of PCTs had been finalised, each PCT was then divided into vegetation zones; each comprising an area of native vegetation in the development site that is the same PCT and has a similar broad condition state. As the Project traverses three distinct bio subregions, the vegetation zones were further divided to each sub-region for the purposes of developing a separate child case for each sub-region in the BAM-C (refer Section 4.1 for more information).

The PCTs identified within the development site are described in detail in **Section 5.4** of this BDAR. Each vegetation zone was assigned to either high, moderate, or low condition. Cleared tracks and highly disturbed areas with no native vegetation or very few native plants were mapped as cleared and disturbed.

Each PCT was assigned to the relevant corresponding Threatened Ecological Community (TEC) where applicable.

The field surveys were designed to assess the environmental variation within the development site. The condition of PCTs was assessed in accordance with Chapter 5 of the BAM and vegetation zones assigned by comparing the dominant species, the general description of location, soil type and other attributes as described in the VIS classification database.

5.3.2 Plot-based floristic vegetation survey and vegetation integrity assessment

A plot-based full floristic survey and vegetation integrity (VI) assessment was undertaken in accordance with the BAM using a series of 20 x 20 metre plots (or 400 metres square (m²) equivalent area), each nested inside a 20 x 50 metre plot (or equivalent 1,000 m² area). In some situations, along narrow PCT patches (such as edge of access track), 10 x 40 metre floristic plots were used. The location of each plot/mid-line completed during the survey is illustrated in **Figure 5-1**. Plots/mid-lines were established to provide a representative assessment of the vegetation integrity of the vegetation zone, accounting for the level of variation in the broad condition state of the vegetation zone. The emphasis was on identifying broad condition states within each PCT and no attempt was made at fine scale mapping in areas of variable vegetation density.

A summary of the survey effort completed in each vegetation zone is provided in **Table 5-1**. The minimum survey requirements for vegetation zones were achieved, with most exceeded so that the variation within each PCT could be adequately sampled. During the biodiversity assessments modifications were made to the development site to avoid remnant forest or National Park boundaries, and as such a small number of VI Plots used in this assessment are outside the development site boundary (usually by less than 30m). The VI data of these plots has been used in the assessment as they are within the same vegetation zones and landscape location. Thirty-five VI assessment plots were surveyed in total throughout the assessment area (see **Table 5-1**),

No VI plots were sampled beneath overhead transmission lines or in cleared power station infrastructure areas as these areas contained no native vegetation (mown exotic grass was dominant). Regular mowing and weed spraying occur under power lines and surrounding power station infrastructure (to remove vegetation and fire risk). As a result of decades of management, native vegetation has been replaced by exotic grasses and bare ground in these areas (see **Photo 5.1 to Photo 5.4**). No PCTs have been mapped in these open areas. Where planted or regrowth eucalypts occur amongst exotic grass, the relevant PCT has been allocated to the tree patch.



Photo 5.1 Mown exotic grass beneath transmission lines and around switch yards does not form any derived version of a PCT.



Photo 5.2 Mown exotic grass surrounding Power stations does not form any derived version of a PCT.



Photo 5.3 Mown exotic grass surrounding power station dam does not form any derived version of a PCT.



Photo 5.4 Mown / slashed exotic grass beneath transmission lines does not form any derived version of a PCT

Biodiversity development assessment report

Table 5-1 Vegetation zone area, condition class and number of BAM plots sampled

Vegetation zone	Plant Community Type name	PCT ID	Vegetation zone identification	Zone area (ha)	Min number of plots required (BAM)	Number of plots completed
Moss Vale sub-region						
MV-1	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	1254	1254_High	0.23	1	2
MV-2	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	1156	1156_High	1.31	1	3
MV-3			1156_Moderate_old regrowth	2.20	2	2
MV-4			1156_Moderate_shrub regrowth	1.06	1	1
MV-5	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	1082	1082_High	2.26	2	2
MV-6			1082_Moderate_old regrowth	4.29	2	3
Illawarra sub-region						
ILL-1	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	1156	1156_High	0.57	1	3
ILL-2			1156_Moderate_old regrowth	0.32	1	2
ILL-3			1156_Moderate_shrub regrowth	0.09	1	1
ILL-4	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	1082	1082_Moderate_old regrowth	0.004	2	3
ILL-5	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	1283	1283_Moderate_old regrowth	0.34	1	2
ILL-6			1283_Moderate_young regrowth	0.08	1	1
ILL-7			1283_Moderate_she-oak regrowth	0.03	1	1
ILL-8	Illawarra Escarpment Blue Gum wet forest	1245	1245_Moderate	1.41	1	3
Ettrema sub-region						
ETT-1	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	1283	1283_Moderate_old regrowth	2.19	2	2
ETT-2			1283_Moderate_young regrowth	0.02	1	1
ETT-3	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion	1083	1083_High	2.98	2	2
ETT-4			1083_Moderate_old regrowth	3.59	2	3
ETT-5			1083_Moderate_shrub regrowth	2.82	2	2
ETT-6	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion	1108	1108_Moderate_old regrowth	1.14	1	3
ETT-7			1108_Low derived regrowth	2.54	2	2

5.4 Plant Community Types

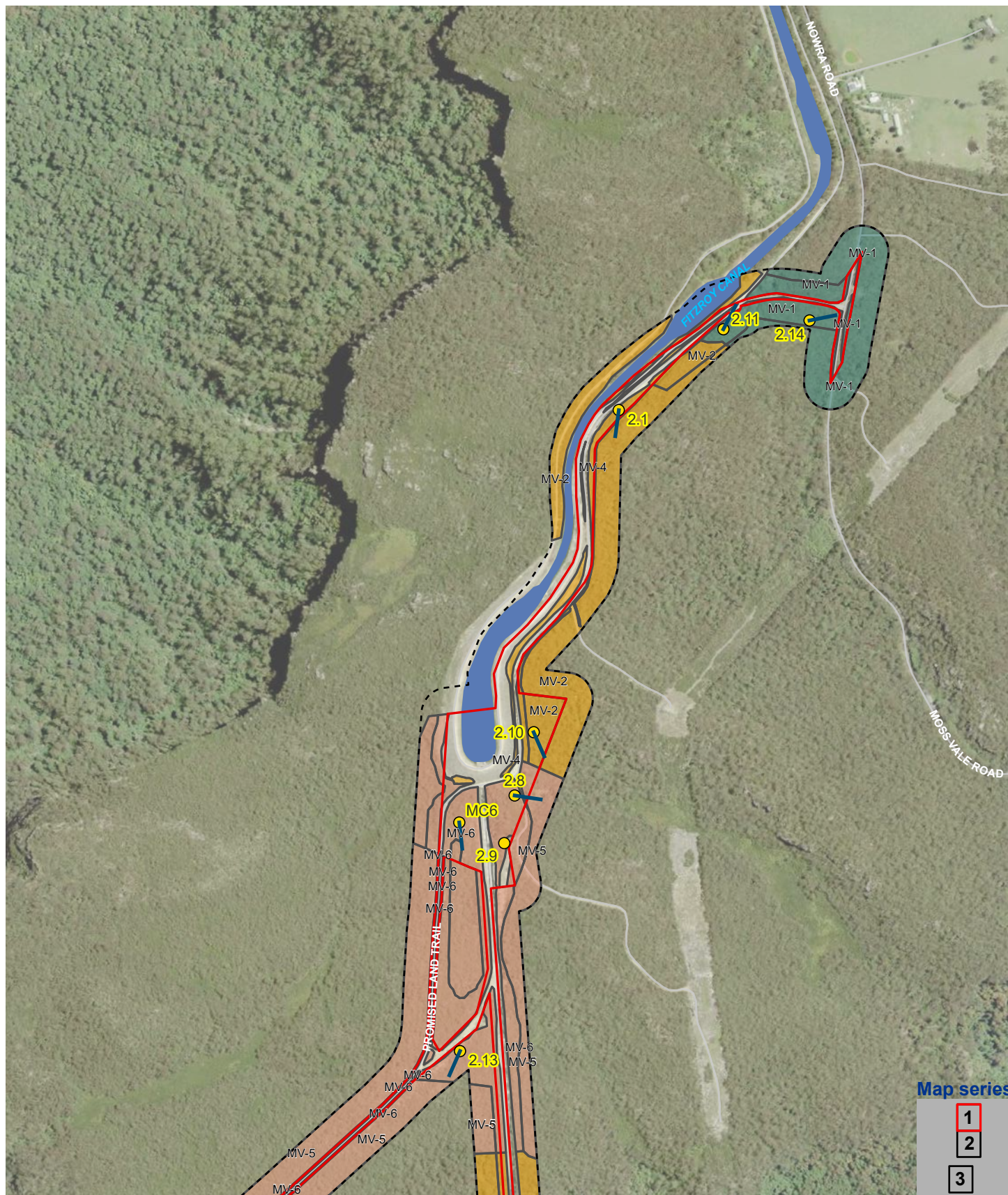
This BDAR describes PCTs in terms of their floristic composition, geological substrate, and relevant regional vegetation classification. The PCTs identified within the assessment area and the area of each PCT to be

directly impacted by the project are identified in **Table 5-2** and their distribution is illustrated in **Figure 5-1**. The PCTs within the direct impact area are the focus of calculating offset requirements.

Descriptions of the vegetation that occurs in the assessment area are provided in the following sections matched to the most likely PCT as described in the BioNet Vegetation Classification database. In some cases, the vegetation on site does not perfectly align with a PCT listed in the BioNet Vegetation Classification database, particularly in historically cleared / regrowth vegetation areas. In these scenarios, the vegetation has been allocated to the PCT with which it most closely aligns floristically, or to the nearest occurring intact vegetation patch.

Table 5-2 PCTs identified within the assessment area and direct impact area

PCT ID	PCT name	Vegetation formation	Vegetation class	TEC	Area in development site (ha)
1254	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Wet Sclerophyll Forests (Shrubby sub-formation)	Southern Escarpment Wet Sclerophyll Forests	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion (BC Act) Southern Highlands Shale Forest and Woodland in the Sydney Basin (EPBC Act)	0.23 ha
1156	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Not a TEC	5.55 ha
1082	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Southeast Dry Sclerophyll Forests	Not a TEC	6.55 ha
1283	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Lowland Wet Sclerophyll Forests	Not a TEC	2.65 ha
1245	Illawarra Escarpment Blue Gum wet forest	Wet Sclerophyll Forests (Shrubby sub-formation)	North Coast Wet Sclerophyll Forests	Not a TEC	1.41 ha
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Not a TEC	9.39 ha
1108	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion	Forested Wetlands	Eastern Riverine Forests	Not a TEC (see chapter 5.7)	3.68 ha



Legend

- BAM Vegetation Integrity Plots
- Vegetation Zone
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
- Development site
- Assessment area
- Waterbody

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources¹

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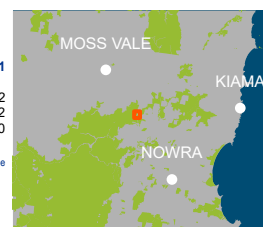
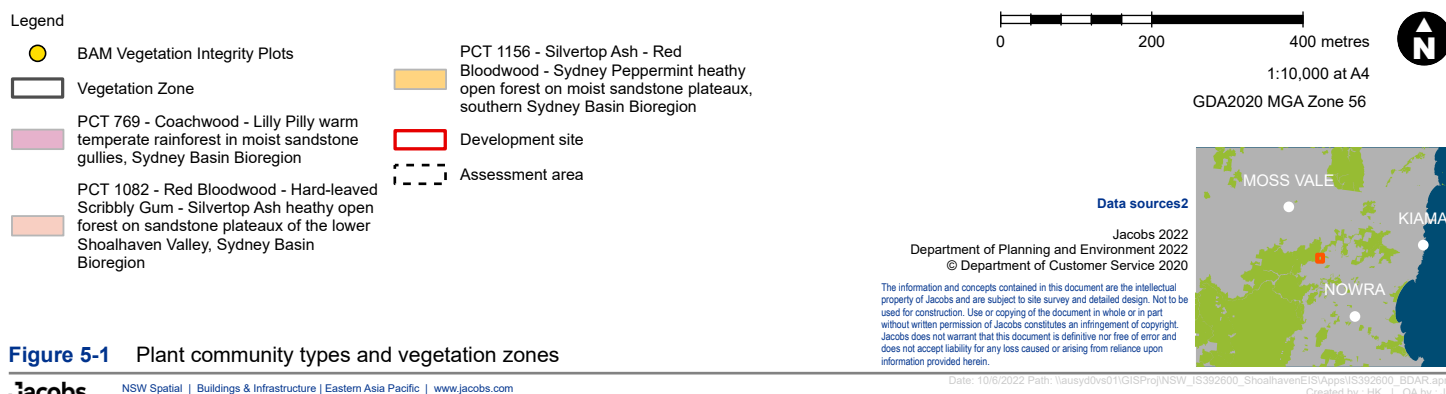
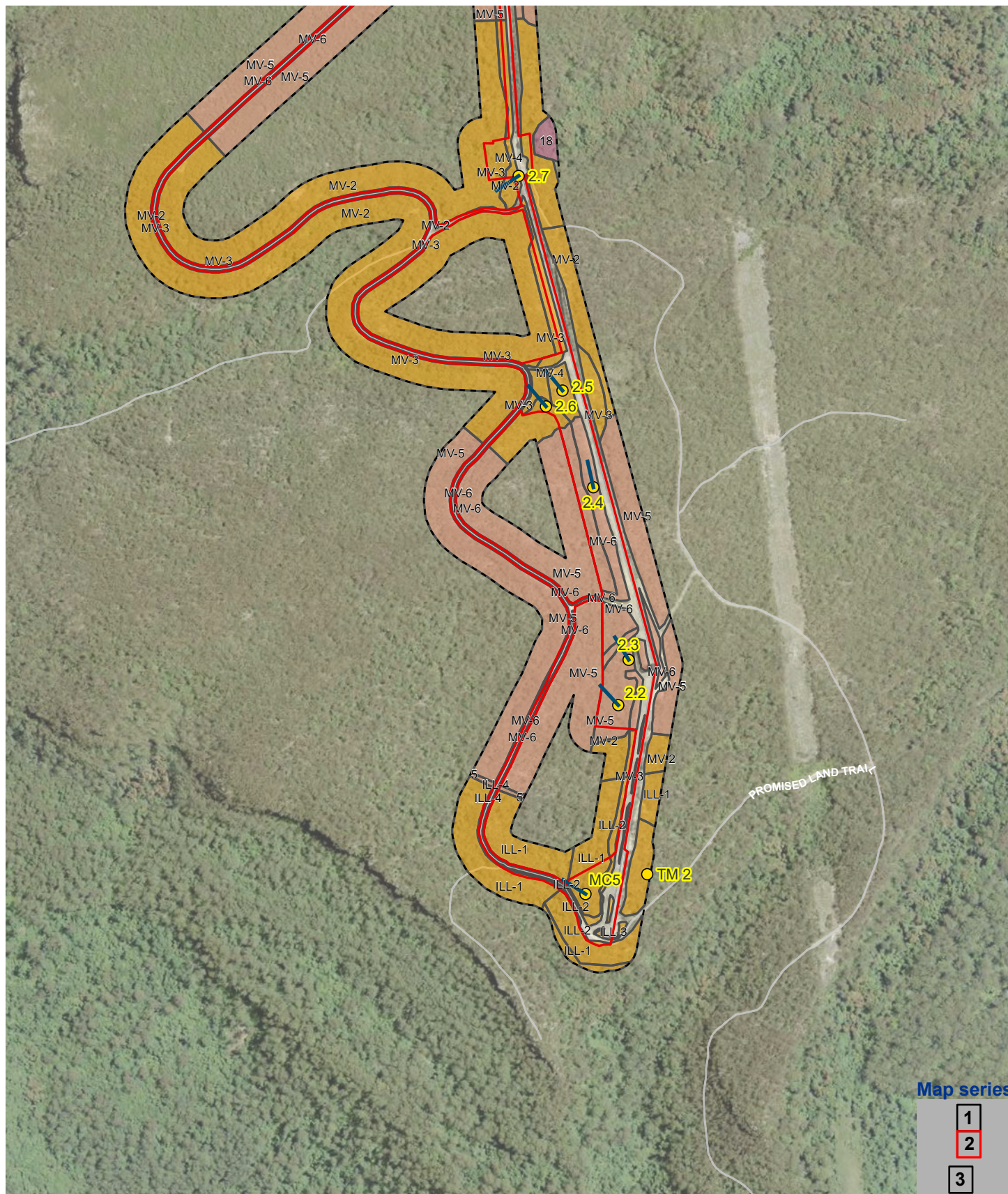
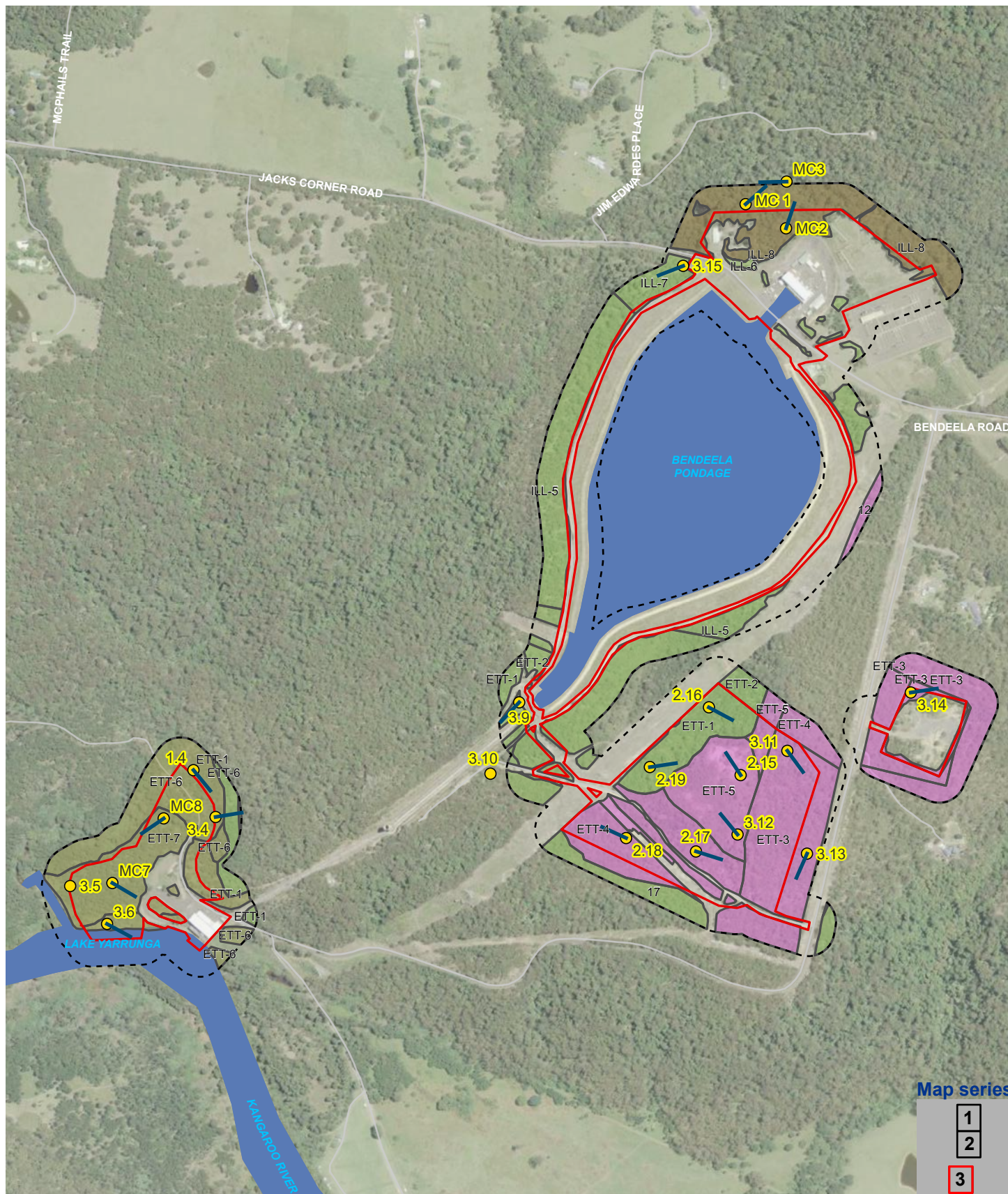


Figure 5-1 Plant community types and vegetation zones





Legend

- BAM Vegetation Integrity Plots
- Vegetation Zone
- PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
- PCT 1108 - River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
- PCT 1283 - Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion
- Development site
- Assessment area
- Waterbody

0 200 400 metres
1:10,000 at A4
GDA2020 MGA Zone 56



Data sources³

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Figure 5-1 Plant community types and vegetation zones

Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (1254)

Vegetation formation: Wet Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Southern Escarpment Wet Sclerophyll Forests

Threatened Ecological Community: Southern Highlands shale woodlands in the Sydney Basin Bioregion (BC Act) and Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion (EPBC Act)

Vegetation zones (condition) and plots:

- MV-1 (High) (Plot 2.14, Plot 2.11).

Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion is described in the BioNet Vegetation Classification database as a tall open forest with an open shrub layer and moist herbaceous groundcover and occurs on shale and the shale/basalt boundary at altitudes between 450 and 900m in the Blue Mountains and Southern Highlands (see **Photo 5.5**).

In the assessment area, this vegetation matches the descriptions of the Shale-Basalt Sheltered Forest (WSF p168) as described by Tozer et al (2010). PCT 1254 occupies loamy shale soils derived from Ashfield Shale in the Wianamatta Group.

PCT 1254 occurs along the start and entry of Promised Land Trail and along Nowra/Moss Vale Road in the north of the assessment area. Surrounding the assessment area, its patch size is estimated to be 22 hectares, mostly within Morton National Park.

This vegetation is most likely to be representative of PCT 1254 for the following reasons:

- This canopy is dense characterised by *Eucalyptus piperita*, *Eucalyptus globoidea* and *Eucalyptus cypellocarpa*
- The mid-storey layer is generally open characterised by *Clematis aristata*, *Eustrephus latifolius*, *Leucopogon lanceolatus* and *Notelaea venosa*
- The ground cover is mostly herbaceous dominated by *Blechnum cartilagineum*; *Dianella caerulea*, *Dichondra repens*, *Glycine clandestina*, *Lomandra longifolia*, *Microlaena stipoides* var. *stipoides*, *Pteridium esculentum*, *Hydrocotyle sibthorpioides* and *Viola hederacea*.
- This vegetation community is confined to shale or transitional shale/sandstone derived soils in the north of the assessment area and gradually transitions with PCT 1156 Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion to the south as sandstone derived soils become more prevalent.

A summary of the vegetation structure and floristics of PCT 1254 is given below in **Table 5-3**. This list of species reflects the local variation gathered from two floristic plots undertaken within the assessment area and also includes incidental observations while moving through the vegetation in the broader assessment area. Vegetation zone MV-1 is 'High' condition class as it contains all structural layers and is mostly remnant Eucalypt Forest, with only small areas of disturbance along the edges of Promised Lands Track. Weeds are minimal in the ground layer and only present in small patches on fire trail edges.

Table 5-3 Floristic and structural summary of PCT 1254

Vegetation layer	Dominant species
Tree canopy (upper stratum)	Eucalyptus piperita, Eucalyptus sieberi, Eucalyptus globoidea, Eucalyptus cypellocarpa, Syncarpia glomulifera, Allocasuarina littoralis.
Midstorey (mid-stratum)	Characterised by shrubs including Acacia obtusifolia, Acacia terminalis, Amperea xiphoclada, Banksia spinulosa, Elaeocarpus reticulatus, Exocarpos strictus, Hibbertia aspera, Lambertia formosa, Leptospermum polygalifolium, Leucopogon lanceolatus, Notelaea venosa, Persoonia levis, Persoonia linearis, Persoonia mollis, Pittosporum multiflorum, Pittosporum undulatum, Pultenaea daphnoides, Xylomelum pyrifforme.
Groundcovers (ground stratum)	<p>Grass and grass like species including Entolasia marginata, Entolasia stricta, Gahnia clarkei, Gahnia sieberiana, Lepidosperma laterale, Lomandra filiformis subsp. filiformis, Lomandra longifolia, Microlaena stipoides, Oplismenus imbecillis, Panicum sp., Rytidosperma sp., Schoenus melanostachys.</p> <p>Forbs including Centella asiatica, Chiloglottis sp., Commelina cyanea, Cryptostylis erecta, Dianella caerulea, Dichondra repens, Dipodium variegatum, Gonocarpus tetragynus, Gonocarpus teucroides, Hydrocotyle laxiflora, Hydrocotyle sibthorpioides, Lagenophora stipitata, Oxalis perennans, Poranthera microphylla, Senecio sp., and Viola hederacea.</p> <p>Ferns including Blechnum cartilagineum, Calochlaena dubia, Cyathea australis, Lindsaea microphylla, Pteridium esculentum, Sticherus lobatus.</p> <p>Species in the 'other' growth forms include Cissus hypoglauca, Clematis aristata, Eustrephus latifolius, Glycine clandestina, Hibbertia scandens, Marsdenia rostrata, Pandorea pandorana, Parsonsia straminea, Smilax glyciphylla.</p>
High Threat Weeds	Rubus fruticosus sp. agg (on Promised Land Trail entry)



Photo 5.5 PCT 1254 – Vegetation zone MV-1 (High condition class) near the entrance to Promised Lands Track from Nowra/Moss Vale Rd.

Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion (1156)

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Sydney Coastal Dry Sclerophyll Forests

Threatened Ecological Community: Not a TEC

Vegetation zones (condition) and plots:

- MV-2 and ILL-1 (High) (Plot 2.6, Plot 2.10, Plot MC5)
- MV-3 and ILL-2 (Moderate_old_regrowth) (Plot 2.1, Plot 2.7)
- MV-4 and ILL-3 (Moderate_shrub_regrowth) (Plot 2.5).

Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion is described in the BioNet Vegetation Classification database as low open forest with a dense sclerophyll shrub layer and open groundcover mainly of sedges occurring on periodically damp, elevated sandstone plateau between 550 and 1000m on the Budderoo and Morton plateau (refer to **Photo 5.6** and **Photo 5.7**).

In the assessment area, this vegetation matches the descriptions of the Budderoo-Morton Plateau Forest (DSF p141) described by Tozer et al (2010) and Coastal Escarpment Moist Shrub/Fern Forest (Vegetation Group 137) described by Gellie (2005). PCT 1156 occupies sandy loam derived from Hawkesbury Sandstone and Mittagong formation.

In the development site, PCT 1156 occurs throughout the plateau along the Fitzroy Falls canal on the Mittagong formation, on sheltered slopes and gully and at the southern portions of Promised Land Trail. There is broad variation within this community which is influenced by dry sclerophyll plants in Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion on the elevated slopes and wet sclerophyll plants in Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion on the lower slopes and gully.

This vegetation is most likely to be representative of PCT 1156 for the following reasons:

- The overstorey characteristic of *Eucalyptus sieberi*; *Corymbia gummifera*; *Eucalyptus piperita*
- The shrub stratum has a range of sclerophyll shrubs characteristic of *Acacia obtusifolia*, *Amperea xiphoclada*, *Aotus ericoides*, *Banksia paludosa*, *Banksia serrata*, *Bossiaea kiamensis*, *Leptospermum trinervium*
- The ground cover is dominated by sedges characteristic of *Gahnia sieberiana*; *Gleichenia dicarpa*; *Lomandra longifolia*.

This vegetation community is confined to sheltered slopes and sandstone seepage zones which grades into drier elevated slopes to form Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion.

A summary of the vegetation structure and floristics of PCT 1156 is given below in **Table 6 5**. This list of species reflects the local variation gathered from five floristic plots undertaken within the assessment area and also includes incidental observations while moving through the vegetation in the broader assessment area.

This PCT has been divided into three vegetation zones in order to separate remnant forest areas (high condition class) from the regrowth forms of vegetation resulting from the original clearing for the existing hydro scheme pipeline. Vegetation zone MV-3 (Moderate_old_regrowth) contains semi-mature eucalypt regrowth with a native midstorey and understorey, whereas vegetation zone MV-4 (Moderate_shrub_regrowth) contains only regrowth shrubs and is generally lacking a canopy layer (apart from sparse juvenile eucalypts). Regrowth vegetation zones often contained very dense shrubs such as *Kunzea ambigua* or *Leptospermum polygalifolium*.

Biodiversity development assessment report

Table 5-4 Floristic and structural summary of PCT 1156

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus sieberi</i> , <i>Eucalyptus piperita</i> , <i>Acacia binervata</i> , <i>Acmena smithii</i> , <i>Allocasuarina littoralis</i> , <i>Banksia serrata</i> , <i>Ceratopetalum apetalum</i> , <i>Corymbia gummifera</i> , <i>Syncarpia glomulifera</i> and <i>Tristaniopsis collina</i>
Midstorey (mid-stratum)	Characterised by shrubs including <i>Acacia mearnsii</i> , <i>Acacia obtusifolia</i> , <i>Acacia terminalis</i> , <i>Aotus ericoides</i> , <i>Banksia ericifolia</i> , <i>Banksia paludosa</i> , <i>Bursaria spinosa</i> , <i>Callicoma serratifolia</i> , <i>Dillwynia</i> spp., <i>Dracophyllum secundum</i> , <i>Elaeocarpus reticulatus</i> , <i>Epacris pulchella</i> , <i>Hakea laevipes</i> , <i>Hibbertia aspera</i> , <i>Isopogon anemonifolius</i> , <i>Kunzea ambigua</i> , <i>Kunzea capitata</i> , <i>Lambertia formosa</i> , <i>Leptospermum continentale</i> , <i>Leptospermum polygalifolium</i> , <i>Leptospermum trinervium</i> , <i>Leucopogon lanceolatus</i> , <i>Melaleuca hypericifolia</i> , <i>Monotoca scoparia</i> , <i>Notelaea venosa</i> , <i>Olearia</i> spp., <i>Persoonia levis</i> , <i>Persoonia linearis</i> , <i>Persoonia mollis</i> subsp. <i>ledifolia</i> , <i>Petrophile sessilis</i> , <i>Pittosporum undulatum</i> , <i>Platysace linearifolia</i> , <i>Podolobium ilicifolium</i> , <i>Pomaderris ligustrina</i> , <i>Pultenaea daphnoides</i> , <i>Tetratheca thymifolia</i> , <i>Xylomelum pyrifforme</i> .
Groundcovers (ground stratum)	Grass and grass like species including <i>Austrostipa pubescens</i> , <i>Caustis flexuosa</i> , <i>Cyathochaeta diandra</i> , <i>Entolasia marginata</i> , <i>Entolasia stricta</i> , <i>Gahnia clarkei</i> , <i>Gahnia sieberiana</i> , <i>Lepidosperma laterale</i> , <i>Lepyrodia scariosa</i> , <i>Lomandra filiformis</i> subsp. <i>filiformis</i> , <i>Lomandra longifolia</i> , <i>Lomandra obliqua</i> , <i>Microlaena stipoides</i> , <i>Oplismenus imbecillis</i> , <i>Panicum effusum</i> , <i>Poa</i> spp., <i>Rytidosperma</i> spp., <i>Schoenus melanostachys</i> . Forbs including <i>Cryptostylis erecta</i> , <i>Dampiera stricta</i> , <i>Dianella caerulea</i> , <i>Drosera spatulata</i> , <i>Gonocarpus teucroides</i> , <i>Lagenophora stipitata</i> , <i>Opercularia hispida</i> , <i>Oxalis perennans</i> , <i>Patersonia glabrata</i> , <i>Poranthera microphylla</i> , <i>Viola hederacea</i> . Ferns including <i>Blechnum cartilagineum</i> , <i>Calochlaena dubia</i> , <i>Gleichenia dicarpa</i> , <i>Lindsaea microphylla</i> , <i>Lycopodium deuterodensum</i> , <i>Pteridium esculentum</i> , <i>Sticherus flabellatus</i> , <i>Sticherus lobatus</i> . Species in the 'other' growth forms include <i>Billardiera scandens</i> , <i>Cissus hypoglauca</i> , <i>Clematis aristata</i> , <i>Cyathea australis</i> , <i>Eustrephus latifolius</i> , <i>Hardenbergia violacea</i> , <i>Morinda jasminoides</i> , <i>Pandorea pandorana</i> , <i>Parsonsia straminea</i> , <i>Smilax glycyphylla</i> .
High Threat Weeds	<i>Axonopus fissifolius</i>



Photo 5.6 Vegetation zone MV-2 near the proposed plateau vertical shaft entry- PCT 1156 (High) (Plot MC5).



Photo 5.7 Vegetation zone MV-4 adjacent to the existing pipeline- PCT 1156 (Moderate-shrub-regrowth) (Plot 2.5).

Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Southeast Dry Sclerophyll Forests

Threatened Ecological Community: Not a TEC

Vegetation zones (condition) and plots:

- MV-5 (High condition class) (Plot 2.3 Plot 2.2)
- MV-6 (moderate_old_regrowth condition class) (Plot 2.4, Plot 2.13, Plot MC6)
- ILL-4 (also moderate_old_regrowth but in Illawarra subregion) (above plots used)

On site, PCT 1082 exists in varying conditions and species assemblages. Less disturbed areas contain a mix of canopy species with a moderate to thick mid-storey of *Banksia*, *Hakea* and *Lambertia*. The canopy species include Red Bloodwood (*Corymbia gummifera*), Silvertop Ash (*Eucalyptus sieberi*), Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*), Old-man *Banksia* (*Banksia serrata*) and Yertchuk (*Eucalyptus consideniana*). The ground layer was often diverse and contained dense leaf litter with occasional sandstone rocks or bare sandy patches. Some disturbed areas of this PCT were found to have a monoculture of regrowth Silvertop Ash with a very sparse understorey and groundlayer (**Photo 5.8** to **Photo 5.10**). Some other regrowth areas (particularly along pipe and track edges) contained dense thickets of *Banksia ericifolia* or *Kunzea ambigua* with no canopy species.

PCT 1082 occurs sandstone plateaux up to 700m elevation in the lower Shoalhaven area. In the assessment area, this vegetation matches the descriptions of the Shoalhaven Sandstone Forest (DSF p148) as described by Tozer et al (2010) and has similarities to South Coast Lowland Dry Shrub Forest Vegetation Group 2 described by Gellie (2005). PCT 1082 occupies sandy loam derived from Wandrawandian Formation and Nowra Sandstone

This vegetation is most likely to be representative of PCT 1082 for the following reasons:

- The overstorey characteristic of *Eucalyptus sieberi*; *Corymbia gummifera*, *Eucalyptus sclerophylla*
- The shrub stratum has a range of sclerophyll shrubs including of *Hakea laevipes*, *Lambertia Formosa*, *Leptospermum trinervium*, *Persoonia levis*, *Platysace linearifolia*
- The ground cover is dominated by native species such as *Lomandra obliqua*, *Caustis flexuosa*, *Entolasia stricta* and *Patersonia sericia*

Table 5-5 Floristic and structural summary of PCT 1082

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Corymbia gummifera</i> , <i>Eucalyptus sieberi</i> , <i>Eucalyptus sclerophylla</i> , <i>Eucalyptus piperita</i> , <i>Eucalyptus consideniana</i> , <i>Eucalyptus agglomerata</i> , <i>Banksia serrata</i> , <i>Allocasuarina litoralis</i>
Midstorey (mid-stratum)	<i>Banksia spinulosa</i> , <i>Banksia ericifolia</i> , <i>Hakea laevipes</i> , <i>Lambertia Formosa</i> , <i>Leptospermum trinervium</i> , <i>Lomatia ilicifolia</i> , <i>Petrophile sessilis</i> , <i>Banksia palludosa</i> , <i>Platysace linearifolia</i> , <i>Pimelea linifolia</i> , <i>Leptomeria acida</i> ,
Groundcovers (ground stratum)	<i>Patersonia sericia</i> , <i>Patersonia glabrata</i> , <i>Lomandra multiflora</i> , <i>Lomandra obliqua</i> , <i>Caustis flexuosa</i> , <i>Entolasia stricta</i>
High Threat Weeds	-

This PCT has been divided into two vegetation zones in order to separate remnant forest areas (high condition class), (Vegetation zone MV-5) from the regrowth forms of vegetation resulting from the original clearing for the hydro scheme pipeline. Vegetation zone MV-6 (Moderate_old_regrowth) contains semi-mature eucalypt regrowth with a native midstorey and understorey. Regrowth vegetation zones often contained very dense shrubs such as *Kunzea ambigua* or *Leptospermum polygalifolium*. Some areas of Vegetation MV-6 along the pipeline edges contained a monoculture of *Eucalyptus sieberi* without midstorey species, and with very sparse ground layer vegetation (See **Photo 5.9**). The dominance of one species in these areas may be due to soil modifications during the original pipeline construction.



Photo 5.8 PCT 1082 - Vegetation zone MV-5 (High condition class).



Photo 5.9 A patch of PCT 1082 – moderate old regrowth (Vegetation zone MV-6 and ILL-4).



Photo 5.10 PCT 1082 – moderate shrub regrowth (Vegetation zone 7) occurs in areas of the plateau that have been more recently cleared or disturbed such as track edges, pipeline corridor edges and other operational areas.

Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion (PCT 1283)

Vegetation formation: Wet Sclerophyll Forests (Grassy sub-formation)

Vegetation class: Southern Lowland Wet Sclerophyll forests

Threatened Ecological Community: Not a TEC

Vegetation zones (condition) and plots:

- ILL-5 and ETT-1 (Moderate_old_regrowth) (Plot 2.19, Plot 2.16)
- ILL-6 and ETT-2 (Moderate_young_regrowth) (Plot 3.9)
- ILL-7 (Moderate_sheoak_regrowth) (Plot 3.15).
- VZ17 (High) (Plot 3.10) (This VZ is outside the development site)

Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion is a tall open forest with a dense shrub understorey occurring on sheltered slopes with loamy soil.

On site, PCT 1283 was dominated by advanced regenerating native vegetation at varying age classes with a mix of tree species including *Syncarpia glomulifera*, *Angophora floribunda*, *Eucalyptus globoidea*, *Eucalyptus eugenioides*, and occasional *Eucalyptus piperita*, *Eucalyptus saligna* x *botryoides* and *Corymbia gummifera* in the canopy. The shrub layer was often very dense with regrowth dominated by *Kunzea ambigua* and *Hakea salicifolia* and had a high richness of other shrubs (n=19) *Leptospermum trinervium*, *Acacia irrorata*, *Callistemon citrinus* and *Melaleuca linariifolia*. This PCT has been divided into four vegetation zones in order to separate remnant forest areas (high condition class) from the regrowth forms of vegetation resulting from the original clearing for the hydro scheme (>45 years). The high condition class areas are not within the development site (after avoidance and boundary refinements) and therefore are labelled VZ 17 (to keep out of the BAM-C entry). Vegetation ILL-5 (Moderate_old_regrowth) contains semi-mature eucalypt regrowth with a mostly native midstorey and understorey, with sometimes high levels of weed invasion. Vegetation zone ILL-6 (Moderate_young_regrowth) contains a highly disturbed mix of shrubs (native and exotic) and is generally lacking a canopy layer (apart from sparse juvenile eucalypts). Regrowth vegetation zones often contained very dense shrubs such as *Kunzea ambigua* or *Leptospermum polygalifolium*. One section of this PCT along the western edge of Bendeela pondage contains a monoculture of previously planted (or seeded) River Oak (*Casuarina Cunninghamiana*) growing on old spoil mounds (from the original dam excavation). This patch is labelled VZ ILL-7 (Moderate_sheoak_regrowth) and has been allocated to this PCT due to the surrounding dominance of *Syncarpia glomulifera* subsp. *glomulifera* and *Eucalyptus eugenioides* (see **Photo 5.11** to **Photo 5.14**).

There was a richness of shrubs including *Breynia oblongifolia*, *Pittosporum undulatum*, *Leucopogon juniperinus*, *Persoonia linearis*, *Allocasuarina littoralis*, *Bursaria spinosa* and *Melicactus dentatus*. The groundcover had a high cover of leaf litter with a range of grasses including *Microlaena stipoides*, *Panicum simile*, *Paspalidium distans*, *Eragrostis brownii*, *Entolasia stricta* and *Oplismenus aemulus*. There were also a range of herbs, rushes, and *Glycine* spp. Climbers

This vegetation is considered most likely to be representative of PCT 1283 for the following reasons:

- Dominance of *Syncarpia glomulifera* with a mix of other diagnostic tree species, including occasional *Eucalyptus piperita*, *Corymbia gummifera*; *Angophora floribunda* as well as *Eucalyptus piperita*
- The middle stratum was generally dense and rich with sclerophyllous shrub species including characteristic species *Acacia obtusifolia*, *Persoonia linearis*, *Banksia spinulosa*, *Elaeocarpus reticulatus*
- The ground stratum is characterised *Dianella caerulea*; *Entolasia stricta*; *Pteridium esculentum* and a suite of ground stratum species common to other PCTs on the site
- Semi-sheltered west facing slope with sandy loam soils on lowlands/foothills below the escarpment, transitioning into alluvial and riparian vegetation further toward Kangaroo River (PCT1108).

Given the past disturbance and high level of tree and shrub regrowth on the site, it was difficult to ascertain a definitive PCT. Some sections of the broader patch were also dominated by *Eucalyptus eugenioides* and *Angophora floribunda* typical of Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (PCT 838), however lacked any regrowth of *Eucalyptus tereticornis*. As the assessment area has characteristic tree species present and occurrence of wet sclerophyllous and mesic rainforest shrubs and low cover of grasses, the community is best suited within the Wet Sclerophyll Forests (Grassy sub-formation) Vegetation Formation.

The site also intergrades with a mix of *Eucalyptus saligna* x *botryoides* transitioning into PCT 1245 especially up- slope to the north where the steeper escarpment provides more shelter and mesic conditions. Regrowth comprised of high densities of natural tree and shrub regeneration with a low abundance of weeds. High Threat Weeds *Lantana camara*, *Ligustrum sinense*, *Ageratina adenophora* were observed in this PCT with a low to moderate cover of abundance.

Table 5-6 Floristic and structural summary of PCT 1283

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Syncarpia glomulifera</i> , <i>Angophora floribunda</i> , <i>Eucalyptus globoidea</i> , <i>Eucalyptus eugenioides</i> , <i>Eucalyptus scias</i> subsp. <i>callimastha</i> , <i>Eucalyptus saligna</i> x <i>botryoides</i> and <i>Corymbia gummifera</i>
Midstorey (mid-stratum)	<i>Kunzea ambigua</i> , <i>Leptospermum polygalifolium</i> , <i>Pittosporum undulatum</i> , <i>Breynia oblongifolia</i> , <i>Acacia obtusifolia</i> , <i>Persoonia linearis</i> , <i>Banksia spinulosa</i> , <i>Elaeocarpus reticulatus</i> , <i>Clerodendrum tomentosum</i>
Groundcovers (ground stratum)	<i>Dianella caerulea</i> ; <i>Entolasia stricta</i> ; <i>Microleana stipoides</i> , <i>Pteridium esculentum</i> , <i>Oplismenus aemulus</i> , <i>Stephania japonica</i>
High Threat Weeds	<i>Lantana camara</i> , <i>Ligustrum sinense</i> , <i>Ageratina adenophora</i>



Photo 5.11 PCT 1283 (High condition class), (Plot 3.10). The development site avoids this vegetation zone (VZ 17).



Photo 5.12 PCT1283 - Vegetation zone ILL-5 (Moderate-old-regrowth) containing semi-mature *Eucalyptus piperita*, *Angophora floribunda* and dense native midstorey layer.



Photo 5.13 PCT1283 - Vegetation zone ILL-6 (Moderate-young-regrowth) containing young *Eucalyptus* species, *Kunzea ambigua* and *Leptospermum polygalifolium*. (Plot 3.9).



Photo 5.14 1283 Moderate_She-oak_regrowth (*Casuarina cunninghamiana*) growing on spoil mound (surrounded by *Syncarpia glomulifera* subsp. *Glomulifera* and *Eucalyptus eugenioides*).

Illawarra Escarpment Blue Gum Wet Forest (PCT 1245)

Vegetation formation: Wet Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: North Coast Wet Sclerophyll Forests

Threatened Ecological Community: Not a TEC

Vegetation zones (condition) and plots:

- ILL-8 (Moderate) (Plot MC1, Plot MC2, Plot MC3).

Illawarra Escarpment Blue Gum Wet Forest is a very tall open forest which can have multiple layers of rainforest trees, palms and shrubs. Grows on deep chocolate clay soils on escarpment benches, alluvial flats and protected gullies.

On site, PCT 1245 was dominated by a mix of regrowth tree species including *Eucalyptus saligna*, *Eucalyptus botryoides* and *Eucalyptus saligna* x *botryoides* and *Syncarpia glomulifera*, with occasional *Angophora floribunda* and *Eucalyptus eugenioides*. Parts of the mid-storey was dense with *Pittosporum undulatum*, *Cassinia longifolia*, *Kunzea ambigua* and *Clerodendrum tomentosum*, as well as vine thickets of *Cissus hypoglauca*. *Rhodamnia rubescens* was also recorded in small numbers (and two specimens within the

development site). A small number of large *Eucalyptus saligna* x *botryoides* within Kings Creek may be remnant.

The shrub layer was very variable, dominated by dense regrowth of *Kunzea ambigua* and *Leucopogon juniperinus* as well as *Leptospermum trinervium* and *Senecio linearifolius*. The groundcover had a high cover of leaf litter with a range of grasses, herbs, climbers and ferns. Dominant species included *Entolasia marginata*, *Microlaena stipoides*, *Oplismenus aemulus*, *Morinda jasminoides*, and *Marsdenia rostrata*.

This vegetation is considered most likely to be representative of PCT 1245 for the following reasons:

- Dominance of *Eucalyptus saligna* x *botryoides*, *Eucalyptus saligna* and *Syncarpia glomulifera* with a mix of other tree species.
- The middle stratum was generally dense and rich with sclerophyllous shrub species including characteristic species *Notelaea venosa*, *Clerodendrum tomentosum*.
- The ground stratum lacked many of the characteristic ferns, but many were nearby in better sheltered slopes to west and south
- Semi-sheltered east facing slope with sandy loam soils.

As the assessment area has characteristic tree species present and occurrence of wet sclerophyllous and mesic rainforest shrubs and low cover of grasses, the community is best suited within the Wet Sclerophyll Forests (Shrubby sub-formation) Vegetation Formation. Regrowth comprised of high densities of natural tree and shrub regeneration with low to moderate levels of weeds. This vegetation zone is labelled moderate condition class as the entire area has been previously cleared for grazing or power station construction (1970s) (Figure 5-1).

Table 5-7 Floristic and structural summary of PCT 1245

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus saligna</i> , <i>Eucalyptus botryoides</i> and <i>Eucalyptus saligna</i> x <i>botryoides</i> , <i>Syncarpia glomulifera</i> , <i>Angophora floribunda</i> , <i>Eucalyptus eugenioides</i>
Midstorey (mid-stratum)	<i>Pittosporum undulatum</i> , <i>Cassinia longifolia</i> , <i>Kunzea ambigua</i> , <i>Clerodendrum tomentosum</i> , <i>Cissus hypoglauca</i> , <i>Cissus antarctica</i> , <i>Acmena smithii</i> , <i>Rhodamnia rubescens</i>
Groundcovers (ground stratum)	<i>Entolasia marginata</i> , <i>Microlaena stipoides</i> , <i>Oplismenus aemulus</i> , <i>Morinda jasminoides</i> , <i>Pteridium esculentum</i> , <i>Marsdenia rostrata</i> .
High Threat Weeds	<i>Lantana camara</i>



Photo 5.15 PCT 1245 to the west of Kangaroo Valley Power station containing mature regrowth vegetation, with some tall Blue Gums (likely remnant) occurring in Kings Creek (ephemeral drainage line).

Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion (PCT 1083)

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Sydney Coastal Dry Sclerophyll Forests

Threatened Ecological Community: Not a TEC

Vegetation zones (condition) and plots:

- ETT-3 (High) (Plot 3.11, Plot 3.13)
- ETT-4 (Moderate_old_regrowth) (Plot 2.17, Plot 3.14, Plot 2.18)
- ETT-5 (Moderate_shrub_regrowth) (Plot 2.15 Plot 3.12).

Within the development site, this PCT is restricted to the valley areas where sandstone geology is present (in the benches below the escarpment, but above the Kangaroo River alluvial slopes). Whilst this PCT is structurally and floristically similar to PCT 1082 (mapped in the plateau portion of development site), it was found to lack the *Eucalyptus sieberi*, *Eucalyptus consideniana*, *Eucalyptus piperita* canopy species which were frequent in PCT 1082. PCT 1082 on the plateau also contained heath habitats consisting of thick *Banksia ericifolia* growing on shallower soils, which was not apparent in the valley areas. Both PCTs are also separated by an altitude of almost 500m (and in separate IBRA subregions).

According to the BioNet VIS classification, this community is a low open forest with a diverse sclerophyll shrub layer and an open groundcover of sedges. This community occurs on crests, ridges and exposed slopes on coastal sandstone plateau. The vegetation in the assessment area is likely to be in the western extent of the distribution as Kangaroo Valley would be in the intergrade of coastal and highlands landscapes. It is unlikely the plateau areas of the Moss Vale subregion would be considered coastal plateau, and this is another reason for the segregation of PCT 1083 and 1082.

Based on historical clearing and disturbance, PCT 1083 has been separated into three vegetation zones for this assessment. Vegetation zone ETT-3 was allocated 'High' condition class as it consists of (likely) remnant forest with all structural components and old-growth *Eucalyptus sclerophylla* and *Corymbia gummifera* trees (some containing hollows). The midstorey and ground layer were floristically diverse and contained no weeds (apart from track or road edges).

Areas that have been historically cleared now contain mature regrowth and are nearing the structural complexity of remnant patches (Eucalypt canopy with midstorey and groundlayer components). These areas were mapped as Vegetation zone ETT-4 'Moderate-old-regrowth'. There was variation in this vegetation zone, with some areas containing a sparse midstorey and others containing very dense *Kunzea ambigua* or *Leptospermum polygalifolium* regrowth (however both variations contained a semi-mature Eucalypt canopy).

Vegetation zone ETT-5 'Moderate-shrub-regrowth' was mapped in areas with thick regrowth of native shrubs but without recruitment of *Eucalyptus* or *Corymbia* species (likely due to more intense clearing as well as modified substrates from previous soil borrow pits and stockpiles). Some regrowth areas (particularly along clearing edges) contained very dense thickets of *Kunzea ambigua* and *Leptospermum polygalifolium* which were out-competing other native species.

Table 5-8 Floristic and structural summary of PCT 1083

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus sclerophylla</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus oblonga</i> , <i>Eucalyptus piperita</i> , <i>Banksia serrata</i> , <i>Syncarpia glomulifera</i>
Midstorey (mid-stratum)	<i>Leptospermum trinervium</i> , <i>Lambertia formosa</i> , <i>Banksia spinulosa</i> , <i>Persoonia levis</i> , <i>Persoonia linearis</i> , <i>Leptospermum polygalifolium</i> , <i>Kunzea ambigua</i> , <i>Platysace linearifolia</i> , <i>Isopogon anemonifolius</i> , <i>Hakea laevipes</i> , <i>Acacia terminalis</i> , <i>Xylomelum pyriforme</i> , <i>Bossiaea heterophylla</i> , <i>Monotoca scoparia</i>
Groundcovers (ground stratum)	<i>Entolasia stricta</i> , <i>Patersonia sericea</i> , <i>Caustis flexuosa</i> , <i>Lomandra filiformis</i> , <i>Lomandra obliqua</i>
High Threat Weeds	-



Photo 5.16 PCT 1083 Vegetation zone ETT-3 (High condition class) near Bendeela road.



Photo 5.17 PCT 1083 Vegetation zone ETT-4 (Moderate old regrowth) near Bendeela road, showing regrowth *Eucalyptus sclerophylla*.



Photo 5.18 PCT 1083 (Plot 3.12) within the assessment area south of Bendeela pondage showing native shrub regrowth dominated by *Kunzea ambigua*, *Hakea laevipes*, and *Leptospermum polygalifolium*. Vegetation zone ETT-5 Moderate-shrub-regrowth.

River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion (PCT 1108)

Vegetation formation: Forested Wetlands

Vegetation class: Eastern Riverine Forests

Threatened Ecological Community: Not a TEC (see Section 5.7)

Vegetation zones (condition) and plots:

- ETT-6 (Moderate_old_regrowth) (Plot 3.6 Plot 3.4, Plot 1.4)
- ETT-7 (Low_derived_grassland) (Plot MC7 Plot MC 8).

River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion is an open eucalypt forest with an open shrub layer and dense cover of grasses and forbs. Grows on sandy alluvial flats, floodplain margins and in riverine corridors (refer to **Photo 5.19** and **Photo 5.20**).

PCT 1108 matches the floristic descriptions of South Coast River Flat Forest (FoW p30) as described by Tozer et al (2010). It occupies the Wandrawandian Formation comprising silty alluvium at 60-80 above sea level riverine corridor associated with the junction of Kings Creek and Kangaroo River. However, the assessment area extent is not flat and does not match the landform of a floodplain or river terrace. Instead, the land here is perched above a very steep, ten-meter-high riverbank, and slopes continuously uphill to the north (and into sandstone escarpments). There is nowhere for water to accumulate and even during very high rainfall events in 2021/2022, this land did not flood.

Much of PCT 1108 has been cleared in the past for livestock grazing and lacks an intact tree canopy and generally depauperate of native plant species. However, diagnostic trees characteristic of this community was observed either scattered or clumped in small groups and comprised *Eucalyptus elata*, *Angophora floribunda*, *Eucalyptus amplifolia* subsp. *Amplifolia* and *Casuarina cunninghamiana*. Patches of *Eucalyptus elata* and *Casuarina cunninghamiana* occur outside development site - to the east and west of the assessment area. Patches of semi-mature *Angophora floribunda* within development site were allocated to VZ ETT-6 (Moderate-old-regrowth condition class). Past disturbance and recent increase in weeds have also reduced tree regeneration. Dieback was prevalent in the large stands of *Acacia mearnsii* (which would have colonized following the original clearing). The recent decrease in the canopy of *Acacia mearnsii* has resulted in proliferation of exotic species such as *Ligustrum sinense*, *Solanum mauritianum* and *Sida rhombifolia* (due to increase light). Much of the ground cover is still dominated by native grasses *Microlaena stipoides* and *Oplismenus aemulus*, however some patches had very high weed cover (these areas have been included in VZ ETT-7 'low derived grassland' condition class).

In development site, PCT 1108 occurs at the southern extent of the project near the Bendeela Pumping Station and up to 700 m upstream of Kings Creek from Kangaroo River.

This vegetation is most likely to be representative of PCT 1108 for the following reasons:

- The overstorey is characteristic of *Angophora floribunda*, *Eucalyptus elata* and (mostly as separate patches)
- The shrub stratum is characteristic of *Acacia mearnsii*, *Breynia oblongifolia* and *Melicytus dentatus*
- The ground cover is dominated by grasses and forbs characteristic of *Dichondra repens*, *Entolasia marginata*; *Hydrocotyle laxiflora*, *Microlaena stipoides* var. *stipoides*; *Oplismenus aemulus*; *Pratia purpurascens*; *Pteridium esculentum* and *Stephania japonica*.

This vegetation community intergrades with wet sclerophyll forest (Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion 1283) further upslope where soils become more sandstone influenced.

A summary of the vegetation structure and floristics of PCT 1108 is given below in **Table 5-9**. This list of species reflects the local variation gathered from four floristic plots undertaken within the assessment area and also includes incidental observations while moving through the vegetation in the broader assessment area.

Table 5-9 Floristic and structural summary of PCT 1108

Vegetation layer	Dominant species
Tree canopy (upper stratum)	Infrequent <i>Angophora floribunda</i> , <i>Eucalyptus eugenoides</i> and <i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i> , <i>Clerodendrum tomentosum</i> , <i>Guioa semiglauc</i>
Midstorey (mid-stratum)	Characterised by very sparse native shrubs including <i>Acacia mearnsii</i> (in senescence), <i>Backhousia myrtifolia</i> (on steep riverbank), <i>Breynia oblongifolia</i> , <i>Bursaria spinosa</i> , <i>Cassinia aculeata</i> , <i>Leucopogon juniperinus</i> and <i>Pittosporum undulatum</i> . Recent senescence of <i>Acacia mearnsii</i> has resulted in loss of shading canopy and subsequent proliferation of exotic species such as <i>Ligustrum sinense</i> , <i>Solanum mauritianum</i> and <i>Sida rhombifolia</i> .
Groundcovers (ground stratum)	Grass species including <i>Microlaena stipoides</i> , <i>Oplismenus aemulus</i> , <i>Entolasia marginata</i> and <i>Eragrostis leptostachya</i> Forbs including <i>Commelina cyanea</i> , <i>Desmodium gunnii</i> , <i>Dichondra repens</i> , <i>Lagenophora stipitata</i> , <i>Oxalis perennans</i> , <i>Pratia purpurascens</i> , <i>Vernonia cinerea</i> , <i>Veronica plebeia</i> . Ferns including <i>Cheilanthes sieberi</i> , <i>Pellaea falcata</i> , <i>Pteridium esculentum</i> Species in the 'other' growth forms include <i>Cissus hypoglauc</i> , <i>Eustrephus latifolius</i> , <i>Glycine clandestina</i> , <i>Glycine tabacina</i> , <i>Hibbertia scandens</i> , <i>Marsdenia rostrata</i> , <i>Morinda jasminoides</i> , <i>Pandorea pandorana</i> , <i>Parsonsia straminea</i> , <i>Stephania japonica</i> . Dense weeds including <i>Sida rhombifolia</i> , <i>Anagallis arvensis</i> , <i>Cirsium vulgare</i> , <i>Conyza</i> spp., <i>Solanum mauritianum</i> , <i>Solanum pseudocapsicum</i> , <i>Tagetes minuta</i> , <i>Verbascum virgatum</i> , <i>Verbena bonariensis</i> .
High Threat Weeds	<i>Ligustrum sinense</i>



Photo 5.19 PCT 1108 to the west of Bendeela Power Station. Ett-6 (Moderate-old-regrowth) contains a canopy of semi-mature *Angophora floribunda* with high levels of weeds in the ground layer (with some areas of native grasses such as *Microlaena stipoides* and *Oplismenus aemulus*).



Photo 5.20 PCT 1108 to the west of Bendeela Power Station. Regrowth vegetation has lost canopy structure following senescence of *Acacia mearnsii*. Minimal recruitment of *Eucalypt* or *Acacia* and only sparse shrubs growing with a groundlayer of native grasses & invasive weeds). Given high cover of native grasses, this area is mapped as low-derived-grassland (Ett-7).

5.5 Vegetation zones and vegetation integrity scores

A description of the vegetation zones identified within the direct impact area and the corresponding current vegetation integrity (VI) score developed from the BAM Calculator is presented in Table 5-10. The VI survey plot data is provided in Appendix B and Appendix C.

Table 5-10 Vegetation zones directly impacted and vegetation integrity score

Vegetation zone	Plant Community Type name	PCT ID	Vegetation zone identification	Zone impact area (ha)	Current VI Score
Moss Vale sub-region					
MV-1	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	1254	1254_High	0.23	69.7
MV-2	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	1156	1156_High	1.31	68.3
MV-3			1156_Moderate_old regrowth	2.2	56.1
MV-4			1156_Moderate_shrub regrowth	1.06	40

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Vegetation zone	Plant Community Type name	PCT ID	Vegetation zone identification	Zone impact area (ha)	Current VI Score
MV-5	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	1082	1082_High	2.26	65.2
MV-6			1082_Moderate_old regrowth	4.29	57.9
Illawarra sub-region					
ILL-1	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	1156	1156_High	0.57	68.3
ILL-2			1156_Moderate_old regrowth	0.32	56.1
ILL-3			1156_Moderate_shrub regrowth	0.09	40
ILL-4	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	1082	1082_Moderate_old regrowth	0.004	57.9
ILL-5	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	1283	1283_Moderate_old regrowth	0.34	45.7
ILL-6			1283_Moderate_young regrowth	0.08	40
ILL-7			1283_Moderate_she-oak regrowth	0.03	60.5
ILL-8	Illawarra Escarpment Blue Gum Wet Forest	1245	1245_Moderate	1.41	46.3
Ettrema sub-region					
ETT-1	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	1283	1283_Moderate_old regrowth	2.19	45.7
ETT-2			1283_Moderate_young regrowth	0.02	40
ETT-3	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion	1083	1083_High	2.98	75.2
ETT-4			1083_Moderate_old regrowth	3.59	46.7
ETT-5			1083_Moderate_shrub regrowth	2.82	38.2
ETT-6	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion	1108	1108_Moderate_old regrowth	1.14	74.3
ETT-7			1108_Low derived regrowth	2.54	22.2

5.6 Patch size

A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land (development site). The patch may extend onto adjoining land beyond the footprint of the development site, and for woody ecosystems, includes native vegetation separated by less than or equal to 100 metres from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to less than or equal to 30 metres. Patch size for each vegetation zone located in the development site was mapped in accordance with Subsection 4.3.2 of the BAM using the following steps:

- Identify vegetation zones that will be included in the same patch
- Identify the boundary of any adjoining intact native vegetation which extends beyond the limit of the development site
- Digitise each patch in a GIS using separate polygons where multiple patches exist
- Calculate the area of each patch in hectare in a GIS.

The patch was then allocated to a patch size class (<5 ha, 5–24 ha, 25–100 ha or >100 ha). Patch size class is used as a filter in the BAM-C to predict threatened species likely to occur or use habitat on development site. In the plateau portions of the assessment area there are no major barriers that break apart vegetation (apart from the existing hydro scheme pipeline, dams and tracks as well as the 40m wide Nowra/Moss Vale Road alignment). All vegetation is within 100m (usually less) of the vast forest areas of Morton NP. The valley portions of the assessment area contain higher levels of fragmentation and clearing from power station areas, dams, public roads and paddocks (private properties). However, based on aerial imagery and regional vegetation mapping, the valley areas still contain contiguous forest patches which are within close proximity to vegetation of development site. As such, the vegetation zones entered in the BAM-C are all contiguous with a maximum patch size class of greater than 100 hectares.

5.7 Threatened ecological communities

The plant community types recorded within the assessment area are generally widespread in the areas of Ettrema, Illawarra and Moss Vale IBRA subregions, with large expanses of dry sclerophyll and wet sclerophyll

forest occupying the sandstone ridges and escarpments of Morton National Park, Budderoo National Park and Kangaroo Valley. However, vegetation communities associated with fertile shale soils of the Southern Highlands and the alluvial river flats of Kangaroo Valley have been largely cleared for agriculture during the 1900s and are now only represented by small and fragmented patches (occurring largely within private property). PCT 1254 (Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion) and PCT 1108 (River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion) have been extensively cleared in these regions and both are often associated with TECs.

- Southern Highlands Shale Woodlands in the Sydney Basin Bioregion (PCT 1254)
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and Southeast Corner bioregions (PCT 1108).

An assessment of each PCT and their likelihood to constitute a TEC is provided below.

Southern Highlands Shale Woodlands in the Sydney Basin Bioregion

Southern Highlands Shale Woodland is confined to a small area in the Southern Highlands. It occurs roughly within an area bounded by the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. This community is restricted to clay soils derived from Wianamatta Shale. This community occurs mostly in scattered patches of less than 5 hectares in area, remnants are extensively fragmented; about 2000 hectares, or less than 5% of the original extent now remains Thackway and Cresswell (1995).

Within the assessment area, PCT 1254 was found to contain characteristic tree species of this TEC, including Mountain Grey Gum (*Eucalyptus cypellocarpa*), Sydney Peppermint (*Eucalyptus piperita*), Narrow-leaved Peppermint (*Eucalyptus radiata*) and White Stringybark (*Eucalyptus globoidea*). Characteristic mid-stratum species such as Yellow tea-tree (*Leptospermum polygalifolium*), Prickly beard-heath (*Leucopogon juniperinus*), Lance beard-heath (*Leucopogon lanceolatus*) and Sweet Pittosporum (*Pittosporum undulatum*) also occur. The landform (on top of a plateau) is also correct, and soils were obviously different to the nearby sandstone - influenced PCT 1156 (Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion). Within the assessment area PCT 1254 occurs along the start and entry of Promised Land Trail and along Nowra/Moss Vale Road in the north of the assessment area. Using available vegetation mapping, the vegetation recorded within the edges of the development site is part of a large patch of around 22 hectares. The vegetation is in good condition (vegetation zone MV1 – high condition class) with only minor disturbance along the edges of the Promised Lands Track. In the assessment area, this vegetation matches the descriptions of the Shale-Basalt Sheltered Forest (WSF p168) as described by Tozer et al (2010). PCT 1254 occupies loamy shale soils derived from Ashfield Shale in the Wianamatta Group.

Given the landscape position of this vegetation, as well as the characteristic plant species recorded, the areas of PCT 1254 in the assessment area conform to the Southern Highlands Shale Woodlands in the Sydney Basin Bioregion EEC. There is 0.23 hectares of this community within development site (see **Figure 5-1** and **Table 5-11**).

River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and Southeast Corner bioregions (Endangered)

This Endangered Ecological Community is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The most widespread and abundant dominant trees typically include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney.

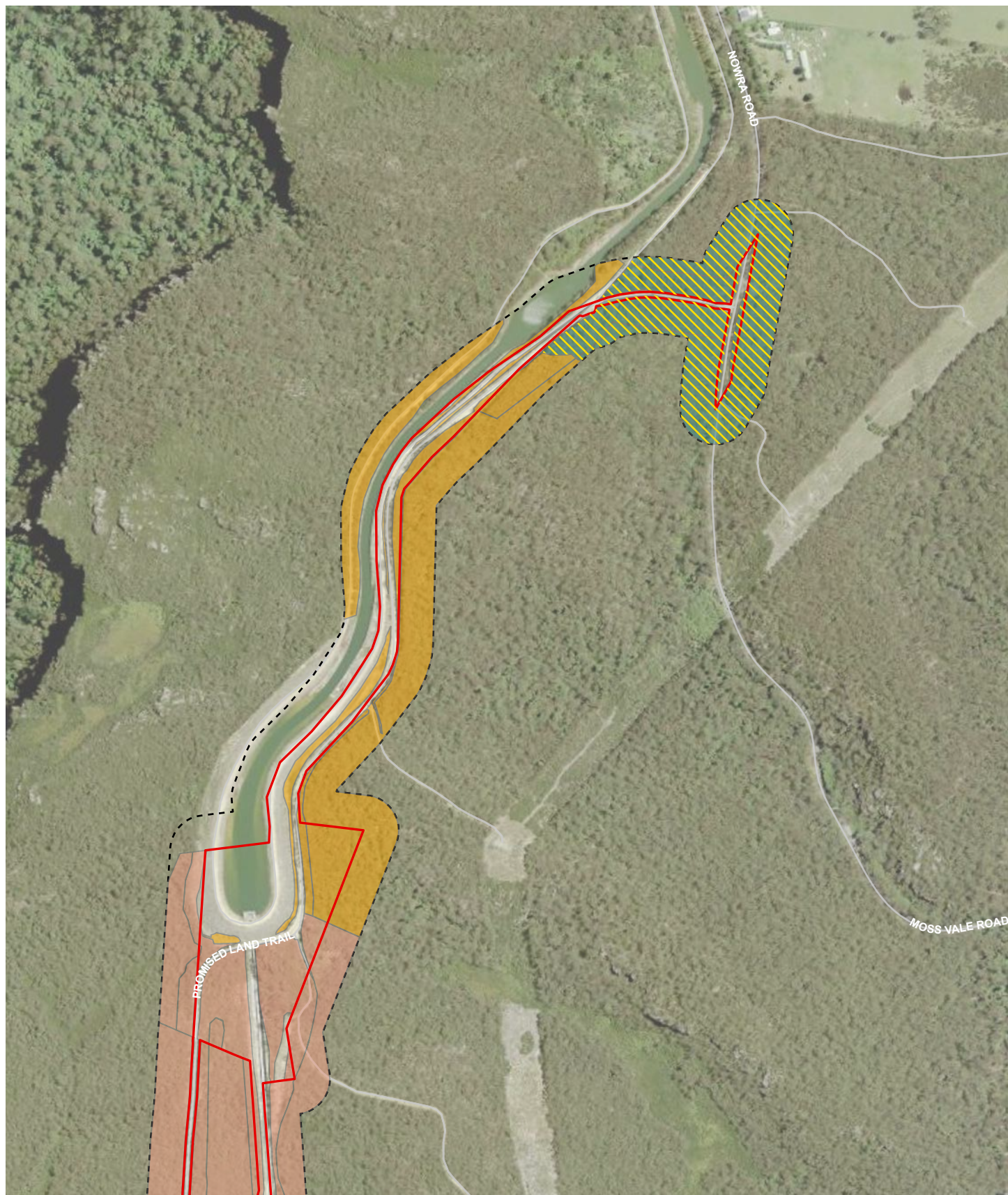
Within the study area a narrow patch of *Backhousia myrtifolia* occupies the water edge of Kangaroo River (growing on very steep and elevated banks) and was mapped as PCT1108. There are no *Melaleuca* species within the PCT 1108 areas of development site -indicating that flooding does not occur here. *Casuarina cunninghamiana* are limited to flat areas further downstream of Kangaroo River and do not occur in development site. Characteristic groundcovers such as *Stephania japonica*, *Microlaena stipoides* var. *stipoides*, *Oplismenus aemulus*, *Pratia purpurascens* and *Pteridium esculentum* were recorded across the assessment area and are abundant in the cleared portions which lack a canopy.

Much of the land along the edges of Kangaroo River was originally cleared for grazing, including the assessment area west of Bendeela Power Station. As a result, the areas of PCT 1108 within development site (3.68 hectares) are highly modified and the majority (2.54 hectares) lacks any trees (including regeneration of canopy species). Areas without trees are mapped as PCT 1108 'derived grassland' and contain native grasses with occasional native shrubs (with high prevalence of weeds).

River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and Southeast Corner bioregions forms part of a complex of forested wetland and treeless wetland communities found throughout the coastal floodplains of NSW. The Project is elevated above Kangaroo River by steep banks, approximately 10 metres tall (see **Photo 5.21** and **Photo 5.22**). Behind the steep banks, the land is sloped and does not represent a river terrace (i.e. no flat benches). Similarly, the land adjacent to Kings Creek (to the west) is sloping. The gradient of slopes increases to the north, into steeper sandstone escarpments. Recent surveys during Summer and Autumn 2022 coincided with very high above average rainfall conditions, and subsequent flooding events occurred of Kangaroo River. The patches of PCT 1108 were observed not to be inundated during these times, nor was water accumulated on the ground within development site. Water is likely to run down-slope directly into Kings Creek or off the steep banks into Kangaroo River below. The assessment area in this location would not periodically flood (or occasionally flood) and would not retain transient water. As a result, the areas of PCT 1108 in development site are not considered to constitute the River flat eucalypt forest TEC as the landscape is not consistent with a periodically inundated alluvial flat, drainage lines or river terraces associated with coastal floodplains.



Photo 5.21 and Photo 5.22 View from above 10m high bank of Kangaroo River (with moderate condition PCT 1108 - *Angophora floribunda* trees).



Legend

- | | |
|--|--|
| <p>PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> | <p>PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Southern Highlands Shale Woodlands in the Sydney Basin Bioregion (Endangered Ecological Community)</p> <p>Development site</p> <p>Assessment area</p> |
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Data sources

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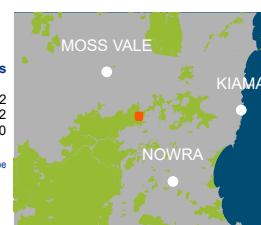


Figure 5-2 Threatened ecological communities

5.8 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the assessment area has been identified using the National GDE Atlas - Atlas of Groundwater Dependent Ecosystems (GDEs) (Bureau of Meteorology, 2020) and the Risk Assessment Guidelines for Groundwater Dependent Ecosystems released by the NSW DPI (Kuginis *et al.*, 2012).

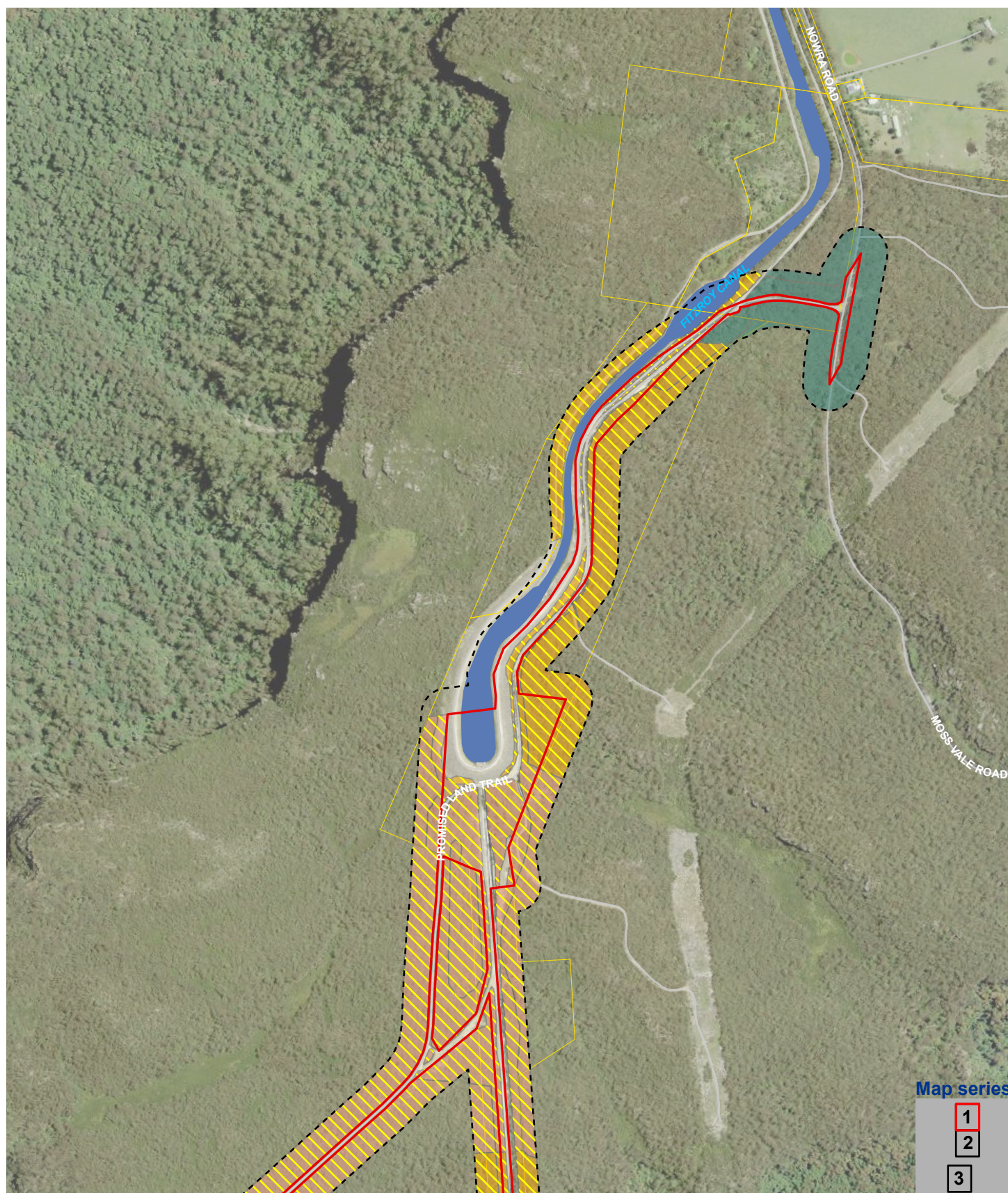
There are three types of GDEs generally recognised and these are as listed on the National GDE Atlas:

- Aquatic ecosystems that rely on the surface discharge of groundwater – including surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – including forests and riparian vegetation
- Subterranean ecosystems – including caves and aquifer ecosystems.

Potential terrestrial GDEs have been identified on the national database in the assessment area:

- Shoalhaven Sandstone Forest - Low potential GDE (PCT 1156, PCT 1082, PCT 1083)
- Turpentine forest - Low potential GDE (PCT 1238)
- Escarpment foothills wet forest -Moderate potential GDE (PCT 1245)
- Riverbank forest - High potential GDE (PCT1108).

The PCTs identified in the development site that correspond with terrestrial GDE mapping are shown in **Figure 5-3**.



PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

Shoalhaven Sandstone Forest - Low potential GDE

Development site

Project area

Waterbody

0 200 400 metres

1:10,000 at A4

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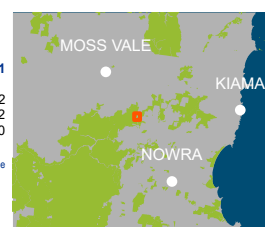
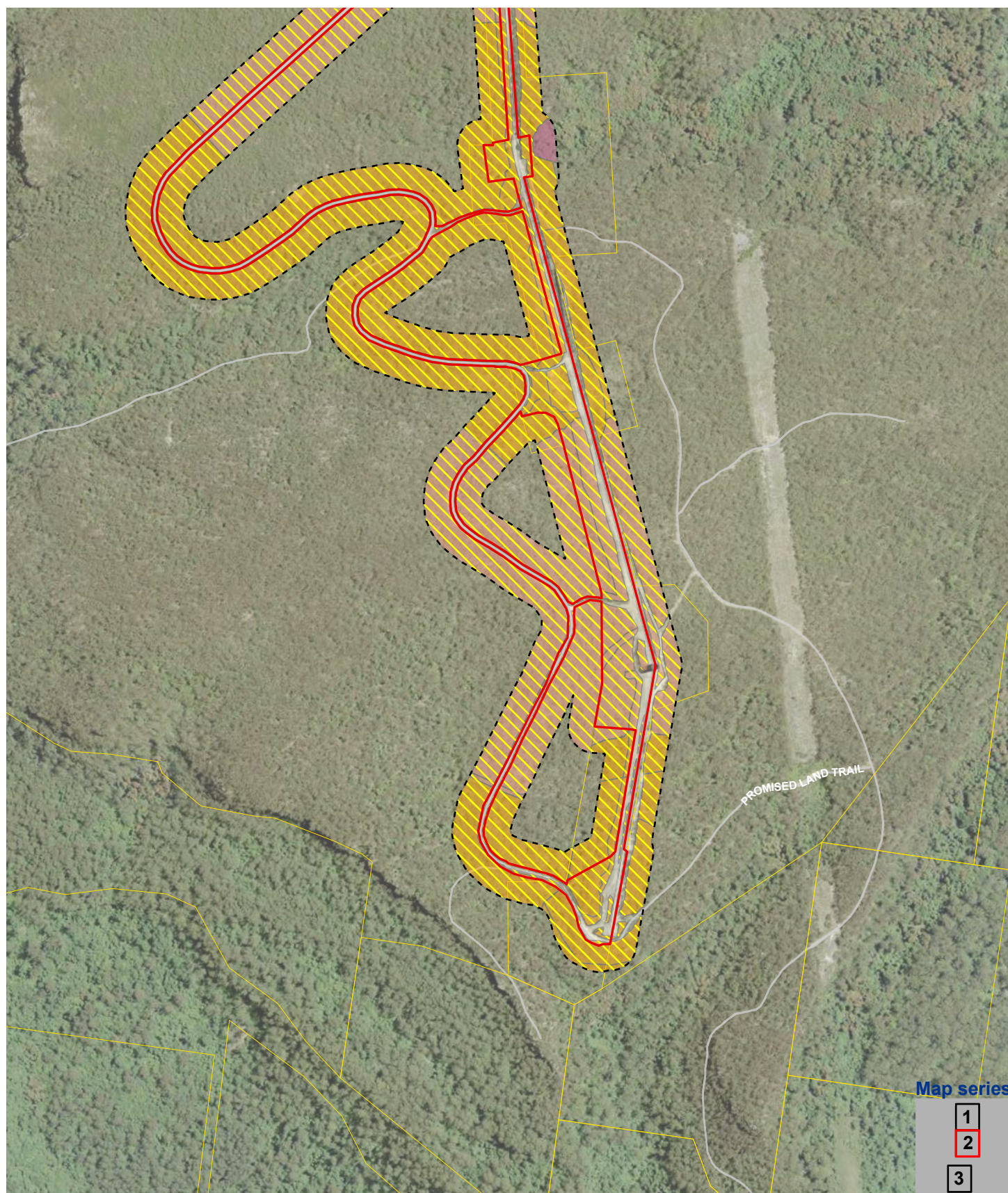


Figure 5-3 Groundwater Dependent Ecosystems



- PCT 769 - Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- Shoalhaven Sandstone Forest - Low potential GDE
- Development site
- Assessment area

0 200 400 metres

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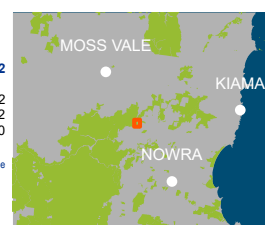
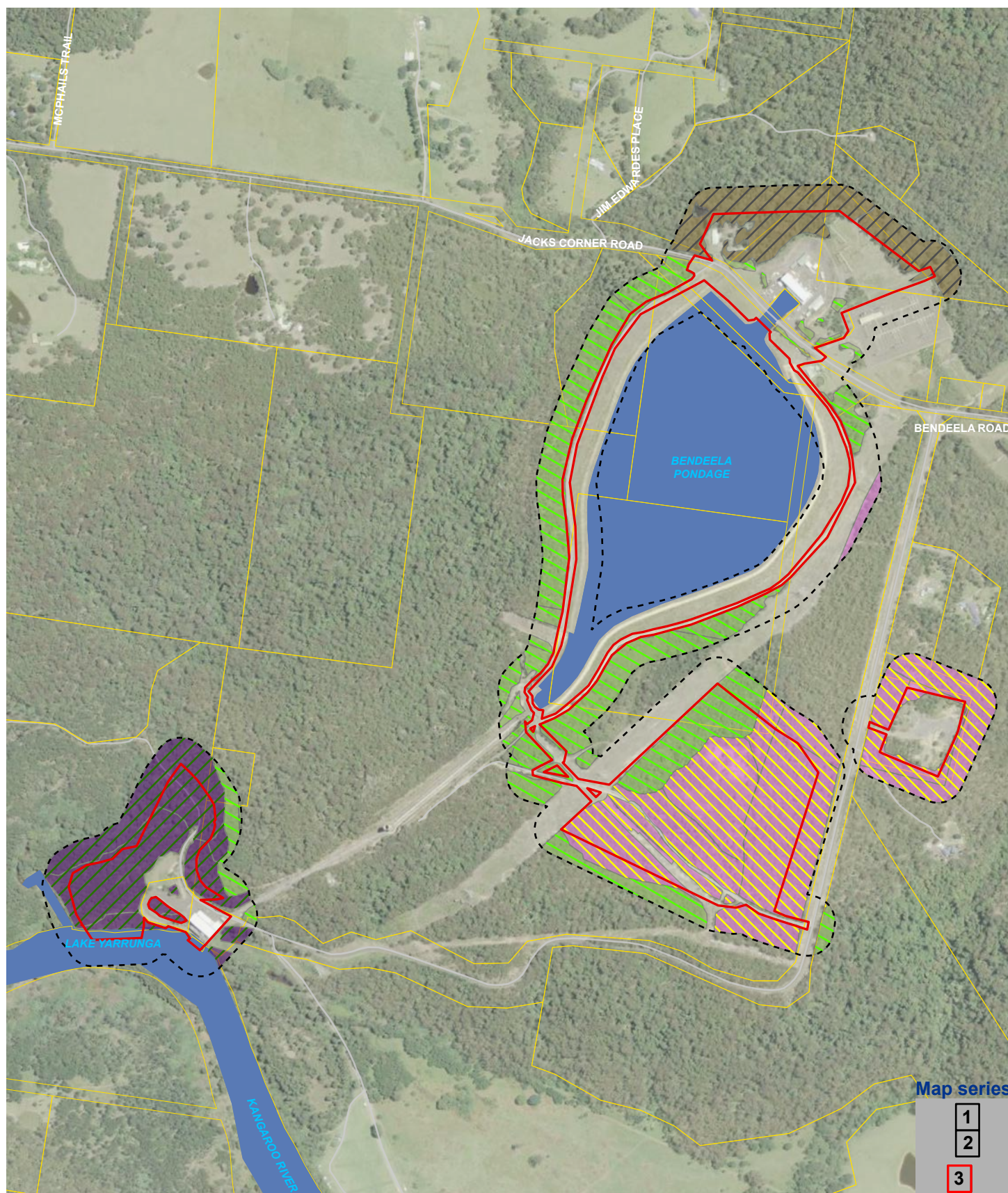


Figure 5-3 Groundwater Dependent Ecosystems



- PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
- PCT 1108 - River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
- PCT 1283 - Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion
- Shoalhaven Sandstone Forest - Low potential GDE
- Turpentine forest - Low potential GDE
- Escarpment foothills wet forest - Moderate potential GDE
- River bank forest - High potential GDE

- Development site
- Assessment area
- Waterbody

0 200 400 metres

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Data sources3

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Figure 5-3 Groundwater Dependent Ecosystems

5.9 Survey limitations

The desktop assessment and field survey undertaken for this BDAR provide a limited view into the ecological values of the assessment area. The diversity of flora and fauna species recorded from this project should not be seen to be comprehensive. It is unlikely that every species present within the development site has been recorded. The field survey aimed to sample the development site and a comprehensive inventory of species was not made. Whilst surveys have been undertaken throughout various seasons, over multiple years, a longer period is often needed to identify all the species present in an area. Some species are only apparent at certain times of the year or under specific weather conditions, (orchids or migratory birds). Breeding and flowering periods do not occur every year for some species. The conclusions of this report are therefore based upon available data and are indicative of the environmental condition of the development site at the time of the surveys. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species. All surveys have been conducted in accordance with the BAM and best practice guidelines.

In many cases there are no clear lines defining the transition between PCTs, so the vegetation mapping provided in this BDAR is supported by on ground floristic surveys and observations of potential ecotones. Plant communities are naturally variable and the boundaries between different PCTs on this site overlap considerably with a gradual transition from one community to another. However, a choice must be made to map and assign a PCT to an area of the site. As mapping necessitates that a hard boundary is drawn to separate PCTs, boundaries of PCTs and vegetation zones have been mapped as best as possible based on observations made during the field survey and based on patterns observed on aerial photography. It is likely that the boundaries of PCTs and vegetation zones will change with time and in response to long-term variation in biophysical conditions on the site such as rainfall and surface drainage patterns.

6. Threatened species

6.1 Background research and data sources

The Biodiversity Assessment Calculator (BAM-C) was used to derive the initial list of candidate species for this assessment by entering bioregion, and subregion, followed by the PCTs recorded, the area of PCTs and the Patch size values. The results were also supplemented with database searches including a review of the BioNet Atlas data and Threatened Biodiversity Data Collection (TBDC), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the locality and the assessment area.

The following databases and information sources were reviewed to prepare a list of potential threatened and migratory species for survey:

- Biodiversity Assessment Calculator (BAM-C) – case numbers 00034804 (Ettrema), 00035326 (Moss Vale) and 00035327 (Illawarra)
- BioNet - the website for the Atlas of NSW Wildlife and Threatened Species Profile Database – last reviewed February and July 2022
- DoAWE Protected Matters Search Tool – searched 19 May 2022
- NSW Biodiversity Values Map and Threshold Tool – reviewed July 2022
- Important Area Maps - reviewed July 2022.

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the EESG NSW Threatened Species Scientific Committee website. At the time of writing, there are no preliminary or provisional listings of relevance to the project (Public exhibition list last updated 14 June 2022).

6.2 Threatened species habitat assessment

This section describes the process of assessing the habitat types within the development site and broader assessment area in order to assess the habitat suitability for threatened species as outlined in Section 5 of the BAM.

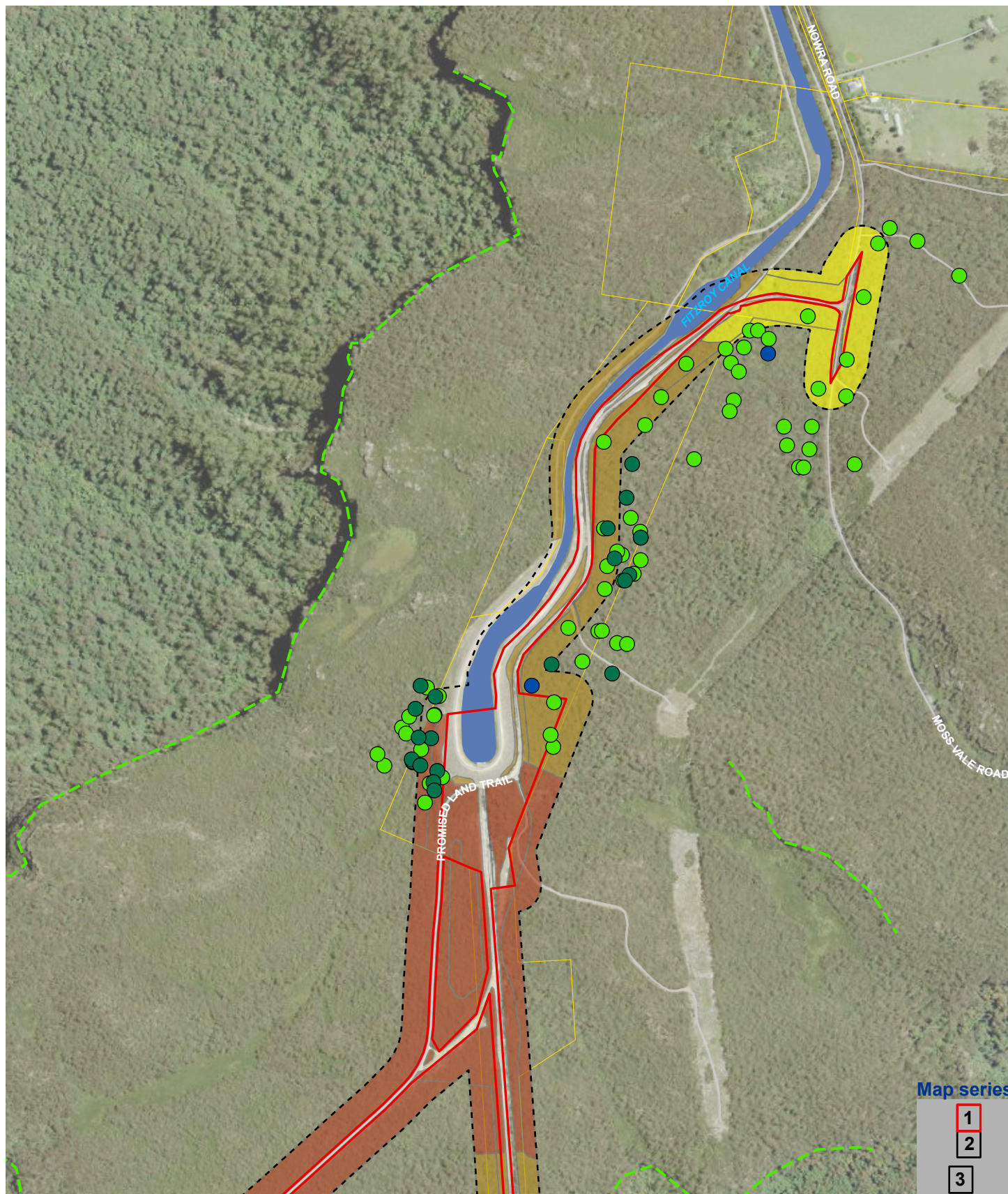
6.2.1 Habitat types

The broad habitat types identified within the development site, along with the corresponding PCT, are described below and quantified in area in **Table 6 1**. Five vegetation classes (Keith, 2004) recognized as six broad habitat types were identified, which occur within the development site. Each PCT in the development site has its own broad habitat type allocation, apart from PCT 1156 and PCT 1083 which both represent Sydney Coastal Dry Sclerophyll Forests. All habitats are well represented in the surrounding forest areas and the locality and particularly widespread in Morton National Park. Photos of each Broad habitat type are provided in **Section 5.4** (with allocated PCTs). **Figure 6-1** shows the location of the habitat types (as associated PCTs) within the development site and assessment area.

Table 6-1 Description of the habitat types available for threatened species in the assessment area

Habitat type (Vegetation Class: Keith 2006)	Associated PCT in the assessment area	Area directly impacted (ha)	Subregion	General description
Southern escarpment wet sclerophyll forests	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT1254)	0.23 ha	Moss Vale	Tall dense eucalypt forest with straight-trunked trees 30-60m tall. The understorey is highly variable in structure and species composition. At some sites tall mesophyllous shrubs, small trees or tree ferns form a closed subcanopy 15 m tall, allowing only a scattering of shade- tolerant ferns and herbs to persist amongst the copious leaf litter. However, at more open sites there is a relatively diverse ground cover of ferns and herbs, and this form of understorey attains its maximum cover and diversity on basalt soils. High elevation sheltered slopes and moist plateau of the escarpment where mean annual rainfall exceeds 1300 mm, extending down moist gullies through rugged terrain where rainfall may decline below 1000 mm per annum. Typically, on moderately fertile granitic soils, but also on loams derived from siltstones, or fertile clay loams on basalt (Keith & Benson, 1988; Keith & Bedward, 1999; Thomas et al. 2000). The areas of PCT 1254 in the assessment area are characteristic of the above description and contain large, mature eucalypts with occasional large tree hollows. The forest floor contains hollow logs, wood debris as well as intact groundcover and midstorey stratum.
Sydney Coastal Dry Sclerophyll Forests	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion (PCT1156)	5.55 ha	Illawarra, Moss Vale	Open eucalypt forests and woodlands 10-25 m tall with prominent and diverse sclerophyll shrub understorey and open groundcover of sclerophyll sedges. Below 700 m elevation on quartzose sandstone ridges, slopes and gullies with infertile sandy loams. Areas receiving 1000 mm to more than 1300 mm mean annual rainfall. Locally variable in relation to topography and soil development. Includes a very diverse and endemic sclerophyll shrub stratum showing floristic affinities with Hinterland and Montane Sydney Dry Sclerophyll Forests and Coastal Dune Dry Sclerophyll Forests. Partially cleared for urban development (Benson & Howell, 1994; Keith, 1995). The patches of 'high condition class' PCT 1156 in the plateau portions of the assessment area are characteristic of the above description and contain a canopy of mature eucalypts with occasional tree hollows. The forest floor contains hollow logs, wood debris as well as diverse shrub understorey. Exposed sandstone rocks are also a feature of the ground layer.
	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion (PCT1083)	9.39 ha	Ettrema	The areas of 'high condition class' PCT 1083 in the valley portions of the assessment area are also characteristic of the above description and contain a canopy of mature eucalypts with occasional tree hollows. The forest floor contains hollow logs, wood debris as well as sandstone rocks. The midstorey stratum ranges from a sparse shrubland to thick regrowth vegetation (particularly where soils are shallower, or vegetation has been historically disturbed). This habitat type regularly intergrades Southern Lowland Wet Sclerophyll Forests (PCT 1238) where gullies and slopes provide more shelter.
South-East Dry Sclerophyll Forests	Red Bloodwood - Hard- leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT1082)	6.55 ha	Moss Vale Illawarra	Open forest 15-25 m tall, dominated by stringybark and ash eucalypts, often with an open subcanopy of Sheoak or wattles. The understorey includes an open cover of sclerophyllous shrubs and a sparse groundcover of sedges and grasses. Ridges and exposed slopes on lowlands, coastal ranges and escarpment from sea level to 1300 m elevation where the average annual rainfall varies from 850 to 1100 mm. The soils are shallow, infertile sandy loams derived from sedimentary or granitic substrates with a high content of quartz. Relatively species-poor compared to other dry sclerophyll forests of the coast and tablelands. Composition varies across the broad altitudinal range, with species richness declining with elevation. (Keith & Bedward, 1999; Thomas et al. 2000). Patches of 'high condition class' PCT 1082 in the plateau portions of the assessment area are characteristic of the above description and contain a canopy of mature eucalypts with occasional tree hollows. The forest floor contains hollow logs, wood debris as well as sandstone rocks. The midstorey stratum ranges from a sparse shrubland to thick heath vegetation (particularly where soils are shallower, or vegetation has been historically disturbed).

Habitat type (Vegetation Class: Keith 2006)	Associated PCT in the assessment area	Area directly impacted (ha)	Subregion	General description
Southern Lowland Wet Sclerophyll Forests	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion (PCT1283)	2.65 ha	Ettrema, Illawarra	Tall dense eucalypt forests with straight-boled trees over 30m tall. Understorey includes an open stratum of tall mesophyllous shrubs, occasional vines and a continuous herbaceous groundcover. Sheltered slopes in coastal foothills mostly below 250m elevation on moderately fertile soils derived from low-quartz sedimentary substrates. Occurs in coastal foothills from Kangaroo valley to Moruya, only found in NSW. Species-rich assemblages, relatively consistent in composition, grading into South coast semi-mesic forests with decreasing moisture availability (Thomas et al., 2000). The areas of 'high condition class' PCT 1238 in the valley portions of the assessment area are characteristic of the above description and contain a canopy of mature eucalypts with occasional tree hollows. The forest floor contains hollow logs, wood debris as well as diverse shrub understorey. Exposed sandstone rocks are also a feature of the ground layer. Vegetation zones which have been historically disturbed generally contain very thick regrowth shrub layers and weedy ground layers.
North Coast Wet Sclerophyll Forests	Illawarra Escarpment Blue Gum wet forest (PCT1245)	1.41 ha	Illawarra	Tall dense forests with straight-boled dominant eucalypts 30-60 m tall, and subdominant stratum of mesophyllous small trees or tall shrubs up to 15 m tall. The understorey comprises a second layer of mesophyllous shrubs, which interrupt an otherwise continuous ground stratum of ferns and herbs. Vines are a conspicuous feature, sprawling over shrubs and smaller trees. Occurs on coastal ranges and foothills, or on alluvium in sheltered creek flats, generally below 500 m elevation on relatively fertile rocky substrates and alluvium where rainfall exceeds 1000 mm per annum. A diverse and variable group of assemblages that vary in composition depending on soil fertility, terrain and elevation (Benson & Hager, 1993; NPWS, 1999; Clarke et al. 2000). Areas of 'moderate condition class' PCT 1245 in the valley portions of the assessment area are characteristic of the above description and contain a canopy of semi-mature eucalypts with occasional old-growth Blue Gums in Kings Creek. Due to past clearing, there are no hollow-bearing trees, and the forest floor is mostly void of large hollow logs. The midstorey stratum ranges from sparse shrubs to vine thickets. This habitat type dominates the sheltered escarpment behind Kangaroo Valley Power station, and intergrades with Southern Lowland Wet Sclerophyll Forests (PCT 1238).
Eastern Riverine Forests	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion (PCT1108)	3.68 ha	Ettrema	Open Casuarina Forest, 10-40 m tall, with a variable non-sclerophyll shrub stratum and patchy groundcover of sedges and herbs, interspersed with leaf litter, cobbles and open sand. A distinctive locally restricted group of assemblages whose composition varies with latitude, elevation and adjoining vegetation. Degraded in some parts of its range by runoff and livestock from adjoining agricultural areas. Riparian corridors in open terrain of the coastal hinterland and tablelands up to 800 m elevation. Soils are moist and dynamic sandy substrates with boulders and cobbles. (Keith & Bedward, 1999; Thomas et al. 2000; Clark et al. 2000). The areas of PCT 1108 within the assessment area lack <i>Casuarina cunninghamiana</i> and instead contain trees such as <i>Angophora floribunda</i> , <i>Eucalyptus elata</i> and <i>Eucalyptus amplifolia</i> . Although the majority of PCT 1108 in development site lacks trees and exists as a derived grassland (with a lack of habitat and structural complexity). The assessment area is also notably raised above Kangaroo River and the landform does not constitute a riverbed, floodplain, or river terrace. The site is 10m above the river height and slopes continuously uphill to the north. No water accumulates in the assessment area (even during high rainfall events).



- Development site
- Project area
- Broad habitat types (Keith, 2004)
- South East Dry Sclerophyll Forests
- Southern Escarpment Wet Sclerophyll Forests
- Sydney Coastal Dry Sclerophyll Forests
- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Greater Glider den tree
- Cliff line (Large-eared Pied Bat Breeding habitat)
- Waterbody

0 200 400 metres

1:10,000 at A4

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Map series

1
2
3

Data sources¹

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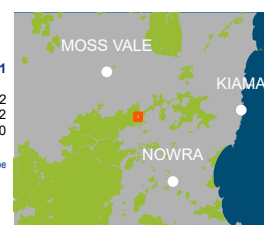
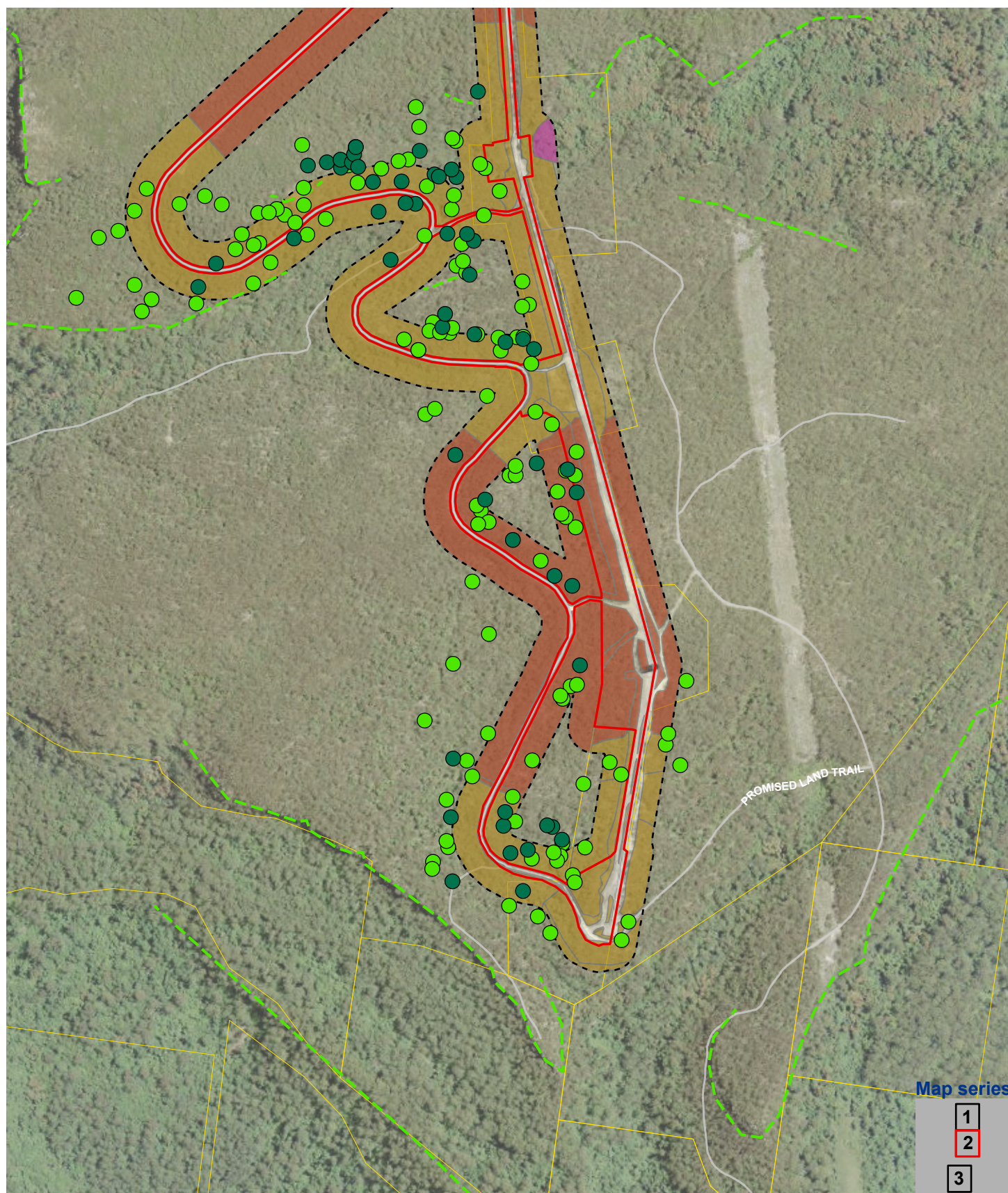


Figure 6-1 Broad habitat types and habitat features within the study area



- Development site
- Project area
- Broad habitat types (Keith, 2004)
-
- South East Dry Sclerophyll Forests
- Sydney Coastal Dry Sclerophyll Forests

- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Cliff line (Large-eared Pied Bat Breeding habitat)

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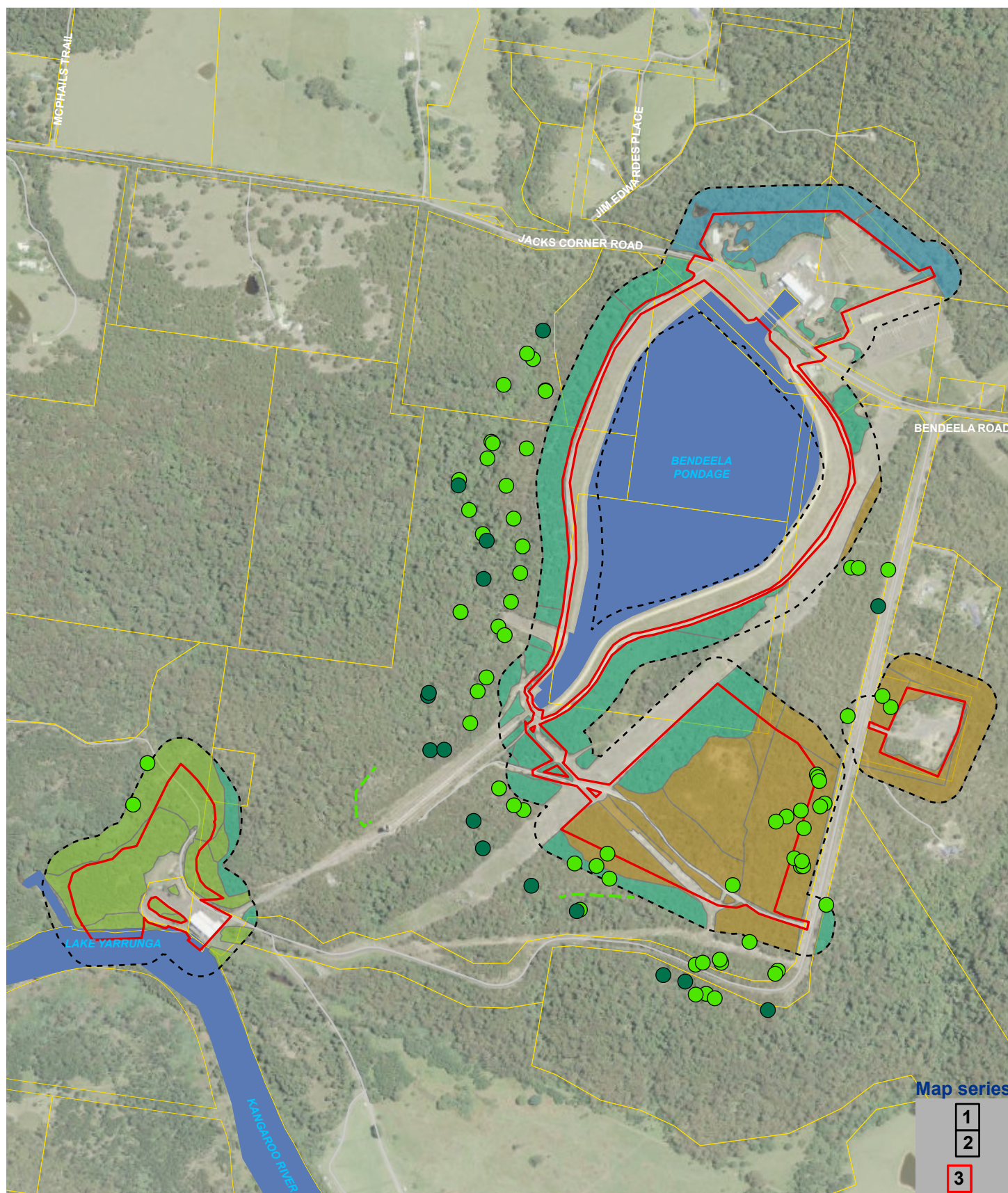
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Figure 6-1 Broad habitat types and habitat features within the study area



- Development site
- Project area
- Broad habitat types (Keith, 2004)
 - Eastern Riverine Forests
 - North Coast Wet Sclerophyll Forests
 - Southern Lowland Wet Sclerophyll Forests
 - Sydney Coastal Dry Sclerophyll Forests
- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Cliff line (Large-eared Pied Bat Breeding habitat)
- Waterbody

0 200 400 metres

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Map series

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Data sources3

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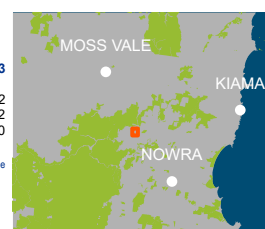


Figure 6-1 Broad habitat types and habitat features within the study area

The areas of each broad habitat type outlined in **Table 6-1** above are the total area of each corresponding PCT within development site. Much of the vegetation within development site (and within each PCT) has been previously cleared or disturbed and no longer meets the structural or floristic condition of the broad habitat type. The 29.5 hectares of vegetation within the development site is comprised of approximately 22.2 ha of regrowth and 7.3 hectares of potentially remnant native vegetation. As such, the habitat quality for threatened species varies greatly between condition classes (and vegetation zones).

6.2.2 Habitat suitability for species that can be predicted by habitat surrogates (ecosystem-credit species)

Ecosystem credit species are those 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. Ecosystem credit threatened species have been assessed in conjunction with information about site context (Section 1 and Chapter 3 of the BAM), PCTs and vegetation integrity attributes (Chapter 4 of the BAM), and data from the TBDC.

The three separate BAM-C cases used in the assessment (per subregion) were used to generate a list of the predicted threatened species that met the criteria outlined in Section 5.2.1 of the BAM. The results of the BioNet Atlas search and the federal DoAWE PMST were also used to inform development of the species list.

The initial list of predicted ecosystem-credit species is provided in **Table 6-2**. The full threatened species habitat suitability assessment is provided in Appendix A. Note that the justification for inclusion / exclusion included in **Table 6-2** is an assessment of potential habitat availability for each ecosystem-credit species and does not necessarily align with the likelihood of that species occurring in the development site, as detailed in **Appendix A**.

Once the initial list of predicted ecosystem-credit species was generated, the geographic limitations of each species (where applicable) were examined to see if they were met. Geographic limitations usually relate to altitude or topographic features and different geographic limitations can be described for different IBRA bioregion and subregions across a species' distribution. Where the development site is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken. However, no geographic limitations were identified for any of the species listed in **Table 6-2**.

In accordance with Section 5.2.2 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur on the development site. Most species do not have any identified habitat constraints, in which case this step was not undertaken. As shown in **Table 6-2**, three ecosystem-credit species were identified as having habitat constraints.

- Glossy Black-Cockatoo (Foraging) habitat is restricted to associated PCTs that contain *Allocasuarina* and *Casuarina* tree species. All associated PCTs within development site were found to contain *Allocasuarina* or *Casuarina* and were included
- The development site contains waterbodies and is therefore suitable as foraging habitat for White-bellied Sea-Eagle. However only PCTs within 1km of waterbodies are included
- Yellow-bellied Glider (*Petaurus australis*) habitat requires the presence of large hollow-bearing trees (hollow diameter >25cm). Only the PCTs and vegetation zones containing hollow-bearing trees, or mature trees (of species which are likely to form hollows) have been included for this species. Vegetation zones which have no mature eucalypts or HBTs were excluded (such as shrub-regrowth, derived grasslands condition classes). Moderate-old-regrowth condition class vegetation zones contained semi-mature eucalypts with small and medium hollows (which may form large hollows in the future) and were included. PCT 1245 contains no HBTs and was excluded
- Under the BAM, targeted survey is not required for ecosystem-credit species. In some circumstances, the TBDC may identify that a species requires assessment for ecosystem-credits and species-credits (a dual credit species). This occurs where part of the habitat is assessed as a species-credit (breeding habitat, or mapped locations identified as important area that is used by a species). The remaining part of the habitat is assessed as an ecosystem-credit (foraging habitat, unmapped locations used by a species)
- There are no mapped important areas within or near the development site for the Regent Honeyeater. However, the BAM-C does not identify this as a habitat constraint for the ecosystem-credit component for this species (and foraging habitat is included). The TBDC states that mapped important areas constitute the species-credit component for this species. This species has been included as an ecosystem-credit species.

Biodiversity development assessment report

Table 6-2 Predicted ecosystem-credit species identified by the BAM-C (Ettrema Subregion, Moss Vale Subregion and Illawarra Subregion)

Species	Common name	EPBC Act	BC Act	Ettrema	Moss Vale	Illawarra	Habitat constraints and geographic limitations	Justification for inclusion / exclusion	Sensitivity to gain class
<i>Anthochaera phrygia</i>	Regent Honeyeater (Foraging)	CE	CE	√		√	none	included	High
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	V	√	√	√	none	included	Moderate
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Foraging)	V	E	√	√	√	none	included	Moderate
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo (Foraging)	V	V	√	√	√	Presence of Allocasuarina and casuarina species	Included (except for PCT 1245 which contains no Allocasuarina or casuarina species)	High
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	√		√	none	included	High
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	√	√	√	none	included	Moderate
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)	-	V	√			Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Included (most vegetation zones are within 1km of Kangaroo River or power station dams)	High
<i>Hieraaetus morphnoides</i>	Little Eagle (Foraging)	-	V	√	√	√	none	included	Moderate
<i>Hirundapus caudacutus</i>	White-throated Needletail	V	-	√	√	√	none	included	High
<i>Lathamus discolor</i>	Swift Parrot (Foraging)	CE	E		√	√	none	included	Moderate
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)	-	V	√	√	√	none	included	Moderate
<i>Neophema pulchella</i>	Turquoise Parrot	-	V	√	√	√	none	included	High
<i>Ninox connivens</i>	Barking Owl (Foraging)	-	V	√	√	√	none	included	High
<i>Ninox strenua</i>	Powerful Owl (Foraging)	-	V	√	√	√	none	included	High
<i>Pachycephala olivacea</i>	Olive Whistler	-	V	√	√	√	none	included	Moderate
<i>Petroica boodang</i>	Scarlet Robin	-	V	√	√	√	none	included	Moderate
<i>Petroica phoenicea</i>	Flame Robin	-	V		√	√	none	included	Moderate

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Species	Common name	EPBC Act	BC Act	Ettrema	Moss Vale	Illawarra	Habitat constraints and geographic limitations	Justification for inclusion / exclusion	Sensitivity to gain class
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	-	V	√			none	included	High
<i>Tyto tenebricosa</i>	Sooty Owl (Foraging)	-	V	√			none	included	High
<i>Ptilinopus regina</i>	Rose-crowned Fruit Dove	-	V			√	North of Gerringong	included	Moderate
<i>Ptilinopus superbus</i>	Superb Fruit Dove	-	V			√	none	included	Moderate
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	E	V	√	√	√	none	included	High
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	√	√	√	none	included	High
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	-	V	√	√	√	none	included	High
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Foraging)	-	V	√	√	√	none	included	High
<i>Miniopterus australis</i>	Little Bent-winged Bat (Foraging)					√			
<i>Petaurus australis</i>	Yellow-bellied Glider	-	V	√	√	√	Hollow-bearing trees / Hollows > 25cm diameter	Included (except for vegetation zones which lack hollow-bearing trees / young regrowth vegetation)	High
<i>Phoniscus papuensis</i>	Golden-tipped Bat	-	V	√		√	none	included	High
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	V	-	√	√	√	none	included	High
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Foraging)	V	V	√	√	√	none	included	High
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	-	V	√	√	√	none	included	High
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	√	√	√	none	included	High
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (Foraging)	V	E	√	√	√	none	included	High
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	-	V	√	√		none	included	High

Key: E = Endangered, V = Vulnerable, M = Migratory

6.2.3 Habitat suitability for species that cannot be predicted by habitat surrogates (species-credit species)

Habitat suitability is identified as the degree to which the habitat needs of threatened species are present at a particular site. Species credit species have been assessed in conjunction with information collected about the context of the development site (Section 3 of the BAM), on PCTs and vegetation integrity attributes in (Section 4 of the BAM), and data obtained from the TBDC (Section 5.2 of the BAM).

Threatened species for which the likelihood of occurrence of the species (or elements of suitable habitat for the species) cannot be confidently predicted by vegetation surrogates and landscape features, and which can be reliably detected by survey, are identified in the TBDC as species-credit species. Based on the assessment of habitat in the assessment area, and review of databases and published information, the species-credit species outlined in **Table 6-3** are considered 'candidate species for further assessment. The full threatened species habitat suitability assessment is provided in Appendix A.

Table 6-3 Candidate species-credit species identified by the three BAM-C cases (by subregion)

Species	Common name	EPBC Act	BC Act	Moss Vale	Ettrema	Illawarra	Sensitivity to gain class
Plants							
<i>Acacia bynoeana</i>	Bynoe's Wattle	V	E	Ö	Ö		High
<i>Boronia deanei</i>	Deane's Boronia	V	V	Ö			High
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	V	E		Ö		Moderate
<i>Calochilus pulchellus</i>	Pretty Beard Orchid	-	E		Ö		High
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Ö	Ö	Ö	Moderate
<i>Daphnandra johnsonii</i>	Illawarra Socketwood	E	E			Ö	Very high
<i>Eucalyptus langleyi</i>	Albatross Mallee	V	V		Ö	Ö	High
<i>Eucalyptus macarthurii</i>	Camden Wollybutt	E	E	Ö			High
<i>Eucalyptus sturgissiana</i>	Ettrema Mallee	-	V		Ö		High
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E		Ö	Ö	Very high
<i>Grevillea raybrownii</i>	-	-	V	Ö	Ö		High
<i>Grevillea rivularis</i>	Carrington Falls Grevillea	E	CE	Ö			High
<i>Helichrysum calvertianum</i>	-	-	V	Ö	Ö	Ö	Moderate
<i>Hibbertia puberula</i>	-	-	E	Ö	Ö	Ö	High
<i>Hibbertia stricta subsp. furcatula</i>	-	-	E		Ö	Ö	High
<i>Irenepharsus trypherus</i>	Illawarra Irene	E	E			Ö	High
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V		Ö		High
<i>Persoonia glaucescens</i>	Mittagong Geebung	V	E	Ö			High
<i>Phyllota humifusa</i>	Dwarf Phyllota	V	V	Ö			High
<i>Pterostylis ventricosa</i>	-	-	CE	Ö	Ö		Moderate
<i>Pterostylis vernalis</i>	-	CE	CE		Ö		Moderate
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	E	V	Ö		Ö	High
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	CE		Ö	Ö	Very high
<i>Solanum celatum</i>	-	-	E			Ö	Moderate
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E			Ö	High
<i>Triplarina nowraensis</i>	Nowra Heath Myrtle	E	E		Ö	Ö	Moderate
<i>Zieria murphyi</i>	Velvet Zieria	V	V	Ö	Ö		High
<i>Zieria granulata</i>	Illawarra Zieria	E	E			Ö	High
Birds							
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	CE	CE		Ö	Ö	High
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	E	V	Ö	Ö	Ö	High

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Species	Common name	EPBC Act	BC Act	Moss Vale	Ettrema	Illawarra	Sensitivity to gain class
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo (Breeding)	V	V	Ö	Ö	Ö	High
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E		Ö		Moderate
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	-	V		Ö		High
<i>Hieraaetus morphnoides</i>	Little Eagle (Breeding)	-	V	Ö	Ö	Ö	Moderate
<i>Lathamus discolor</i>	Swift Parrot (Breeding)	CE	E	Ö		Ö	Moderate
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	-	V	Ö	Ö	Ö	Moderate
<i>Ninox connivens</i>	Barking Owl (Breeding)	-	V	Ö	Ö	Ö	High
<i>Ninox strenua</i>	Powerful Owl (Breeding)	-	V	Ö	Ö	Ö	High
<i>Petroica rodinogaster</i>	Pink Robin	-	V			Ö	High
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	-	V		Ö	Ö	High
<i>Tyto tenebricosa</i>	Sooty Owl (Breeding)	-	V		Ö		Very high
Mammals							
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	-	V	Ö	Ö	Ö	High
<i>Petauroides volans</i>	Greater Glider	V	-	Ö	Ö	Ö	High
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	Ö		Ö	High
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E	E	Ö	Ö	Ö	High
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	E		Ö	Ö	Very high
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Ö	Ö	Ö	Very high
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Breeding)	-	V	Ö	Ö	Ö	Very high
<i>Miniopterus australis</i>	Little Bent-winged Bat (Breeding)	-	V			Ö	Very high
<i>Myotis macropus</i>	Southern Myotis	-	V	Ö	Ö	Ö	High
<i>Phascolarctos cinereus</i>	Koala	E	E	Ö	Ö	Ö	High
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	Ö	Ö	Ö	High
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Breeding)	V	V	Ö	Ö	Ö	High
Reptiles							
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (Breeding)	V	E	Ö	Ö	Ö	Very high
Amphibians							
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Ö	Ö	Ö	Moderate
<i>Litoria aurea</i>	Green & Golden Bell Frog	V	E		Ö	Ö	High
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Ö	Ö	Ö	High
<i>Mixophyes balbus</i>	Stuttering Frog	V	E	Ö		Ö	Very high
<i>Pseudophryne australis</i>	Red-crowned Toadlet	-	V	Ö		Ö	Moderate

Key: CE = Critically Endangered, E = Endangered, V = Vulnerable

6.2.3.1 Identifying geographic and habitat constraints

Once the initial list of predicted candidate species-credit species was generated (Table 6-3), the geographic limitations of each species (where applicable) were examined to see if they were met. Where the development site is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken. In accordance with Section 5.2.2 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to potentially occur on the development site. A habitat assessment within the assessment area was used to identify the habitat elements listed in Table 6-4 for each species. Some species do not have any identified habitat constraints in the TBDC, in which case this step was not undertaken. The species included or excluded based on the presence or absence of geographic or habitat constraints are outlined below in Table 6-4.

Table 6-4 Candidate species-credit species identified by the BAM-C with geographic limitations or habitat constraints, assessment of relevance to the development site and justification for further consideration

Species	EPBC Act	BC Act	Habitat constraint	Geographic limitation	Assessment
Plants					
<i>Boronia deanei</i> (Deane's Boronia)	V	V	<ul style="list-style-type: none"> Riparian areas and drainage lines or within 100m. Margins of swamps or within 100m 	-	Included - Habitat constraint present in development site.
<i>Eucalyptus langleyi</i> (Albatross Mallee)	V	V	-	South of Kangaroo Valley and East of Yalwal Creek	Excluded -development site is not within the geographic limitation north of Yalwal Creek
<i>Eucalyptus sturgissiana</i> (Etrema Mallee)	-	V	<ul style="list-style-type: none"> Rocky areas. Shallow soil over flat sandstone rock plate or within 100m 	-	Included - Habitat constraint present in development site.
<i>Genoplesium baueri</i> (Bauer's Midge Orchid)	E	E	-	Within 20 km of Nowra	Included in valley portion of development site only. Plateau portion is beyond 20km of Nowra and is in a different IBRA subregion.
<i>Grevillea rivularis</i> (Carrington Falls Grevillea)	E	CE	-	East of Fitzroy Falls	Excluded: The Carrington Falls Grevillea is confined to the Carrington Falls area on the upper Kangaroo River west of Kiama, within Budderoo National Park
<i>Helichrysum calvertianum</i>	-	V	Rocky areas or within 50 m of rocky areas	-	Included - Habitat constraint present in development site.
<i>Pterostylis vernalis</i>	CE	CE	Moss gardens	-	Included - Habitat constraint present in development site.
<i>Solanum celatum</i>	-	E	-	Shoalhaven River Valley	Included – site is within Shoalhaven River valley
<i>Triplarina nowraensis</i> (Nowra Heath Myrtle)	E	E	-	Within 20 km of Nowra	Included – site is within 20km from Nowra
Birds					
<i>Anthochaera phrygia</i> (Regent Honeyeater Breeding)	CE	CE	As per mapped areas	-	Excluded – the assessment area is not within the mapped important area for this species
<i>Lathamus discolor</i> (Swift Parrot Breeding)	CE	E	As per mapped areas	-	Excluded – the assessment area is not within the mapped important area for this species
<i>Callocephalon fimbriatum</i> (Gang-gang Cockatoo Breeding)	E	V	Eucalypt tree species with hollows greater than 9 cm diameter	-	Included - Habitat constraint present in development site.
<i>Calyptorhynchus lathamii</i> (Glossy Black-Cockatoo Breeding)	V	V	Living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground	-	Included - Habitat constraint present in development site.
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle Breeding)	-	V	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	-	Included - Habitat constraint present in development site.
<i>Hieraaetus morphnoides</i> (Little Eagle Breeding)	-	V	Nest trees - live (occasionally dead) large old trees within vegetation	-	Included - Habitat constraint present in development site.
<i>Lophoictinia isura</i> (Square-tailed Kite Breeding)	-	V	Nest trees	-	Included - Habitat constraint potentially present in development site.
<i>Ninox connivens</i> (Barking Owl Breeding)	-	V	Hollow bearing trees. Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground	-	Included - Habitat constraint present in development site.

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Species	EPBC Act	BC Act	Habitat constraint	Geographic limitation	Assessment
<i>Ninox strenua</i> (Powerful Owl Breeding)	-	V	Hollow bearing trees. Living or dead trees with hollow greater than 20cm diameter	-	Included - Habitat constraint present in development site.
<i>Tyto novaehollandiae</i> (Masked Owl Breeding)	-	V	Hollow bearing trees. Living or dead trees with hollow greater than 20cm diameter	-	Included - Habitat constraint present in development site.
<i>Tyto tenebricosa</i> (Sooty Owl Breeding)	-	V	Caves or cliff lines/ledges. Hollow bearing trees Hollow bearing trees. Living or dead trees with hollow greater than 20cm diameter	-	Included - Habitat constraint present in development site.
Mammals					
<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat)	V	V	Cliffs. Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels	-	Included - Habitat constraint present in development site.
<i>Miniopterus orianae oceanensis</i> (Large Bent-winged Bat Breeding)	-	V	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave - observation type code "E nest-roost, with numbers of individuals >500	-	Excluded - Habitat constraints absent from development site.
<i>Miniopterus australis</i> (Little Bent-winged Bat - Breeding)	-	V	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave - observation type code "E nest-roost, with numbers of individuals >500	-	Excluded - Habitat constraints absent from development site.
<i>Myotis macropus</i> (Southern Myotis)	-	V	Hollow bearing trees, Within 200 m of riparian zone, Bridges, caves or artificial structures within 200 m of riparian zone. includes rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site.	-	Included - Habitat constraint present in development site.
<i>Isodon o. obesulus</i> (Southern Brown Bandicoot)	E	E	Requires dense ground cover in a variety of habitats	-	Included - Habitat constraint present in development site.
<i>Petrogale penicillata</i> (Brush-tailed Rock-wallaby)	V	E	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines	-	Included - Habitat constraint present in development site.
<i>Phascolarctos cinereus</i> (Koala)	E	E	Presence of koala use trees	-	Included - Habitat constraint present in development site.
<i>Potorous tridactylus</i> (Long-nosed Potoroo)	V	V	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest))	-	Included - Habitat constraint present in development site.
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox - Breeding)	V	V	Breeding camps	-	Excluded. No breeding camp within or adjacent to site
Reptiles					
<i>Hoplocephalus bungaroides</i> (Broad-headed Snake)	V	E	Rocky areas including escarpments, outcrops and pogodas within the Sydney Sandstone geologies	-	Included - Habitat constraint present in development site. Habitat determined to be poor quality. See habitat assessment.
Amphibians					
<i>Litoria aurea</i> (Green and Golden Bell Frog)	V	E	-Semi-permanent/ephemeral wet areas -Within 1km of wet areas /Swamps Within 1km of waterbody	-	Included - Habitat constraint present in development site.

Key: CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory

6.2.3.2 Candidate species removed from the assessment

According to Section 5.2.3 (Step 3) of the BAM, a candidate species credit species is considered unlikely to occur on the subject land if one of the following applies

- a. After carrying out a field assessment:
 - i. the assessor determines that microhabitats required by a species are absent from the subject land (or specific vegetation zone). This must be based on evidence such as published literature, or
 - ii. the assessor determines that the habitat constraints or microhabitats are degraded to the point that the species is unlikely to use the subject land (or specific vegetation zones).
- b. An expert report states that the species is unlikely to be present on the subject land or specific vegetation zones.

A field habitat assessment was undertaken to determine whether the habitats within the development site were substantially degraded to the point that a suggested candidate species is unlikely to utilise the development site (or specific vegetation zones). No species were excluded on the basis of degraded habitats.

There were a number of threatened species returned from the calculator that are species-credit species if breeding habitat would be impacted. The development site does not contain potential breeding habitat for the following species:

- *Regent Honeyeater (Breeding) and Swift Parrot (Breeding)* - The species-credit component for both of these species listing is within 'mapped important areas'. The important areas mapped was checked and the study area is confirmed to fall outside these areas for both species, and breeding is not expected within the assessment area. There are no important areas mapped in the locality. This species was removed from the candidate species lists
- *Large Bent-winged Bat (Breeding) and Little Bent-winged Bat (Breeding)* - The species-credit component for both these species listing is 'breeding habitat features such as a cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records'. Small concrete culverts were inspected for roosting bats. No bats were located. No suitable habitat features (including large caves or structures to support a breeding colony for these bats species) exist in the assessment area. While it is noted that there are cliffs in the locality, these are associated with crevices, and shallow overhangs and no caves have been located
- *Grey-headed Flying-fox (Breeding)* - No breeding camp occurs within or adjacent to the assessment area. The nearest known camp is in Kangaroo Valley township (approximately 4km from the assessment area). This species was removed from the candidate species list.
- Upon review of the TBDC, three species were removed on the basis that the development site is outside of the known geographic distribution
- *Grevillea rivularis* (Carrington Falls Grevillea) - The Carrington Falls Grevillea is confined to the Carrington Falls area on the upper Kangaroo River west of Kiama, within Budderoo National Park
- *Eucalyptus langleyi* (Albatross Mallee) - Reported in the Illawarra BAM-C case as 'south of Kangaroo Valley' and reported in the Ettrema BAM-C case as 'east of Yalwal Creek'
- *Persoonia glaucescens* (Mittagong Geebung) - The Mittagong Geebung's historical distribution places the northern and eastern limit at Couridjah (Thirlmere Lakes), the southern limit at Fitzroy Falls and the western limit at High Range. However, recent surveys have indicated that the species no longer extends to Fitzroy Falls or Kangaloon and that the present southern limit is near Berrima. The northern limit appears to have contracted a few kilometres south to Buxton.

6.2.3.3 Candidate species added to the assessment

The Development site covers areas of Kangaroo Valley plateau, escarpment and the valley floor. As described in Chapter 4.1 there are three IBRA subregions intersecting the assessment area (Moss Vale SR, Illawarra SR and Ettrema SR). Three separate BAM-C cases were prepared and each has identified a suite of candidate species for further assessment, as such no additional species beyond the list from the BAM-C have been added.

6.2.3.4 Identifying candidate species for further assessment

The list of species retained for further assessment and targeted by surveys are shown in **Table 6-5**.

Table 6-5 Summary of candidate species-credit species for further assessment

Species	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAIL*	Associated habitat in development site from TBDC
Plants						
<i>Acacia bynoeana</i>	Bynoe's Wattle	V	E	High	No	PCT 1083, PCT 1082
<i>Boronia deanei</i>	Deane's Boronia	V	V	High	No	PCT 1082
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	V	E	Moderate	Yes	PCT 1083, PCT 1082
<i>Calochilus pulchellus</i>	Pretty Beard Orchid	-	E	High	Yes	PCT 1083, PCT 1082
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Moderate	No	PCT 1083, PCT 1082, PCT 1283
<i>Daphnandra johnsonii</i>	Illawarra Socketwood	E	E	Very high	Yes	PCT 1245
<i>Eucalyptus macarthurii</i>	Camden Wollybutt	E	E	High	No	PCT 1254
<i>Eucalyptus sturgissiana</i>	Ettrema Mallee	-	V	High	No	PCT 1083, PCT 1082
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	Very high	Yes	PCT 1083 in valley portion only
<i>Grevillea raybrownii</i>	-	-	V	High	No	PCT 1083, PCT 1156
<i>Helichrysum calvertianum</i>	-	-	V	Moderate	No	PCT 1083, PCT 1156
<i>Hibbertia puberula</i>	-	-	E	High	No	PCT 1083, PCT 1082, PCT 1156
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	-	-	E	High	No	PCT 1083, PCT 1082
<i>Irenepharsus trypherus</i>	Illawarra Irene	E	E	High	No	PCT 1245
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	High	Yes	PCT 1083, PCT 1082
<i>Phyllota humifusa</i>	Dwarf Phyllota	V	V	High	No	PCT 1082
<i>Pterostylis ventricosa</i>	-	-	CE	Moderate	No	PCT 1083, PCT 1082, PCT 1156, PCT 1283
<i>Pterostylis vernalis</i>	-	CE	CE	Moderate	Yes	PCT 1083, PCT 1082
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	E	V	High	Yes	PCT 1082
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	CE	Very high	Yes	PCT 1245, PCT 1283
<i>Solanum celatum</i>	-	-	E	Moderate	No	PCT 1245
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E	High	No	PCT 1245
<i>Triplarina nowraensis</i>	Nowra Heath Myrtle	E	E	Moderate	No	PCT 1083, PCT 1082
<i>Zieria murphyi</i>	Velvet Zieria	V	V	High	No	PCT 1083, PCT 1082
Birds						
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	E	V	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1254, PCT 1283

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Species	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAI*	Associated habitat in development site from TBDC
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo (Breeding)	V	V	High	No	PCT 1082, PCT 1083, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Moderate	No	PCT 1083
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	-	V	High	No	PCT 1083, PCT 1108
<i>Hieraetus morphnoides</i>	Little Eagle (Breeding)	-	V	Moderate	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	-	V	Moderate	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Ninox connivens</i>	Barking Owl (Breeding)	-	V	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1254, PCT 1283
<i>Ninox strenua</i>	Powerful Owl (Breeding)	-	V	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Petroica rodinogaster</i>	Pink Robin	-	V	High	No	PCT 1245, PCT 1254
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	-	V	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Tyto tenebricosa</i>	Sooty Owl (Breeding)	-	V	Very high	Yes	PCT 1245, PCT 1254, PCT 1283
Mammals						
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	-	V	High	No	PCT 1082, PCT 1083, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Petauroides volans</i>	Greater Glider	V	V	Very high	Yes	PCT 1082, PCT 1083, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E	E	High	No	PCT 1083, PCT 1254, PCT 1283
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	Very high	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	-	V	High	No	PCT 1083, PCT 1108, PCT 1245, PCT 1254, PCT 1283
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	-	High	No	None listed in TBDC for PCTs in the study area
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Breeding)	-	V	High	No	PCT 1082, PCT 1083, PCT 1156, PCT 1254, PCT 1283
<i>Myotis macropus</i>	Southern Myotis	V	E	Very high	No	PCT 1082, PCT 1083, PCT 1245, PCT 1254

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Species	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAI*	Associated habitat in development site from TBDC
<i>Phascolarctos cinereus</i>	Koala	E	E	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	High	No	PCT 1082, PCT 1083, PCT 1156, PCT 1245, PCT 1283
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	High	No	PCT 1082, PCT 1083, PCT 1108, PCT 1156, PCT 1245, PCT 1254, PCT 1283
Reptiles						
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (Breeding)	V	E	Very high	No	PCT 1083, PCT 1082, 1254 1156
Amphibians						
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Moderate	No	PCT 1283, PCT 1254, PCT 1156, PCT 1245, PCT 1083, PCT 1082
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	High	No	PCT 1245
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	High	No	PCT 1083, PCT 1082, PCT 1156
<i>Mixophyes balbus</i>	Stuttering Frog	V	E	Very high	Yes	1082 1245
<i>Pseudophryne australis</i>	Red-crowned Toadlet	-	V	Moderate	No	PCT 1083, PCT 1082, PCT 1245, PCT 1254

Note: SAI* = Serious and Irreversible Impact Entity as identified by the BAM-C.

6.3 Targeted threatened species surveys

After the candidate species list had been developed, targeted threatened species surveys were undertaken. Details of the surveys effort and techniques used are described below and the results of the surveys presented in **Section 6.4**.

6.3.1 Threatened plant surveys

Details of the PCTs present in the assessment area as well as habitat assessments were used to refine the locations of preferred habitats for each species in order to focus survey effort. Preferred habitat for targeted threatened plant species are described in **Table 6-6**. Associated PCTs for each species are taken from their profile on the BioNet TBDC base. Habitat descriptions are also taken from the BioNet profiles for each species.

Table 6-6 Targeted threatened plant species and preferred habitat description

Species	Growth form / stratum	Habitat and distribution
<i>Daphnandra johnsonii</i> (Illawarra Socketwood)	Tree / canopy	Restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Suitable vegetation includes rainforest and moist eucalypt forest. The only associated habitat for this species within the development site is PCT 1245.
<i>Eucalyptus macarthurii</i> (Camden Wollybutt)	Tree / canopy	Has a moderately restricted distribution. It is currently recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges, of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park. Occurs in grassy woodland on relatively fertile soils. The only associated habitat within the development site for this species is PCT 1254 (0.23ha near the intersection of Promised Lands Track and Nowra/Moss Vale Rd).
<i>Eucalyptus sturgissiana</i> (Ettrema Mallee)	Tree / canopy	The Ettrema Mallee is mostly restricted to the Northern Budawang Range in Morton National Park, with a few occurrences on the nearby coastal plain. Usually grows as an emergent in low shrub-heath. Grows on sandy, swampy soils although little is known of this species' ecology. The BAM-C habitat constraints include <i>Rocky areas or Shallow soil over flat sandstone rock plate or within 100m</i> . The associated habitat for this species within the development site is PCT 1083, PCT 1082. The nearest records are approximately 20km south-west of the assessment area and south of the Shoalhaven River.
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	Tree / canopy	Occurs in coastal districts north from Batemans Bay in NSW, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Extremely susceptible to infection by Myrtle Rust (which is already present in development site). The associated habitat within the development site for this species is PCT 1245 and PCT 1283.
<i>Acacia bynoeana</i> (Bynoe's Wattle)	Shrub / midstorey	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (<i>Corymbia gummifera</i>), Scribbly Gum (<i>Eucalyptus haemastoma</i>), Drooping Red Gum (<i>E. parramattensis</i>), Old Man Banksia (<i>Banksia serrata</i>) and Small-leaved Apple (<i>Angophora bakeri</i>). The associated habitat within the development site for this species is PCT 1082 and PCT 1083. Surveys also focused on disturbed and open areas such as pipeline edges and track edges.
<i>Boronia deanei</i> (Deane's Boronia)	Shrub / midstorey	There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau), mainly in conservation reserves. Wildfires have depleted some populations. This species has a geographical constraint - <i>riparian areas and drainage lines or within 100m</i> , and <i>margins of swamps or within 100m</i> . The only associated habitat within the development site for this species is PCT 1082. The areas of PCT 1082 lack swamps or creeks, however, this species was targeted during all transects of PCT 1082, with focused effort near ephemeral drainage lines on the Plateau.
<i>Grevillea raybrownii</i>	Shrub / midstorey	Occurs in Eucalyptus open forest and woodland with a shrubby understorey on sandy, gravelly loam soils derived from sandstone that are low in nutrients. Generally occurs on ridgetops and, less often, slopes and benches of Hawkesbury Sandstone and Mittagong Formation. Suitable habitat for this species is limited to PCT 1083 and PCT 1156. Kangaroo Valley and Fitzroy falls localities lack any records of this species.
<i>Hibbertia puberula</i>	Shrub / midstorey	Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. Occurs on sandy soil often associated with sandstone, or on clay. The distribution of this species extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. The associated habitat within the development site for this species is PCT 1083, PCT 1082 and PCT 1156.

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Species	Growth form / stratum	Habitat and distribution
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	Shrub / midstorey	Known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. The species usually grows in 'gravelly loam or clay soil in heath under open woodland'. Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone. The associated habitat within the development site for this species is PCT 1083 and PCT 1082.
<i>Melaleuca deanei</i> (Deane's Paperbark)	Shrub / midstorey	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. There is a cluster of eight records near Tallowa Dam (approximately 15km west of the assessment area). The associated habitat within the development site for this species is PCT 1083 and PCT 1082.
<i>Phyllota humifusa</i> (Dwarf Phyllota)	Shrub / midstorey	Dwarf Phyllota is known from the southern Blue Mountains (Bimlow Tableland), the Joadja area west of Mittagong and Penrose area near Paddy's River. Records east of Bundanoon and Bowral are very scarce and there are no records around Kangaroo Valley. The species occurs in dry sclerophyll forest, sometimes near swamps, in deep sandy soils or gravelly loams over a sandstone substrate. Accompanying trees are often Brittle Gum <i>Eucalyptus mannifera</i> , Narrow-leafed Peppermint <i>E. radiata</i> or Sydney Peppermint <i>E. piperita</i> . The associated habitat within the development site for this species is PCT 1082.
<i>Solanum celatum</i>	Shrub / midstorey	This shrub is restricted to an area from Wollongong to south of Nowra and west to Bungonia. Its habitat includes rainforest clearings or wet sclerophyll forest and is generally found in disturbed margins and clearings. According to the BAM-C geographical constraint, this species is restricted to the Shoalhaven River Valley. The only associated habitat within the development site for this species is PCT 1245.
<i>Syzygium paniculatum</i> (Magenta Lilly Pilly)	Shrub / midstorey	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. The only associated habitat within the development site for this species is PCT 1245.
<i>Triplarina nowraensis</i> (Nowra Heath Myrtle)	Shrub / midstorey	Nowra Heath Myrtle occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanoon. The Development site is within the 40 km of Nowra BAM-C geographical constraint. The associated habitat within the development site for this species is PCT 1083 and PCT 1082.
<i>Zieria murphyi</i> (Velvet Zieria)	Shrub / midstorey	The Velvet Zieria is found in sheltered positions in moist gullies in moist eucalypt forest with sandy soil. Velvet Zieria is found in the Blue Mountains at Mt Tomah and in the southern highlands where it has been recorded in Morton National Park in the Bundanoon area, and at Penrose. Several populations of fewer than 1000 plants are known to occur in both the Blue Mountains and Morton National Parks. The few populations in the Penrose area are believed to be within Morton NP and the largest is between 250 and 500 plants, but the others are much smaller. The associated habitat within the development site for this species is PCT 1083 and PCT 1082.
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	Forb / ground	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. 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 associated habitat within the development site for this species is PCT 1083 and PCT 1082.
<i>Calochilus pulchellus</i> (Pretty Beard Orchid)	Forb / ground	It is known from the Sydney Basin Bioregion, where a total of less than 30 adult plants have been recorded in three sites over a range of 40 km on the South Coast of NSW, at altitudes from 20-560 m above sea level. All currently known sites are within the Shoalhaven Local Government Area. At Vincentia the species grows in low Scribbly Gum dominated woodland with a low wet heath understorey. The soil is a sandy loam overlying

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Species	Growth form / stratum	Habitat and distribution
		sandstone. In Booderee National Park it grows in a tall heathy association. In Morton National Park on the Little Forest Plateau it occurs in low heath among scattered clumps of emergent eucalypts and Banksia in shallow coarse white sand over sandstone, in a near-escarpment area subject to strong orographic precipitation. The associated habitat for this species within the development site is PCT 1083 and PCT 1082.
<i>Cryptostylis hunteriana</i> (Leafless Tongue Orchid)	Forb / ground	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Munmorah State Conservation Area, Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park and Ben Boyd National Park. The associated habitat for this species within the development site is PCT 1083, PCT 1082 and PCT 1283.
<i>Genoplesium baueri</i> (Bauer's Midge Orchid)	Forb / ground	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone. This species is not known from Moss Vale IBRA subregion (which incorporate plateau areas of development site) and the BAM-C geographical constraint states that this species is <i>Within 20 km of Nowra</i> . The associated habitat within the development site for this species is PCT 1082 and PCT 1083. However given the areas of PCT 1082 are on the plateau and outside the 20 kms from Nowra extent (and in Moss Vale IBRA subregion), suitable habitat for this species is limited to PCT 1083 on the site. Records of this species are clustered around Nowra and Jervis Bay, although a single record exists to the north of Bomaderry (Generalised to 10km by NSW DPI).
<i>Helichrysum calvertianum</i>	Forb / ground	Occurs in dry sclerophyll forest and heathland with rock outcrops, predominantly on Hawkesbury sandstone soils. There is a cluster of records in Fitzroy Falls. The BAM-C habitat constraint for this species is <i>Rocky areas or within 50 m of rocky areas</i> . The associated habitat within the development site for this species is PCT 1083 and PCT 1156.
<i>Irenepharsus trypherus</i> (Illawarra Irene)	Forb / ground	Prefers to grow on steep rocky slopes near cliff lines and ridge tops that extend south and east of the Illawarra escarpment. Has also been recorded in deep sandstone gorges along the Shoalhaven River. The only associated habitat within the development site for this species is PCT 1245. The areas of PCT 1245 within the development site do not contain rocky habitats or cliff lines. Nonetheless, it was searched for during transects in this PCT.
<i>Pterostylis ventricosa</i>	Forb / ground	Predominantly occurs in more open areas of tall coastal eucalypt forest often dominated by one or more of the following tree species:- Turpentine, Spotted Gum, Grey Ironbark, Blackbutt, White Stringybark, Scribbly Gum and Sydney Peppermint. Often favours more open areas such as along powerline easements and on road verges where the tree overstorey has been removed or thinned. <i>Pterostylis ventricosa</i> is known from populations at St Georges Basin, Sussex Inlet and west of Nowra in the Shoalhaven and also near Tallong and Mittagong in the Southern Highlands. The St Georges Basin population was used as the reference site for flowering in 2022. The associated habitat within the development site for this species is PCT 1083, PCT 1082, PCT 1156, PCT 1283.
<i>Pterostylis vernalis</i>	Forb / ground	<i>Pterostylis vernalis</i> is only known from the Nowra area on the NSW south coast. There are five known populations located to the west and south-west of Nowra. Four are within a few kilometres of each other, and one is located approximately 18 km to the south-west. <i>Pterostylis vernalis</i> grows in open sites around moss gardens in shallow soil over sandstone sheets or moss gardens on heavy laterite associated soils, in heath and dry heathy forest/woodland. The associated habitat within the development site for this species is PCT 1083, PCT 1082.
<i>Rhizanthella slateri</i> (Eastern Australian Underground Orchid)	Forb / ground	<i>Rhizanthella slateri</i> grows in forest, usually under a deep layer of organic litter. It is known from populations in the Bulahdelah area, the Watagan Mountains, Blue Mountains, Dharug National Park and near Nowra, each population only known from a few individuals. Nearest records are in the Jervis Bay region to the south of Nowra. The associated habitat within the development site for this species is PCT 1082.

The threatened flora surveys were guided by the methodology and effort described in the *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (Department of Planning, Industry and Environment, 2020). The application of the described guidelines is not mandatory, but they provide an indication of the effort that is likely required. The main method adopted was using multiple ecologists to walk parallel search transects within the assessment area, while also conforming to the species prescribed survey timing (specific months) and preferred habitat identified in the TBDC. This approach was used to adequately cover the large areas of potential habitat for the above listed species. In open woodland habitats (generally sparser), surveyors had a good line of site and were able to adopt 10-20 metre transect spacing to search for small herbs and sub-shrub species. The location of walked transects are presented in **Figure 6-2**, some gaps between transects are visible in the recorded GPS tracks for the following two reasons.

- Many areas were in a state of early successional regrowth having previously been cleared for the original scheme, and these contained very dense patches of coloniser species such as *Kunzea ambigua*, *Hakea laevipes*, *Banksia ericifolia*, *Gahnia clarkei* or *Leptospermum polygalifolium*. Numerous dense regrowth patches were impassable for surveyors and where vegetation could not be walked through using parallel spaced transects. In these instances transects were adjusted to traverse the edges of the dense vegetation (see **Photos 6.1** to **Photo 6.4** for examples). Such patches were deemed to be poor habitat for the target threatened flora species given their poor structural attributes and obvious dominance of the pioneer species (competition for space, sunlight, water and nutrients)
- An area (or PCT) did not require survey for a target species during one of the seasonal surveys (as the PCT is not an associated habitat according to the TBDC).



Photo 6.1 Dense *Gleichenia dicarpa* and *Leptospermum polygalifolium* is poor habitat for target species



Photo 6.2 Dense *Banksia ericifolia* along pipe and track edges was inaccessible and is poor habitat for target species



Photo 6.3. Dense exotic Privet (*Ligustrum sinense*) in parts of PCT 1108 was inaccessible and is poor habitat for target species



Photo 6.4. Dense *Kunzea ambigua* was inaccessible and is poor habitat for target species



Photo 6.5 Dense *Leptospermum polygalifolium* and *Gahnia clarkei* was inaccessible and is poor habitat for target species

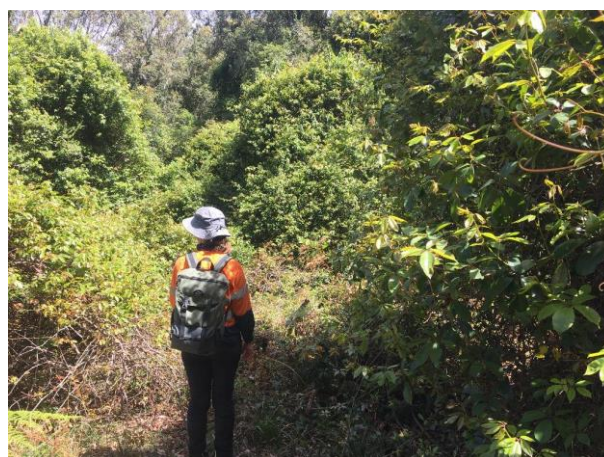


Photo 6.6 Dense *Cissus hypoglauca* in PCT1245 was inaccessible and is poor habitat for target species

Despite the dense regrowth encountered in some portions of the assessment area, many suitable habitat niches exist throughout the assessment area. All potentially suitable habitats for target flora species were surveyed comprehensively (and up to three times for the year-round detectable species). Transects were walked through areas of suitable habitat, with a focus on the assessment areas expected to be directly impacted. Transects undertaken in Spring 2021 were undertaken in a much larger area than the current Development site boundaries, as development site was later refined and searched again in 2022. A description of the survey efforts for each species is detailed below:

Targeted searches - 2021/2022

In order to capture the optimal survey conditions for the range of target species, three seasonal surveys were conducted between 2021 and 2022, including the spring, summer, and autumn seasons. Spring surveys were undertaken in October 2021, summer surveys in December 2021 with some additional survey of PCT 1245 in January 2022 and autumn surveys were undertaken in April and May 2022.

Each seasonal survey covered all suitable habitats for the target species (see **Figure 6-2** for search effort). Due to a large list of target species - to avoid missing plants, the surveys undertaken in spring and summer utilised two people per transect. Two people per transect was necessary to adequately survey the ground stratum and midstorey / canopy stratum simultaneously. This 'double up' effort was also required to meet the guidelines of a maximum of 5 species searched for per stratum (per person). The April and May 2022 survey was targeting late summer /autumn flowering threatened orchids only, so only one person per transect was required during this survey (ground stratum searches only). A summary of surveys and survey effort in 2021 and 2022 for threatened flora species is provided below in **Table 6-7**.

Table 6-7 Targeted threatened plant species – survey effort

Survey timing	Approx. Transect length	Approx. search time (hrs)	No. people	Approx. Person hours
25 th – 30 th October 2021	74 km	56	2	112 hrs
6 th – 10 th December 2021	59 km	26	4	104 hrs
27 th – 28 th January 2022	8 km	14	2	28 hrs
20 th – 21 st April 2022	22 km	15	2	30 hrs
4 th -6 th May 2022	36 km	27	3	81 hrs

Approximately 200 km of transects were completed during flora surveys (2021 & 2022). A summary of the survey effort based on the area of habitat and stratum for each target plant species is provided in **Table 6-8**. The location of tracks walked during the threatened plant surveys are illustrated on **Figure 6-2A** to **Figures 6.2C**. The development site has been adjusted and refined since the initial surveys, and as a result some previous flora transects were conducted over a larger extent than the current development site (particularly spring 2021 survey. Survey effort in areas now deducted from the development site (in the same PCTs and

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similar landscape positions) was included when assessing likelihood of occurrence of threatened plants within the development site.

Table 6-8 Targeted threatened plant species – survey effort

Species	Required survey period (TBDC)	Survey timing	Associated PCT on site	Survey guideline*	Approx. effort
Trees / canopy					
<i>Daphnandra johnsonii</i> (Illawarra Socketwood)	year-round	October & December 2021. April & May 2022	PCT 1245	Parallel traverse 10-20 m spacing	<u>October 2021:</u> 3.8km in PCT 1245 <u>January 2022:</u> 8km in PCT 1245
<i>Eucalyptus macarthurii</i> Camden Wollybutt	year-round	October & December 2021. April & May 2022	PCT 1254	Parallel traverse 20-40 m spacing	<u>October 2021:</u> 5.4km PCT 1254
<i>Eucalyptus sturgissiana</i> Etrema Mallee	year-round	October & December 2021. April & May 2022	PCT 1082 PCT 1083	Parallel traverse 20-40 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082 <u>December 2021:</u> 11.9 km in PCT 1082 10.6km in PCT 1083 <u>April 2022:</u> 11.5km in PCT 1083 <u>May 2022:</u> 12.5km in PCT 1082
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	year-round	October December 2021	PCT 1245 PCT 1283	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 3.8km in PCT 1245 13.6km in PCT 1283 <u>December 2021:</u> 10.8km in PCT 1283 <u>January 2022:</u> 8km in PCT 1245 <u>April & May 2022:</u> 11.5km in PCT 1283
Shrubs / midstorey					
<i>Acacia bynoeana</i> (Bynoe's Wattle)	year-round	October & December 2021. April & May 2022	PCT 1082 PCT 1083	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082 <u>December 2021:</u> 11.9 km in PCT 1082 10.6km in PCT 1083 <u>April 2022:</u> 11.5km in PCT 1083 <u>May 2022:</u> 12.5km in PCT 1082
<i>Boronia deanei</i> (Deane's Boronia)	September–November	October 2021	PCT 1082	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 13.5 km in PCT 1082
<i>Grevillea raybrownii</i>	October- December	October & December 2021	PCT 1156	Parallel traverse 10-20 m spacing	<u>October 2021:</u> 18.6km in PCT 1156 <u>December 2021:</u> 15.9km in PCT 1156
<i>Hibbertia puberula</i>	October -December	October & December 2021	PCT 1083, PCT 1082, PCT 1156.	Parallel traverse 5-10 m spacing 1-2 km length	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082, 18.6km in PCT 1156 <u>December 2021:</u> 11.9 km in PCT 1082 10.6km in PCT 1083, 15.9km in PCT 1156
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	October -December	October & December 2021	PCT 1083, PCT 1082	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082 <u>December 2021:</u> 11.9 km in PCT 1082, 10.6km in PCT 1083
<i>Irenepharsus trypherus</i> (Illawarra Irene)	December-April	December 2021 & January 2022	PCT 1245	Parallel traverse 5-10 m spacing 1-2 km length	<u>January 2021:</u> 8km in PCT 1245
<i>Melaleuca deanei</i> (Deane's Paperbark)	year-round	October & December 2021. April & May 2022	PCT 1082 PCT 1083	Parallel traverse 10-20 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083, 13.5 km in PCT 1082 <u>December 2021:</u> 11.9 km in PCT 1082, 10.6km in PCT 1083

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Species	Required survey period (TBDC)	Survey timing	Associated PCT on site	Survey guideline*	Approx. effort
					<u>April 2022:</u> 11.5km in PCT 1083 <u>May 2022:</u> 12.5km in PCT 1082
<i>Phyllota humifusa</i> (Dwarf Phyllota)	November - January	December 2021	PCT 1082	Parallel traverse 10-15 m spacing	<u>December 2021:</u> 11.9 km in PCT 1082
<i>Syzygium paniculatum</i> (Magenta Lilly Pilly)	April-June	May 2022	PCT 1245	Parallel traverse 5-10 m spacing	<u>May 2022:</u> Small number of known Syzygium trees were checked within PCT1245.
<i>Solanum celatum</i>	August - November	October 2021	PCT 1245	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 3.8km in PCT 1245
<i>Triplarina nowraensis</i> (Nowra Heath Myrtle)	year-round	October & December 2021 2021. April & May 2022	PCT 1082 PCT 1083	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082 <u>December 2021:</u> 11.9 km in PCT 1082 10.6km in PCT 1083 <u>April 2022:</u> 11.5km in PCT 1083 <u>May 2022:</u> 12.5km in PCT 1082
<i>Zieria murphyi</i>	September - November	October 2021	PCT 1082 PCT 1083	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082
Forbs / ground layer					
<i>Caladenia tessellata</i>	September - October	October 2021	PCT 1082 PCT 1083	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082
<i>Calochilus pulchellus</i> Pretty Beard Orchid	October- November	October 2021	PCT 1082 PCT 1083	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082
<i>Cryptostylis hunteriana</i> (Leafless Tongue Orchid)	December – February	December 2021	PCT 1082 PCT 1083 PCT 1283	Parallel traverse 5-10 m spacing	<u>December 2021:</u> 11.9 km in PCT 1082 10.6km in PCT 1083, 10.8 km in PCT 1283
<i>Genoplesium baueri</i> (Bauer's Midge Orchid)	February - March	April (outside survey window)	PCT 1082 PCT 1083	Parallel traverse 5-10 m spacing 1-2 km length	<u>April 2022:</u> 11.5km in PCT 1083 (likely outside flowering)
<i>Helichrysum calvertianum</i>	August -February	October & December 2021	PCT 1083 and PCT 1156.	Parallel traverse 10-15 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 18.6km in PCT 1156 <u>December 2021:</u> 10.6km in PCT 1083 15.9km in PCT 1156
<i>Pterostylis ventricosa</i>	March – May	April and May 2022	PCT 1083, PCT 1082, PCT 1156, PCT 1283	Parallel traverse 5-10 m spacing	<u>April & May 2022:</u> 11.5km in PCT 1083 12.5km in PCT 1082, 18.3km in PCT 1156 11.5km in PCT 1283
<i>Pterostylis vernalis</i>	August -October	October 2021	PCT 1083, PCT 1082	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 11.6 km in PCT 1083 13.5 km in PCT 1082
<i>Rhizanthella slateri</i> Eastern Australian Underground Orchid	September - November	October 2021	PCT 1082	Parallel traverse 5-10 m spacing	<u>October 2021:</u> 13.5 km in PCT 1082

** The number of required survey kms is not relevant to this assessment as the total areas of associated PCTs were walked during seasonal surveys. Cleared areas adjacent to PCTs (such as tracks, pipe corridor and other disturbance areas) were also searched for all species which favour disturbance and patch edges.

Targeted searches - 2018/2019

During the preliminary project planning stages in 2018 and 2019, four rounds of targeted flora searches were undertaken throughout the assessment area and surrounds. The same assemblage of candidate threatened plant species listed in **Table 6-8** above were also targeted. Approximately 21 km of distance was walked by a team of two ecologists during the preliminary searches. A summary of the distance covered on foot and approximate number of hours expended during each field survey event is provided in **Table 6-9**. These preliminary surveys were undertaken prior to the release of *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (Department of Planning, Industry and

Biodiversity development assessment report

Environment, 2020), and do not adequately cover the recommended transect spacing required by the latest guidelines. Given this, the 2018 and 2019 flora surveys are treated only as supplementary to the comprehensive surveys (2021 and 2022) outlined above.

Table 6-9 Targeted threatened plant species – 2018-19 survey effort

Survey timing	Transect length	Approx. search time	No. people	Person hours
22-23 October 2018	4 km	14 hrs.	2	28 hrs.
10-11 January 2019	2 km	14 hrs.	2	28 hrs.
11-15 February 2019	12 km	32 hrs.	2	64 hrs.
4-5 March 2019	3 km	14 hrs.	2	28 hrs.

Flora survey weather conditions

2021 / 2022

Rainfall was below average during the survey periods, with the exception of October 2021, while February 2022 experienced a 72% decrease from the typical monthly average recorded at Fitzroy Falls (Red Hills) weather station (068248).

- Table 6-10 Weather conditions during targeted plant surveys 2021-22

Survey timing	Average Temp (°C)		Total rainfall during survey (mm)	Rainfall three months preceding survey (mm)
	max	min		
25 th – 30 th October 2018	21	7.2	0	254
6 th – 10 th December 2021	19.5	10.8	4	365
27 th – 28 th January 2019	25.1	15.2	0	431
20 th – 21 st April 2022	22.3	6.9	2	1040
4 th – 6 th May 2022	17.6	8.4	0	1110

2018/2019

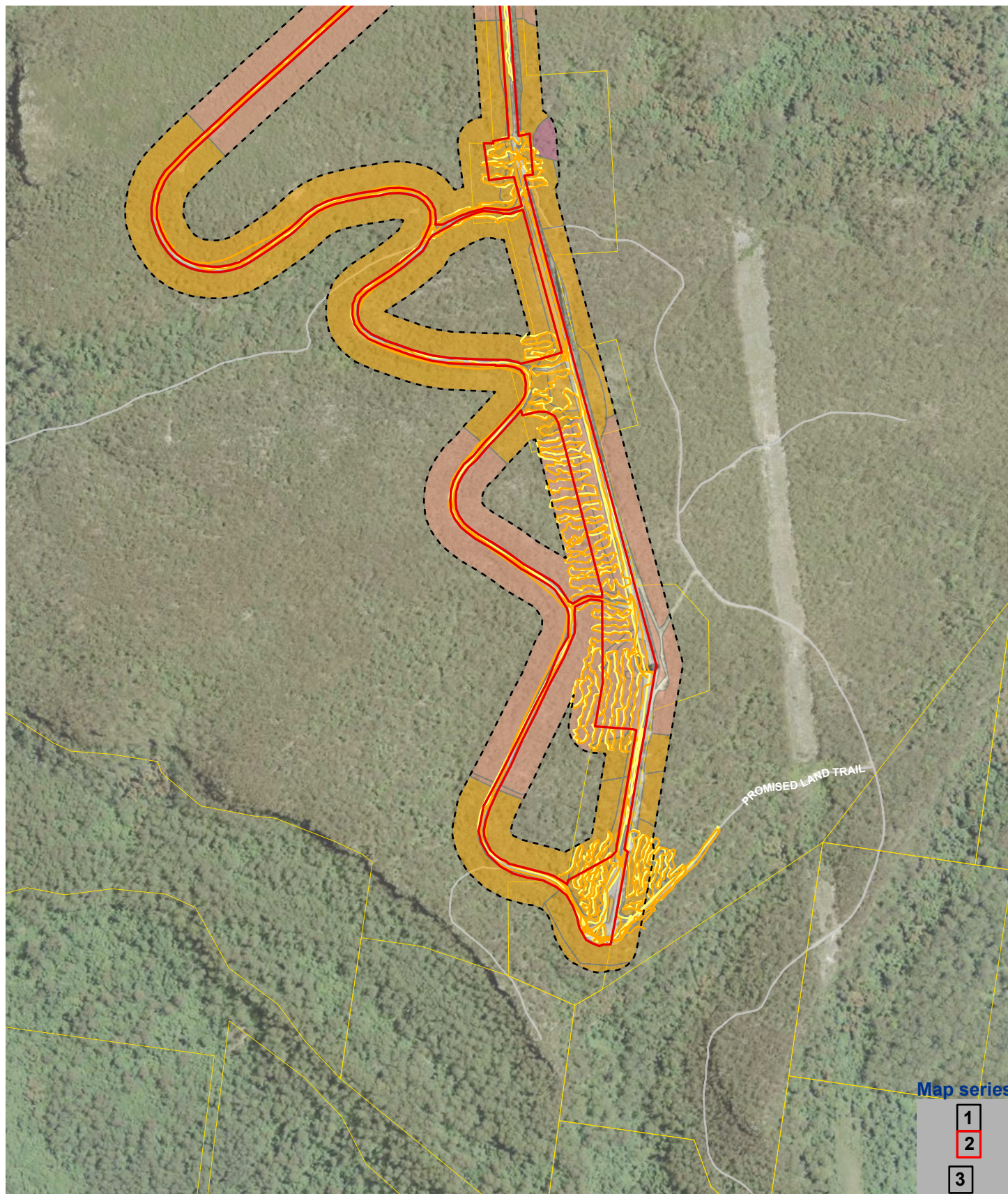
Weather conditions during the survey periods were generally sunny, with mostly low cloud cover and mild to warm temperatures recorded at Moss Vale AWS (0628239).

- Table 6-11 Weather conditions during targeted plant surveys 2018-19

Survey timing	Average Temp (°C)		Total rainfall during survey (mm)	Rainfall three months preceding survey (mm)
	max	min		
22-23 October 2018	11.2	24.1	0	208
10-11 January 2019	15.5	22.1	3	439
11-15 February 2019	11.4	26.1	0	426
4-5 March 2019	15.8	32.1	0	222



Figure 6-2A Threatened flora targeted surveys - Spring 2021



- PCT 769 - Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- Threatened flora transect**
- MC
 - Emma
 - Development site
 - Assessment area

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56

Data sources2

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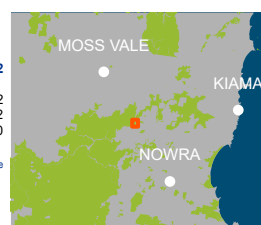


Figure 6-2A Threatened flora targeted surveys - Spring 2021

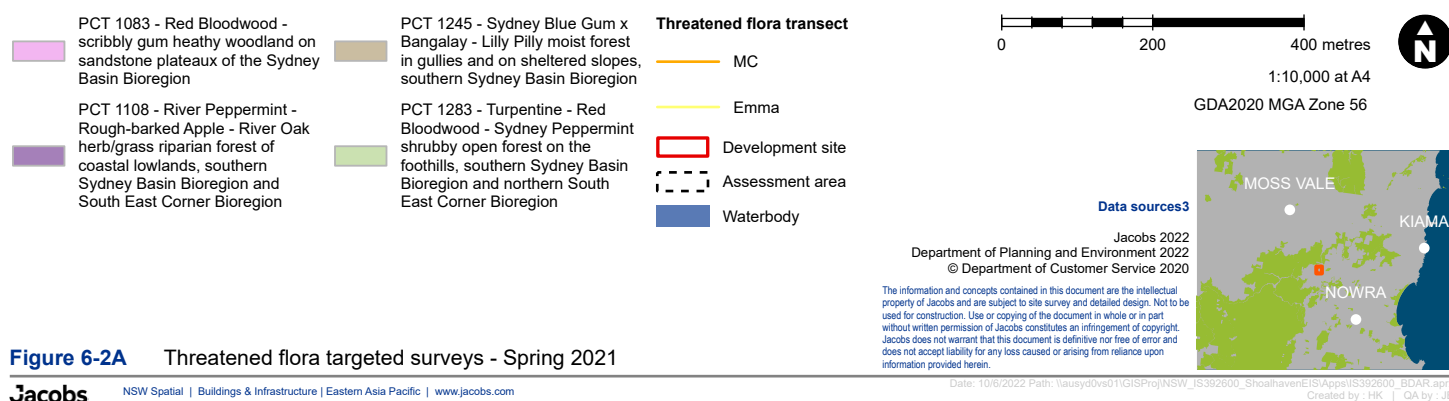
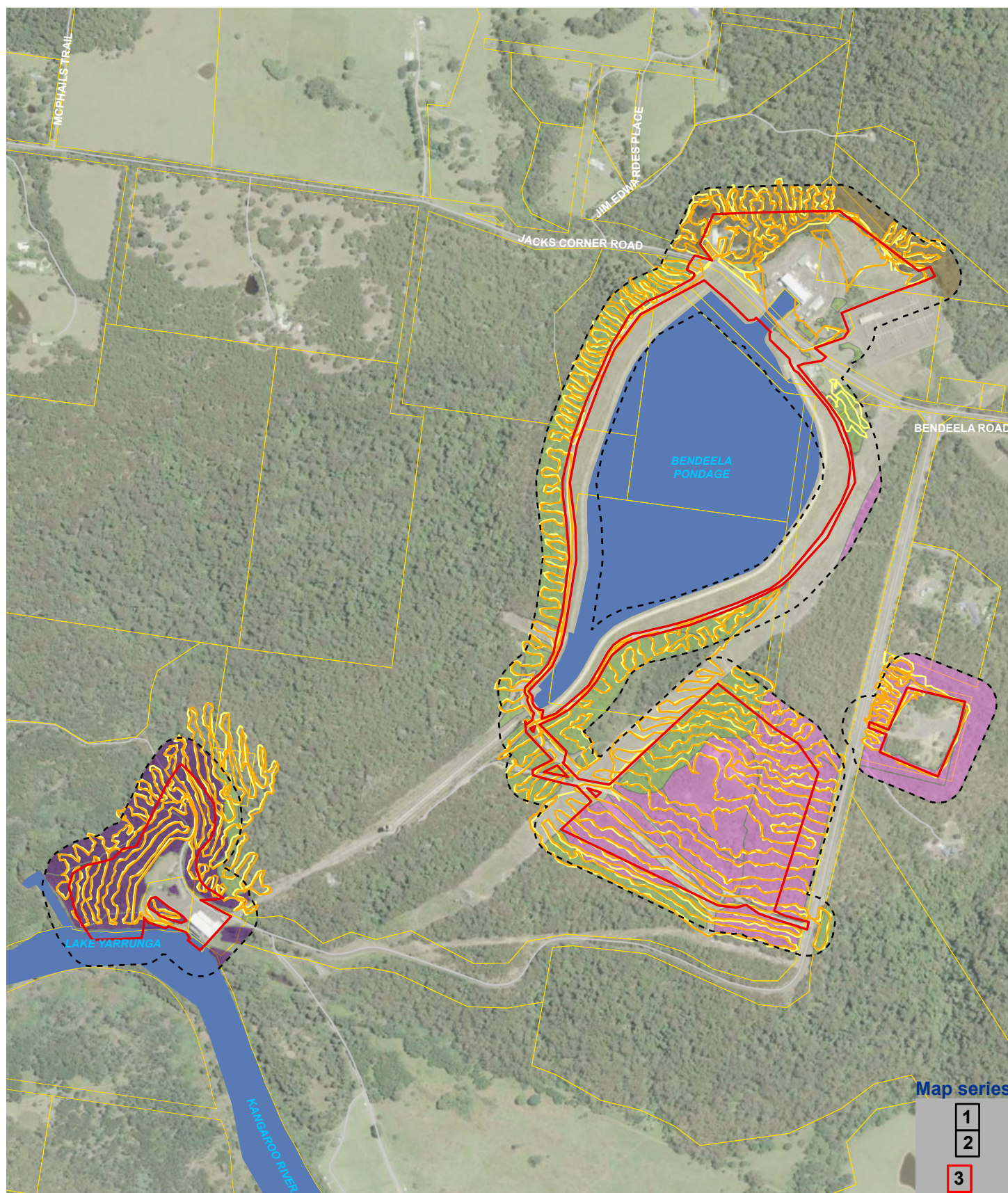
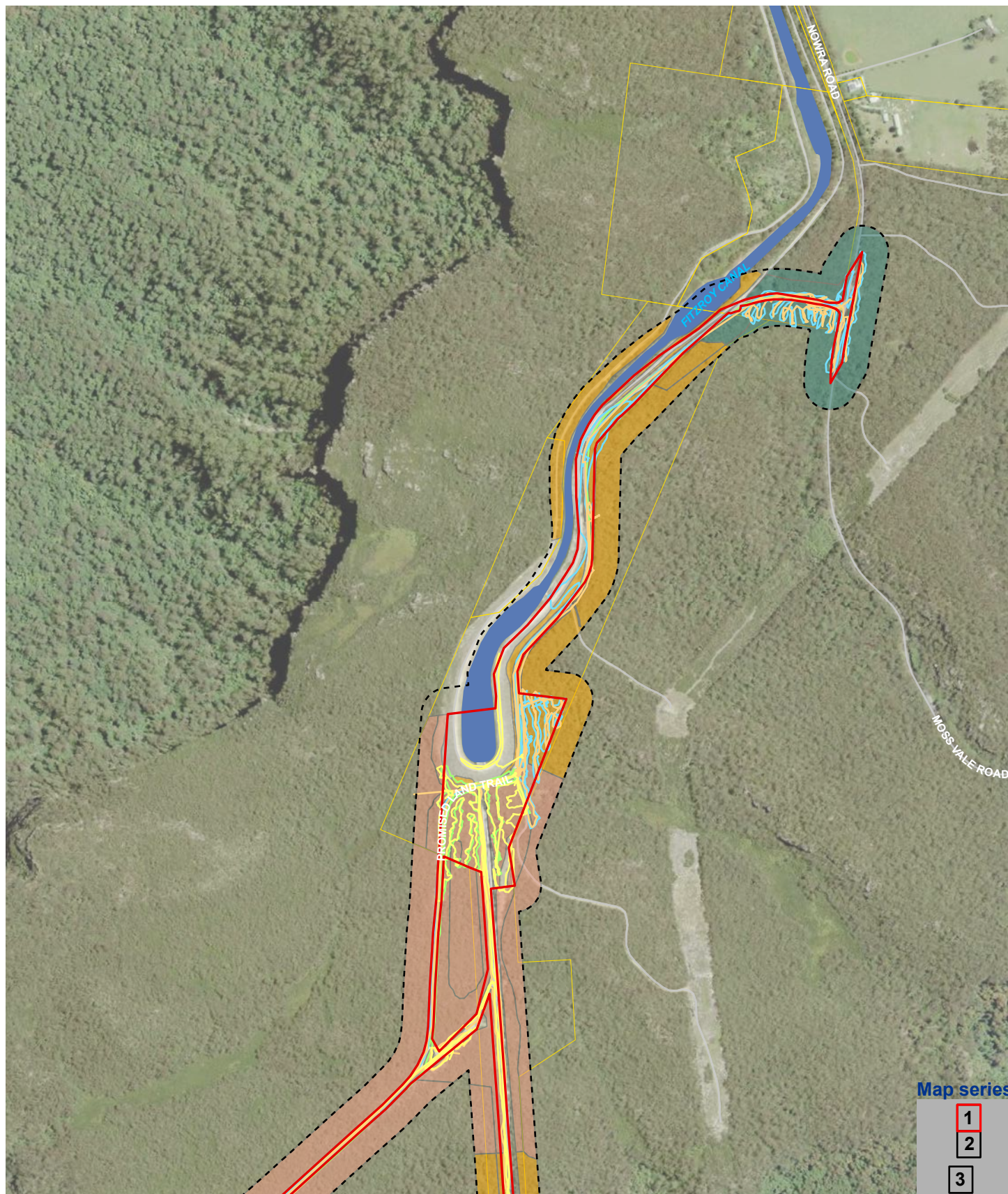


Figure 6-2A Threatened flora targeted surveys - Spring 2021



PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

Threatened flora transect

EmmaGPS_SummerTracks

EvelynGPS_SummerTracks

MattGPS_SummerTracks

TimGPS_SummerTracks

Development site

Assessment area

Waterbody

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56

Data sources¹

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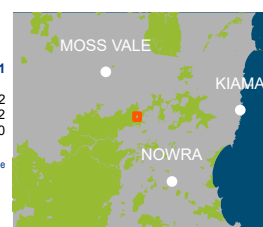
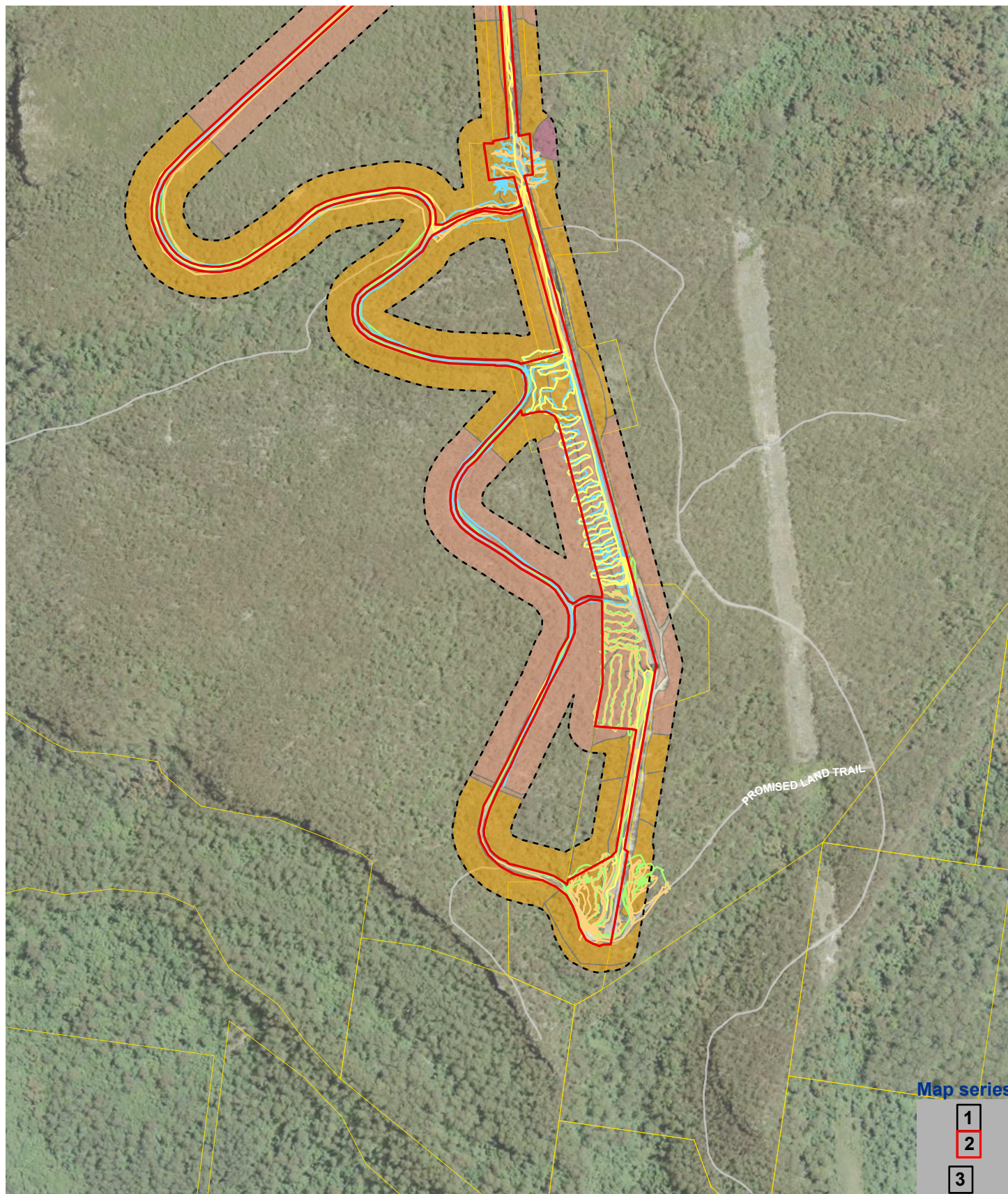


Figure 6-2B Threatened flora targeted surveys - Summer 2021/2022



- PCT 769 - Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

Threatened flora transect

- EmmaGPS_SummerTracks
- EvelynGPS_SummerTracks
- MattGPS_SummerTracks
- TimGPS_SummerTracks
- Development site
- Assessment area

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



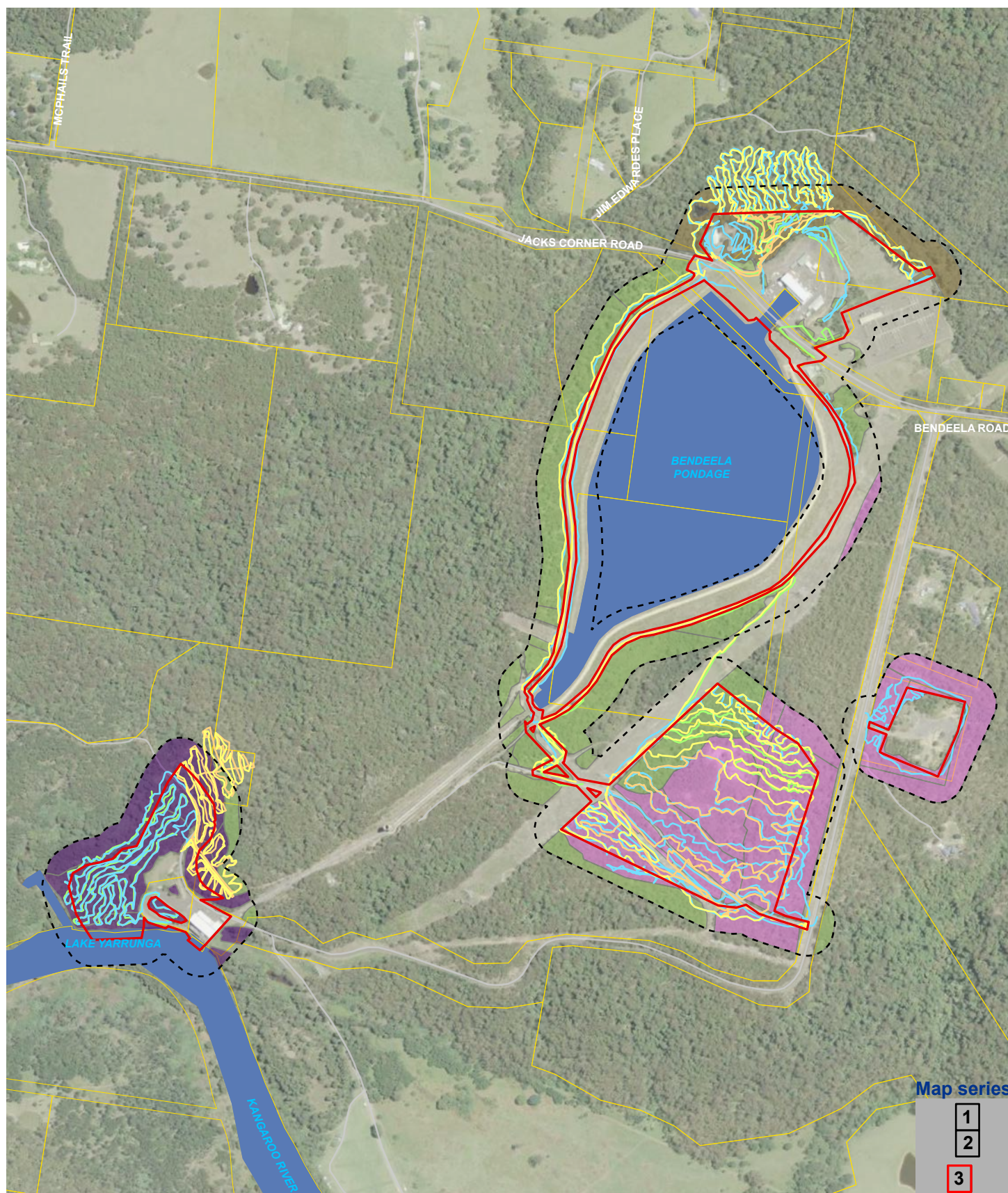
Data sources2

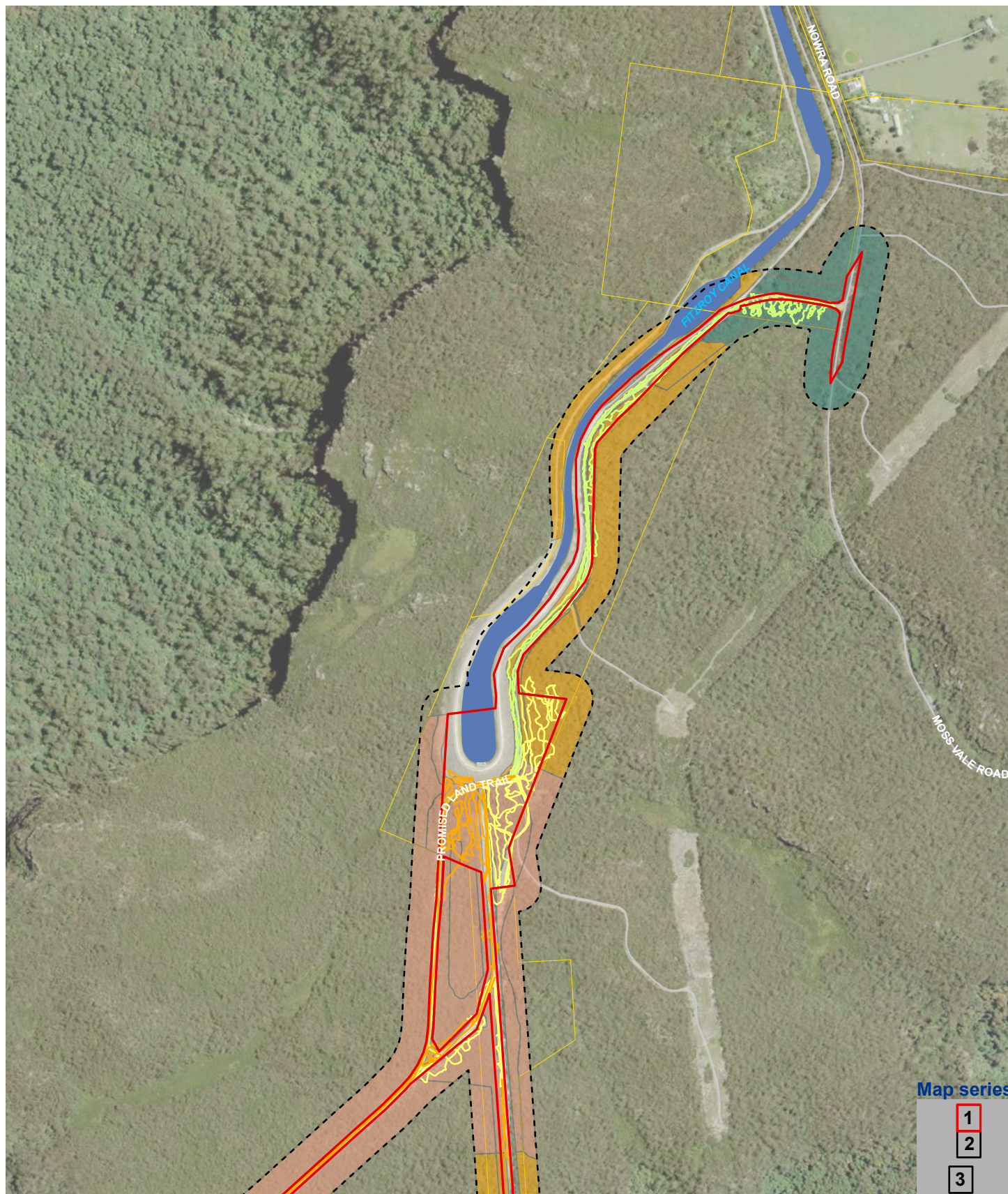
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Figure 6-2B Threatened flora targeted surveys - Summer 2021/2022





- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
- Threatened flora transect**
- AdritaGPS
 - KirstyGPS
 - MattGPS
 - Development site
 - Assessment area
 - Waterbody

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56

Data sources¹

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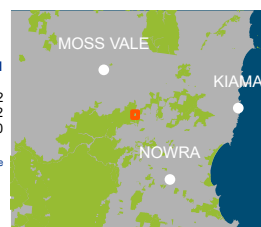
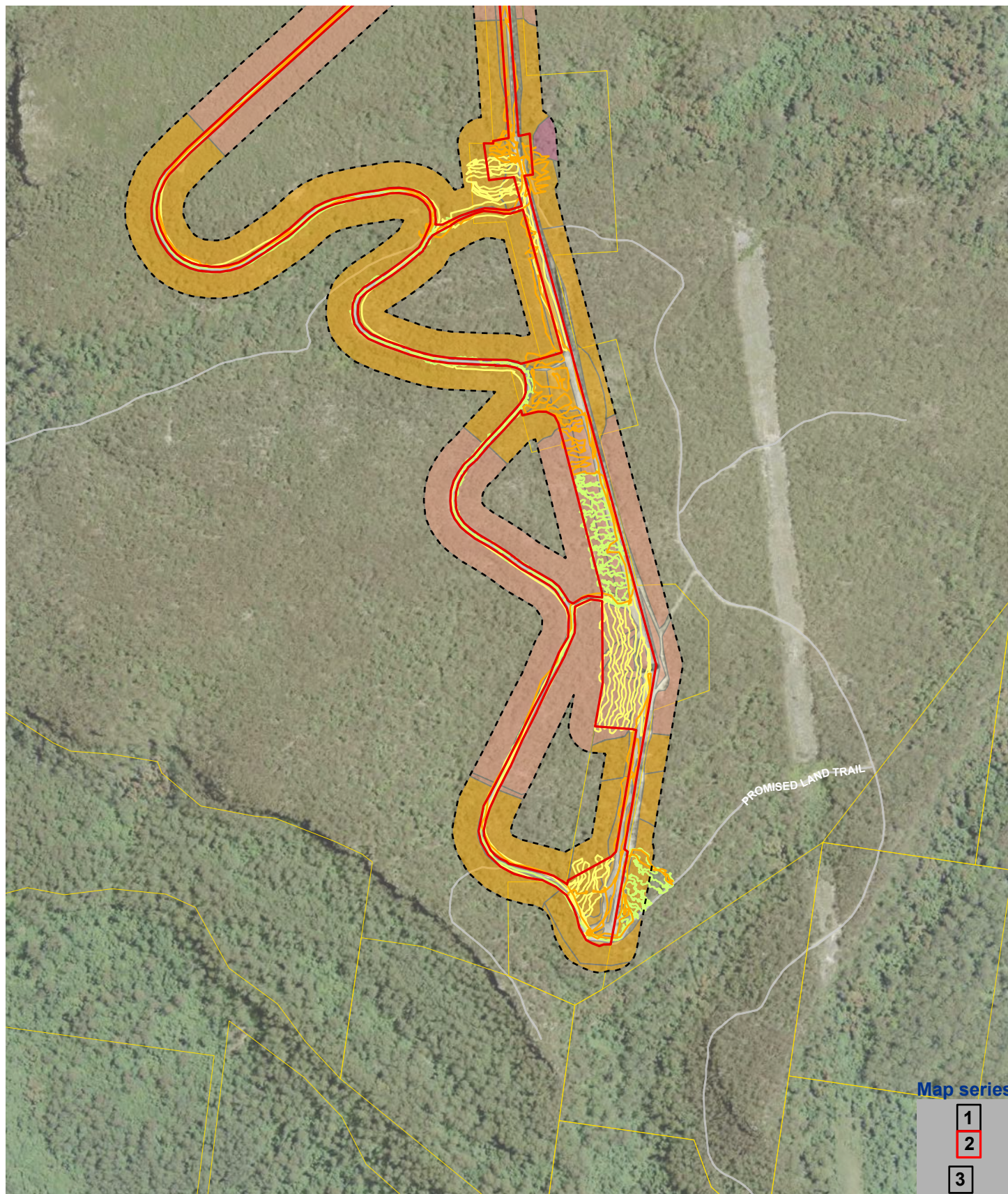


Figure 6-2C Threatened flora targeted surveys - Autumn 2022



- PCT 769 - Coachwood - Lilly Pilly**
warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash**
heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint**
heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- Threatened flora transect**
- AdritaGPS
 - KirstyGPS
 - MattGPS
 - Development site
 - Assessment area

0 200 400 metres
1:10,000 at A4
GDA2020 MGA Zone 56

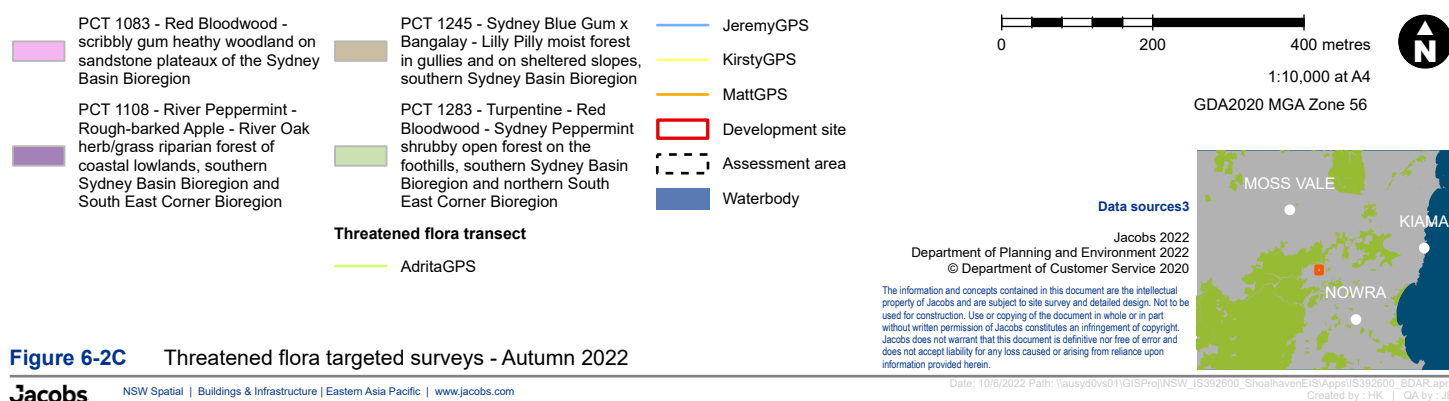
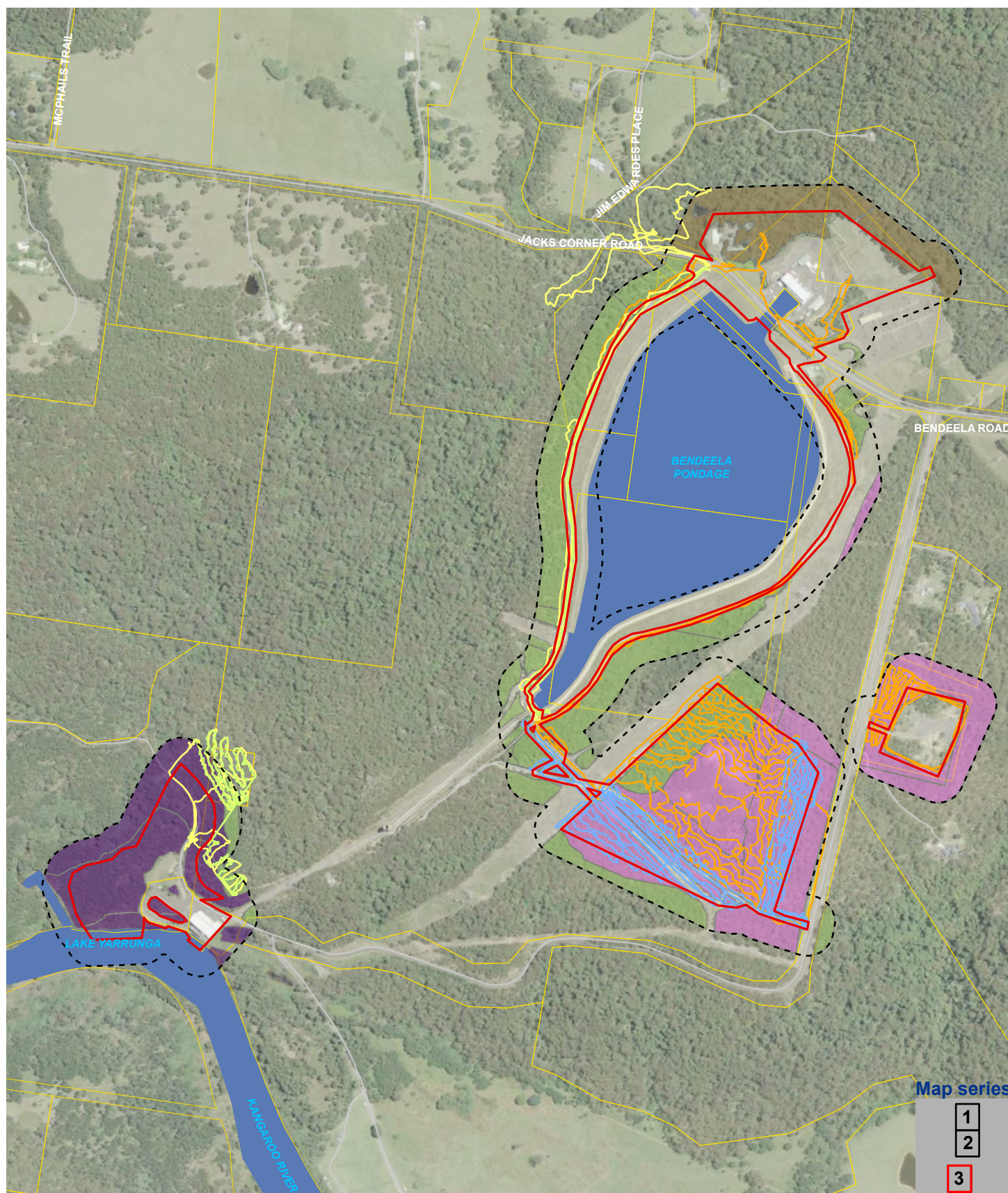
Data sources2

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Figure 6-2C Threatened flora targeted surveys - Autumn 2022



6.3.2 Threatened animal surveys

Targeted threatened species surveys were undertaken for animals that had potential habitat within the development site and broader assessment area. The details of this process are provided in **Section 6.2** of this BDAR. The primary focus was on targeting threatened species identified as candidate species-credit species, however survey data was collected for all species. Surveys included diurnal and nocturnal effort using a stratified sampling approach that aimed to sample the range of habitats present. Opportunistic observations of threatened species were also recorded during survey activities and generally while present in the assessment area.

The following animal species were targeted during surveys:

- Diurnal birds: Pink Robin, Gang-gang Cockatoo (breeding), Glossy Black-cockatoo (breeding), Little Eagle (breeding), Square-tailed Kite (breeding), White-bellied Sea-Eagle (breeding)
- Nocturnal birds (breeding): Barking Owl, Powerful Owl, Masked Owl, Sooty Owl
- Ground mammals: Southern Brown Bandicoot (eastern), Long-nosed Potoroo, Brush-tailed Rock-wallaby, Spotted-tailed Quoll
- Arboreal mammals: Yellow-bellied Glider, Greater Glider, Squirrel Glider, Eastern Pygmy-possum, Koala
- Bats: Large-eared Pied Bat, Southern Myotis, Grey-headed Flying-fox (Breeding), Large Bent-winged Bat (Breeding) and Little Bent-winged Bat (Breeding)
- Amphibians: Stuttering Frog, Green and Golden Bell Frog, Red-crowned Toadlet, Littlejohn's Treefrog, Giant Burrowing Frog.

Surveys were focused on areas within the development site and where possible also occurred in adjacent habitats that extended beyond the development site which may be indirectly impacted by the project. Some surveys for threatened species were also undertaken in adjacent areas which have since been left out of the project design (current developments site). Previous surveys undertaken in adjacent patches of the same PCTs have been incorporated into the survey effort for some threatened species (**Figure 6-3**).

Surveys were conducted over five periods in February and March 2019, December 2021 through to February 2022, August 2022 and lastly October 2022). Surveys used a combination of sampling techniques to suit a range of target species based on the methodology and effort as outlined in the document *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation, 2004) and later guidelines including:

- NSW Survey Guide for Threatened Frogs A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method (Department of Planning, Industry and Environment, 2020)
- 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (Office of Environment and Heritage 2018)
- Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (Department of Planning and Environment, 2022)
- Survey Guidelines for Australia's Threatened Birds (Department of the Environment Water Heritage and the Arts, 2010b)
- Survey Guidelines for Australia's Threatened Frogs (Department of the Environment Water Heritage and the Arts, 2010c)
- Survey Guidelines for Australia's Threatened Mammals (Department of the Environment Water Heritage and the Arts, 2011a)
- Survey Guidelines for Australia's Threatened Reptiles (Department of the Environment Water Heritage and the Arts, 2011b).

6.3.2.1 Diurnal birds

The survey for diurnal birds focused on breeding habitat of the Gang-gang Cockatoo, Glossy Black-Cockatoo, White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite. Additionally, all other bird species were recorded as they were encountered during the various surveys of the assessment area (over multiple seasons) and target surveys were also undertaken throughout all habitats using timed area searches (approximately 20 minutes each). Threatened bird species which require habitat features to be identified were undertaken by searching for active stick nests, use of tree hollows, or chewed *Allocasuarina littoralis* cones (Glossy Black Cockatoo), chewed Eucalypt fruit (potentially Gang-gang Cockatoo) and large stick nests for raptors.

The diurnal bird surveys were undertaken by using the standard technique of timed area searches. All birds observed or heard were recorded in areas of 1 ha over a 20-minute period. Eighteen timed searches were undertaken within or adjacent to development site. The timed area searches were undertaken at dawn, mid-morning or dusk. Opportunistic observations of target bird species and location were also noted while moving through habitat undertaking other field activities. Comprehensive flora search transects in Spring, Summer and Autumn were also appropriate survey periods for the Eastern Bristlebird which usually occupies groundcover vegetation and can be flushed out when alarmed.

Potential signs of breeding habitat for raptors including the White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite were searched for while moving through the habitats within the assessment area. Observers searched for any large stick nests in the top of the canopy of large trees in the forest habitats.

Commonwealth survey guidelines for other threatened bird species suggest a survey requirement for 10 hours of bird surveys over five days (two hours per day) for sites less than 50 ha in size.

Commonwealth survey guidelines for raptor nest searches suggest 8 hours over 4 days (2 hours per day) for sites less than 50 ha. The survey undertaken for this BDAR exceeds the recommended survey effort (Table 6-12).

Survey effort was generally distributed evenly between the forested habitats within and adjacent to the assessment area, including dry sclerophyll forests (PCTs 1156, 1083 and 1082), wet sclerophyll forests (PCTs 1245, 1283 and 1254) and riverine forest (PCT 1108).

A summary of the survey effort undertaken for threatened diurnal birds is provided in **Table 6-12**.

Table 6-12 Summary of survey effort for threatened diurnal birds

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Glossy Black-cockatoo	April – Aug (breeding)	<ul style="list-style-type: none"> 18-22 February 2019 	<ul style="list-style-type: none"> 18 timed searches 	<ul style="list-style-type: none"> Varied from 1 to 2 observers at each site
Gang-gang Cockatoo	Oct – Jan (breeding)	<ul style="list-style-type: none"> 17-22 March 2019 	<ul style="list-style-type: none"> Opportunistic observation throughout survey period 	<ul style="list-style-type: none"> Timed searches = approximately 6 person hours
Little Eagle	Aug – Oct (breeding)	<ul style="list-style-type: none"> 6-10 December 2021 	<ul style="list-style-type: none"> Observation to locate large stick nests undertaken throughout survey period 	<ul style="list-style-type: none"> Opportunistic observations = 80 hours
Square-tailed Kite	Sept – Jan	<ul style="list-style-type: none"> 16-18 August 2022 	<ul style="list-style-type: none"> Targeted tree hollow survey and mapping of potential and actual nest trees to 200 metres from development site 	<ul style="list-style-type: none"> Approximately 60 km of ground was covered during the survey, walking and driving, during which time all hollow-bearing trees and large trees with stick nests were surveyed out to 200 m from development site
White-bellied Sea-Eagle	July – Dec (breeding)	<ul style="list-style-type: none"> 23-24 August 2022 		<ul style="list-style-type: none"> Effort for stick nest and hollow tree surveys was 9 days by two observers (72 hours total). Hollows inspected for approx 20 minutes each.
Eastern Bristlebird	Year-round	<ul style="list-style-type: none"> 17-20 October 2022 		

Note: The main fauna survey period was conducted outside of the breeding survey period for the Square-tailed Kite, therefore the surveys for these species focused on the number of potential nest trees that meet the habitat constraints criteria.

Mapping potential and actual nest trees and stick nests

A targeted survey of potential nest trees for the Gang-gang Cockatoo and Glossy Black-Cockatoo was conducted by two ecologists over five days (16-18 August and 23-24 August 2022) and comprised a search and mapping of all suitable hollow bearing trees within development site, and additional 200 m search buffer of the assessment area to account for possible disturbance to a nest site and to determine species polygons. This targeted search also focused concurrently on identifying large stick nests that may be used by White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite.

Potential nest trees (living or dead) for cockatoos were identified and mapped if they met the following criteria:

- Gang-Gang Cockatoo - (i) at least 9 metres above ground and (ii) hollow diameter of 10cm (iii)
- Glossy Black-Cockatoo - (i) at least 8 m above ground (ii) in stems with diameter >30cm, (iii) hollow diameter is at least 15cm, (iv) stem angle is at least 45 degrees and may be vertical.

The survey conducted in August coincided with the breeding season for the Glossy Black Cockatoo (i.e. April to August) and thus provided an opportunity to confirm an actual nest tree if present from the trees identified.

A second round of hollow-bearing tree inspections was conducted by two ecologists over four days between 17th and 20th of October 2022. This coincided with the breeding season of the Gang-Gang Cockatoo (October to January). Each suitable hollow-bearing tree was inspected for 10-20 minutes to identify possible usage. Larger clusters of hollow-bearing trees were also re-visited a second time (on separate days) to monitor for presence of cockatoos in the vicinity (such as calling or foraging). Presence and activity of Gang-gang cockatoos near hollow-bearing trees was also investigated during flora surveys in December 2021.

A stick nest was identified as a potential nest site if they met the following criteria:

- White-bellied Sea Eagle - living or dead trees within 1km of river, lake large dams or creek (nesting period July-December)
- Square-tailed Kite - nest dimensions not defined in TBDC (nesting period Sept-Jan)
- Little Eagle – nest dimensions not defined in TBDC (nesting period Aug-Oct).

The search for potential nest trees and raptor stick nests was restricted to the 200 m buffer. This is because beyond 200 m of development site on the plateau was not accessible due to cliffs and steep terrain. Any nest sites below the cliff line would be considered outside the zone of potential disturbance. Similarly, searches on the eastern side of the existing pipeline were restricted to a 100 m buffer, as the proposed physical construction activity would (installation of the new pipe) would be adjacent to the existing pipe and cleared edge and deemed to be outside the zone of disturbance.

6.3.2.2 Nocturnal birds

The survey for nocturnal birds focused on the Barking Owl, Sooty Owl, Powerful Owl and Masked Owl (Large Forest Owls) and focussed predominantly on the forested habitats with larger eucalypt trees, including dry sclerophyll forests (PCTs 1156, 1083 and 1082) and wet sclerophyll forests (PCTs 1283, 1245 and 1254).

Presence / absence surveys

Surveys were undertaken both inside and outside of the breeding periods for these Large Forest Owl species. for example the targeted survey outside the breeding season was carried out with three survey events comprising call playback and spotlighting over 16 nights between 18-22 February 2019, 17-22 March 2019 and 6-10 December 2021 to determine if the target species were present during the non-breeding period. Owl call playback sites were completed at 10 sites. Call broadcast was played intermittently for each target species followed by a 10-minute listening period for a total of 10 nights. Where possible call playback sites were established near suitable habitat features (i.e. large hollow bearing trees) along spotlight meanders. Spotlights were turned off during call broadcast to avoid spooking owls and to encourage owls to call or approach. Call playback was followed by a 10-minute spotlight of the canopy in the vicinity of the call playback site to detect any owls attracted to the calls.

Potential and actual nest tree surveys

A targeted survey for 'potential' nest trees was conducted within development site and within a 100 m buffer to account for potential disturbance zone and map a species polygon if required. The characteristics of suitable hollow bearing trees recorded included: tree species, diameter at breast height, hollow types, sizes and heights. Evidence of previous inhabitancy such as owl pellets, scat whitewash, animal carcasses, etc. were also searched for beneath each tree. Potential nest trees were identified and mapped if they met the following criteria:

- Barking Owl - living or dead trees with hollows greater than 20 cm and greater than 4 m above ground (survey May to December)
- Masked Owl - living or dead trees with hollows greater than 20 cm (survey May-Aug)
- Powerful Owl - living or dead trees with hollows greater than 20 cm (survey May-Aug)
- Sooty Owl - living or dead trees with hollows greater than 20 cm (survey May-Aug).

Potential nest trees were then surveyed in the breeding period to determine 'actual' nest sites. This involved nocturnal surveys over 5 nights (between 15-23 August 2022) whereby stationary surveys were conducted at the potential nest trees sites, listening for active owls and stagwatching hollows at dusk. To support the efficacy of the owl stag watch survey, identification of the potential nest tree sites during the day were refined into the following groups additional to the criteria above:

- Poor - hollows with high exposure to the elements, large (tall hollow stumps) chimney hollows at 3m in height with no branches for perching or small trees with small hollows at 20cm in size
- Good – hollows protected or semi-exposed in large trees with foliage or regrowth foliage, hollows on large boughs or trunk, hollows >6m height at 20-40cm in size
- Very Good – hollows protected in very large trees with foliage or regrowth foliage, sometimes multiple hollows meeting criteria on large boughs or trunk, hollows >6m height at 20-50cm or greater if not too exposed to elements.

Potential nest trees with a 'good' or 'very good' class were assigned to the stag watch survey as these were considered to provide the most suitable nesting sites for Large Forest Owls. The nocturnal stag watch survey then involved two observers positioned directly at or near to these trees (where trees were in close proximity) for a period of 90 minutes (30 minutes before sunset and 60 minutes following sunset). Observers recorded any animal activity associated with target trees, including nearby nocturnal fauna calls and local weather conditions.

A summary of survey effort for threatened large forest owls is provided in **Table 6-13**.

Table 6-13 Survey effort for Large Forest Owls

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Barking Owl	May – December (breeding habitat survey)	<ul style="list-style-type: none"> • 18-22 February 2019 • 17-22 March 2019 • 6-10 December 2021 • 15-18 August 2022 • 22-23 August 2022 	<ul style="list-style-type: none"> • 10 spotlighting sites (each with multiple call playback sites). • Driven spotlighting transects between spotlighting sites • Searches and mapping undertaken to identify large hollow-bearing trees within development site and a 100 m buffer • Owl pellets searched for beneath large trees • assessment area examined for cliff lines and caves • Stag watch survey of potential nest trees 	<ul style="list-style-type: none"> • 12 nights spotlighting • Approximately 50 person hours spotlighting • 10 nights call playback • 5 nights stag watching by two observers (each person spent 90 minutes on each night) for total of 15 person hours
Powerful Owl	May – August (breeding habitat survey)			
Masked Owl	May – August (breeding habitat survey)			
Sooty Owl	April – August (breeding habitat survey)			

6.3.2.3 Arboreal mammals

The targeted surveys for threatened terrestrial and arboreal mammal species focused on Eastern Pygmy Possum (EPP), Yellow-bellied Glider (YBG), Squirrel Glider (SG), Greater Glider (GG) and Koala. The survey involved an integrated approach using tree mounted infrared sensor cameras, tree mounted Elliott traps, spotlighting, call playback (YBG and Sq.) and scat searches (Koala). A summary of the overall survey effort is provided in **Table 6-14**. Survey sites were established to sample potential habitat within dry sclerophyll forests (PCTs 1156, 1083 and 1082), wet sclerophyll forests (PCTs 1245, 1283 and 1254) and riverine forest (PCT 1108). The recommended survey effort for arboreal mammals is 24 Elliott trap nights over 3 to 4 consecutive nights per stratification unit up to 50 ha in size (plus additional effort for every additional 100 ha). No guidelines are provided for the use of remote cameras.

Camera traps were placed in the habitats in a roughly even distribution along the assessment area to maximise survey coverage. Baits were made of a peanut butter/honey/oats mix and were placed in weather-proof cannisters approximately 1.5 m away from the camera, which was positioned approximately 2 m above the ground (mounted on a tree). The cameras were set on a timer to operate between 6 pm to 6 am. Whilst cameras were often left operational for more than a month at a time, the baits are assumed to expire within two weeks following installation. Therefore the survey effort for each camera is calculated as 14 nights following installation. The 2021/2022 survey included re-baiting of cameras, such that a second round of 14 nights survey was achieved (batteries were also replaced). A total of 476 camera 'trap nights' was accrued during 2019 and 2021/2022 surveys. Given the assessment area has been changed and refined since the 2019 surveys, four tree mounted cameras were previously set over 500m outside the current assessment area boundary, and were not counted in the survey effort provided (data from those cameras was checked regardless). Previous camera locations within 100m of development site are still counted as part of the survey.

Tree mounted Elliott B traps were baited with the same peanut butter/honey/oats mix. Traps were mounted between 1.5m and 3m height to target both SG and EPP. Traps were located near flowering Proteaceae plants where possible to further attract some of the potentially occurring target species. Tree trunks were also sprayed daily with a honey and water mix. During two surveys in 2019, 200 arboreal Elliott 'trap nights' were accrued across the assessment area.

Spotlighting was undertaken over a total of 13 nights during 2019 (February and March) and 2021 (December) surveys. Spotlighting was undertaken with two people and averaged two hours per night. Spotlighting was supplemented with call playback for arboreal mammals targeting SG, YBG and Koala that respond to vocalisations.

Surveys for Koalas in 2019 involved application of the Spot Assessment Technique (SAT), (Phillips and Callaghan (2011)) to assign threshold values for low, medium (normal) and high Koala activity. A SAT plot is approximately 40x40m wide and located around a centrally located tree (suitable koala feed tree, koala scratches tree or koala observation tree). The ground beneath all suitable trees in the plot are checked for presence/absence of Koala faecal pellets. The surveys within the assessment area used 20 SAT plots (culminating in a search beneath 344 trees), combined with spotlighting and opportunistic surveys throughout. No evidence of Koalas was recorded.

Table 6-14 Survey effort for arboreal mammals

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Eastern Pygmy Possum	Oct- Mar	<ul style="list-style-type: none"> 18 to 22 February 2019 	6 arboreal Elliott trap sites (10 tree mounted traps at each site)	<ul style="list-style-type: none"> 200 arboreal Elliott trap nights across the assessment area (100 on plateau and 100 in valley areas) (2019)
Yellow-bellied Glider	Year round	<ul style="list-style-type: none"> 17 to 22 March 2019 		<ul style="list-style-type: none"> 14 cameras (tree mounted), (two weeks bait duration = 196 camera nights) (2019) +
Squirrel Glider		<ul style="list-style-type: none"> 6 to 9 December 2021 (tree 	<ul style="list-style-type: none"> 24 camera trap sites 	<ul style="list-style-type: none"> 10 cameras (tree mounted), (two weeks bait duration - rebaited for 2nd round (Jan 27th) = 280 camera nights) (2021/2022) = Total 476 camera nights (tree mounted)
Greater Glider				

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Koala		mounted cameras re-baited January 27, 2022)	(tree mounted) <ul style="list-style-type: none"> • 10 spotlighting areas. • 20 Koala SAT sites (30 minutes each) 	<ul style="list-style-type: none"> • 12 nights spotlighting (2 persons for average 2 hrs) Approximately 48 person hours (2019, 2021) • 10 nights call playback (2019, 2021) • 344 trees inspected for Koala scats throughout the assessment area. (20 SAT Plots) (2019)



Photo 6.7 Arboreal Elliot trap B setup (near patch of *Banksia serrata*)



Photo 6.8 Tree-based camera setup

6.3.2.4 Ground mammals

The targeted surveys for threatened terrestrial mammal species focused on Southern Brown Bandicoot, Long-nosed Potoroo, Brush-tailed Rock-wallaby and Spotted-tailed Quoll. The survey program involved an integrated approach of infrared sensor cameras, ground Elliott A traps and spotlighting. A summary of the overall survey effort is provided in **Table 6-15**. Survey sites were established within suitable habitat within dry sclerophyll forests (PCTs 1156, 1083 and 1082), wet sclerophyll forests (PCTs 1283, 1245 and 1254) and riverine forest (PCT 1108). The recommended survey effort for ground mammals is 24 Elliott trap nights over 3 to 4 consecutive nights per stratification unit up to 50 ha in size (plus additional effort for every additional 100 ha). No guidelines are provided for the use of remote cameras.

Ground-based camera traps were placed in suitable habitats in a roughly even distribution along the assessment area to maximise survey coverage. Baits were made of a peanut butter/honey/oats mix and were placed in weather-proof cannisters approximately 1.5 m away from the camera, which was positioned approximately 20cm above ground (mounted low on a tree), (four cameras were also baited with sardines for four nights in March 2019 to target spotted-tailed quoll). The cameras were set on a timer to operate between 6 pm to 6 am. Whilst cameras were often left operational for more than a month at a time, the baits are assumed to expire within two weeks following installation. Therefore the survey effort for each camera is calculated as 14 nights following installation. A total of 294 camera 'trap nights' was accrued during 2019 and 2021/2022 surveys. Given the assessment area has been changed and refined since the 2019 surveys, one camera was previously set over 500m outside the current assessment area boundary, and was not counted in the survey effort provided (data from that camera was checked regardless). Previous camera locations within 100m of the current Development site are still counted as part of the survey. No sandstone cliffs for Brush-tailed Rock-wallaby occur within development site (apart from the engineered pipeline cuttings - which lack suitable features). Rocky slopes and minor cliffs exist in the wider assessment area and sometimes within 50m of development site. These slopes were checked for Brush-tailed Rock-wallaby and scats multiple times during diurnal surveys, and frequently during the spring, summer and autumn flora

surveys. The large escarpments of the plateau edges are outside the assessment area (beyond 200 m) and were not checked due to safety and access constraints.

Elliott A traps were set for three nights along three transects with 20 traps per transect (60 traps). These were baited with peanut butter/honey/oats mix. Traps were set on the ground near suitable habitat features such as hollow logs or rocky areas. During surveys in December 2021, 180 ground Elliot 'trap nights' were accrued across the assessment area.

Spotlighting was undertaken over a total of 13 nights during 2019 (February and March) and 2021 (December) surveys. Spotlighting was undertaken with two people and averaged two hours per night.

Table 6-15 Survey effort for ground mammals

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Southern Brown Bandicoot (eastern)	Year round	<ul style="list-style-type: none"> 18 to 22 February 2019 17 to 22 March 2019 6 to 9 December 2021 	<ul style="list-style-type: none"> 3 ground Elliott trap sites (20 traps at each site) 21 ground camera sites 10 spotlighting areas. 	<ul style="list-style-type: none"> 180 ground based Elliott A trap nights across the assessment area (2021) 11 cameras, (two weeks bait duration = 154 camera nights) (2019)+ 10 cameras (two weeks bait duration = 140 camera nights) (2021/2022) = Total 294 camera nights (ground-based) 12 nights spotlighting (2 persons for average 2 hrs) Approximately 48 person hours (2019, 2021)
Long-nosed Potoroo				
Brush-tailed Rock-wallaby				
Spotted-tailed Quoll				



Photo 6.9 Elliot A trap setup



Photo 6.10 Ground-based camera setup

6.3.2.5 Bats

The survey used the combined approach of live capture using harp traps supplemented with ultrasonic bat call recording with acoustic detectors (AnaBat). Harp traps and acoustic recorders were set up along watercourses or potential flight corridors expected to be flight routes for target species. Traps were set in the late afternoon and checked early the following morning. Any bats caught were removed in the early morning, biometric data taken and then bats placed in a cool shaded location and released at dusk.

The ecosystem credit bat species expected in the location (see **Section 6.2.2**) are relatively wide-ranging and were considered likely to utilise the majority of PCTs present within the assessment area during foraging activity. However, apart from a sparse distribution of tree hollows, the presence of breeding habitat and roosts within the assessment area is limited.

The Eastern Bentwing-bat, Little Bentwing-bat and Large-eared Pied Bat are ecosystem credit species for foraging habitat and species credit species where breeding habitat will be impacted. The 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (Office of Environment and Heritage, 2018) indicates that the focus of the survey should be to determine whether any breeding habitat for these three species is present and whether it would be impacted. For the purpose of the BAM, breeding habitat is specific habitat features that are used, or presumed likely to be used, by threatened bat species as maternity sites. Breeding habitat is considered present if there is:

1. potential breeding habitat, and
2. breeding individuals of the target species on the subject land.

Potential breeding habitat for the Eastern Bentwing-bat, Little Bentwing-bat and Large-eared Pied Bat is identified as caves, tunnels, mines or other structures known or suspected to be used, including species records in the NSW BioNet Atlas with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or identified from the scientific literature. Such habitat features do not occur within the assessment area, however, may be present in the nearby cliff lines and rock escarpments of Kangaroo Valley (considerable distance outside of the assessment area and Development site). Concrete culverts on the site were checked and found to be poor habitat due to smooth concrete ceilings (cylindrical) with few grip points for roosting bats.

Southern Myotis foraging habitat includes creeks, pools and waterways with permanent pools >3m diameter. Roosting/breeding habitat includes riparian vegetation within 200 m of suitable waterways (where hollow-bearing trees can be used for roosting or breeding). Man-made structures such as bridges, wharves and tunnels can also be utilised by breeding colonies. For the purposes of this assessment, all waterways in the assessment area with widths >3m are included as suitable foraging habitat, with all PCTs in the surrounding 200m buffer considered suitable. This includes Kangaroo River, Bendeela pondage (power station dam), Fitzroy Canal and most of Kings Creek. The permanent pools of Kings Creek are beyond development site boundary, however its 200m buffer encompasses areas of PCT 1245 and PCT 1238. This creek was flowing during the survey, with numerous pools up to 6m in diameter with depths of approximately 0.75 metres.

The assessment area and adjacent forested areas do not contain any Grey-headed Flying-fox camps and therefor there is no Breeding habitat for this species. The closest Grey-headed Flying-fox colony is located within the town of Kangaroo Valley, approximately 4km from the southern portion of the assessment area. This species was targeted during spotlighting surveys across the assessment area.

▪ Table 6-16 Survey effort for threatened bats

Common name	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Eastern Bentwing-bat	December – February	<ul style="list-style-type: none"> 18 to 22 Feb 2019 17 to 22 Mar 2019 6 to 9 Dec 2021 	<ul style="list-style-type: none"> 6 Anabat sites 8 harp trap sites 	<ul style="list-style-type: none"> 8 AnaBat monitoring nights (2019)+
Little Bentwing-bat	December – February			<ul style="list-style-type: none"> 4 AnaBat monitoring nights (2021) = 12 nights total
Large-eared Pied Bat	November - January			<ul style="list-style-type: none"> 12 harp trap nights (8 in plateau areas, 4 in valley areas) (2019) +
Southern Myotis	October - March			<ul style="list-style-type: none"> 4 harp trap nights (2 in plateau areas, 2 in valley areas) (2021) = 16 trap nights total
Grey-headed Flying-fox	October - December			<ul style="list-style-type: none"> Searches for camps during all other surveys. 12 nights spotlighting (2 persons for average 2 hrs) Approximately

Common name	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
				48 person hours (2019, 2021)



Photo 6.11 Harp trap installed on track (possible fly-way)

6.3.2.6 Amphibians

The target species for the threatened frog surveys were the Red-crowned Toadlet (*Pseudophryne australis*), Giant Burrowing Frog (*Heleioporus australiacus*), Green and Golden Bell Frog (*Litoria aurea*), Littlejohn's Tree Frog (*Litoria littlejohni*) and the Stuttering Frog (*Mixophyes balbus*). The survey used the combined approach of aural – visual encounter surveys (with spotlighting and call playback techniques). Environmental conditions during three survey periods were optimal for all four species, with warm temperatures and numerous rainfall events - including 50mm over a 24hr period recorded on 18/03/19 followed by two days of 10mm falls.

Two creek lines were prioritised for survey due to their proximity to development site. Trimble's Creek crosses the central section of the plateau portion of the development site (flowing beneath the existing pipeline through a concrete culvert). In the valley areas, Kings Creek flows behind Kangaroo Valley Power station southwards to Kangaroo River (however the watercourse is now outside the revised Development site extent), (surveys in Kings Creek remain valid). Both Creeks were surveyed using an approx. 500 metres transect per water body (where possible - as some sections weren't always inundated and are ephemeral). Surrounding forest was also inspected during spotlight meanders and included areas of PCT 1245 and PCT 1156. This area was surveyed repeatedly using the recommended techniques and following heavy rainfall (when possible). Nocturnal driving surveys along Bendeela Rd (adjacent to part of the assessment area) were also undertaken during rainfall on two evenings. Numerous ephemeral water courses and drainage lines occurring within the plateau portions of the assessment area were also surveyed using the same techniques. Surveys here were focused along the edges of the Promised Lands Fire Trail and the existing pipeline where water flowed or pooled in sandstone drainage lines.

The recommended surveys for the Green and Golden Bell frog also require tadpole searches, call playback and active searches (nocturnal and diurnal). Favourable habitat for this species is large permanent swamps and ponds with plenty of emergent vegetation, and these features are largely absent from the assessment area. Whilst surveyors were actively searching and listening for this species during amphibian searches or general spotlighting surveys, greater priority was given to the other target amphibian species. The Green and Golden Bell Frog is considered to only have a very low chance of occurring on basis of no suitable habitat.

Given the assessment area is mostly within a WaterNSW managed catchment (Shoalhaven Special Areas), ecologists had to follow strict site safety and access requirements, which were influenced by weather conditions. The heavy rainfall events of spring 2021, summer and autumn 2022 resulted in WaterNSW keeping catchments closed on many occasions. This meant that contractors could not access the Special area due to safety restrictions and surveys following heavy rainfall events were not always possible. However, the 2019 surveys coincided with rain events and the lower flood risks that year meant that site access was easier.

Table 6-17 Survey effort for threatened amphibians

Species	Survey period limitation	Survey timing	No. survey sites / techniques	Survey effort
Red-crowned Toadlet	Year-round	• 18 to 22 Feb 2019	• Two 500m transects amphibian searches (along Trimble's Creek and Kings Creek).	• 12 nights spotlighting (aural-visual)
Littlejohn's Tree Frog	July – Nov	• 17 to 22 Mar 2019		• (2 persons for average 2 hrs) Approximately 48 person hours (2019, 2021).
Giant Burrowing Frog	Sept–May. After heavy rain preferred.	• 6 to 9 Dec 2021	• Spotlighting surveys at multiple nearby drainage lines and culverts during rainfall.	• Tadpole survey in pools -8 surveys x 10 min per pool (80 min approx.).
Green and Golden Bell Frog	Aug–Feb preferably after rain.		• Four tadpole search locations	• 8 nights call playback
Stuttering Frog	Sept–Mar			

Littlejohn's Tree Frog (*Litoria littlejohni*) (and *Litoria watsoni*)

Amphibian surveys carried out in February and March 2019, and December 2021 are outside the recommended survey period for this species (July – November, according to the NSW Survey Guide for Threatened Frogs (DPIE, 2020). However, according to the SPRAT Profile, Lemckert (2004) presents evidence that calling can occur at any time of year with a possible peak from February to April. A potential survey gap exists due to timing of surveys against published guidelines.

Giant Burrowing Frog (*Heleioporus australiacus*)

Amphibian surveys carried out in February and March 2019, and December 2021 did not meet the duration of 8 repeat surveys following heavy rainfall as recommended in the NSW Survey Guide for Threatened Frogs (DPIE, 2020). Whilst survey effort was 6 nights, with 4 surveys during light to moderate rainfall, the rainfall amounts did not meet the >50 mm in 24 hours OR >100 mm over three days guidelines. Therefore, a potential survey gap exists.

6.3.2.7 Reptiles

The Broad-headed Snake (*Hoplocephalus bungaroides*) is the only threatened reptile to be targeted in the survey. This species is nocturnal and occurs predominantly in sandstone outcropping of the Hawkesbury, Narrabeen and Shoalhaven groups. Detection of this species can be difficult as it often shelters beneath flaking sandstone and between crevices during the day. Potential habitat for this species in the assessment area is limited to a few areas of exposed rock outcrops located between the Promised Land Trail and the existing pipeline. These areas were targeted used dedicated searches and habitat assessment.

The Survey Guidelines for Australia's Threatened Reptiles (Department of Sustainability, Environment, Water, Population and Communities, 2011) indicates that the optimal survey conditions occur from late spring through to mid-summer, which appears to be the period of greatest movement of individuals. During summer, this species may leave rock outcrops and move into dry forest areas on ridgelines. The recommended survey methods also include searching suitable sheltering sites (under rocks or in crevices) on westerly-facing sandstone cliffs by day during winter (Webb & Shine 1997).

To search for Broad-headed Snake three transects of approximately 1 ha each (300 x 30m) were systematically searched for the presence of broad-headed snakes within rocky habitat. The search involved lifting rocks, and searching in crevices with torchlight. Time spent searching was recorded, as well as number of rocks lifted, and number of rocks assessed to be of suitable snake habitat (defined below).

Each transect was searched simultaneously by two ecologists, for a minimum of 30 minutes. This process was repeated over two separate days, so that each transect was searched twice, always between the hours of 10am–3pm. (Note: first day of survey was 2pm–4pm due to scheduling constraints. Second day of survey began at 9:20am for same reason. Transect #3 was only surveyed on day two).

Assess habitat suitability

The quality of the rock habitat along the transect was assessed by counting the total number of rocks lifted and the number that were potentially suitable for use by the Broad-headed Snake. Rocks considered suitable if

- they are positioned on a rock substrate and not partially buried in soil
- have less than 50% debris under them
- are of an appropriate size class (>3 cm thick and at least 10 cm in length and width)
- positioned relatively flat on the substrate.

These criteria are adopted from Goldingay (1998) and Webb and Shine (1998) and considered suitable habitat for Broad-headed Snake.

The habitat assessment also recorded the aspect and the slope of the transect site, as well as the cover of vegetation canopy over 50m intervals. This was done to further determine the suitability of the habitat. A lower density of vegetation cover allows for greater sun exposure onto the rocks, which influences the temperatures underneath the rocks. Broad-headed snakes are known to favour sheltering under rocks which reach warm evening temperatures (Pringle *et al.* 2003). Additionally, the snakes favour westerly-facing slopes, as these maintain warmer rock temperatures than easterly slopes.

Table 6-18 Details of rock habitat survey and dedicated search for Broad-headed Snake

Transect #	No. of rocks lifted and searched	No. of rocks considered suitable habitat for BHS	Slope/Aspect	Time spent searching
1	41	1 (2.4%)	Slightly SW	Repeated survey for total of 2 person hours
2	69	5 (7.2%)	Sth for first 150m, N for remaining 150m	Repeated survey for total of 2 person hours
3	17	0 (0%)	Slightly SE	Repeated survey for total of 2 person hours

No broad-headed snakes were located and the lack of discovery of any broad-headed snakes was largely attributed to the lack of suitable habitat in the assessment area. As presented in the table above, very few of the rocks searched were classified as suitable "snake rocks". The main reason for this low number is that most rocks (95%, n=121) searched were positioned directly on the sand/soil, and not on bare rock. Additionally, a smaller number (16%, n=20) of rocks searched had a higher amount of leaf litter and other debris underneath.

In addition to the lack of suitable rock-on-rock habitat, the general aspect of the ridge lines in the assessment area were not west-facing, as is preferred by the broad-headed snake indicates that the habitat in the assessment area is not considered suitable for the broad-headed snake.

Canopy cover varied across the three transect locations, averaging 24% at transect 2 and 51% at transect 3. However, this did not consider the cover provided by the midstorey, which would increase the percentage cover at each site.

6.3.2.8 Weather conditions (fauna surveys)

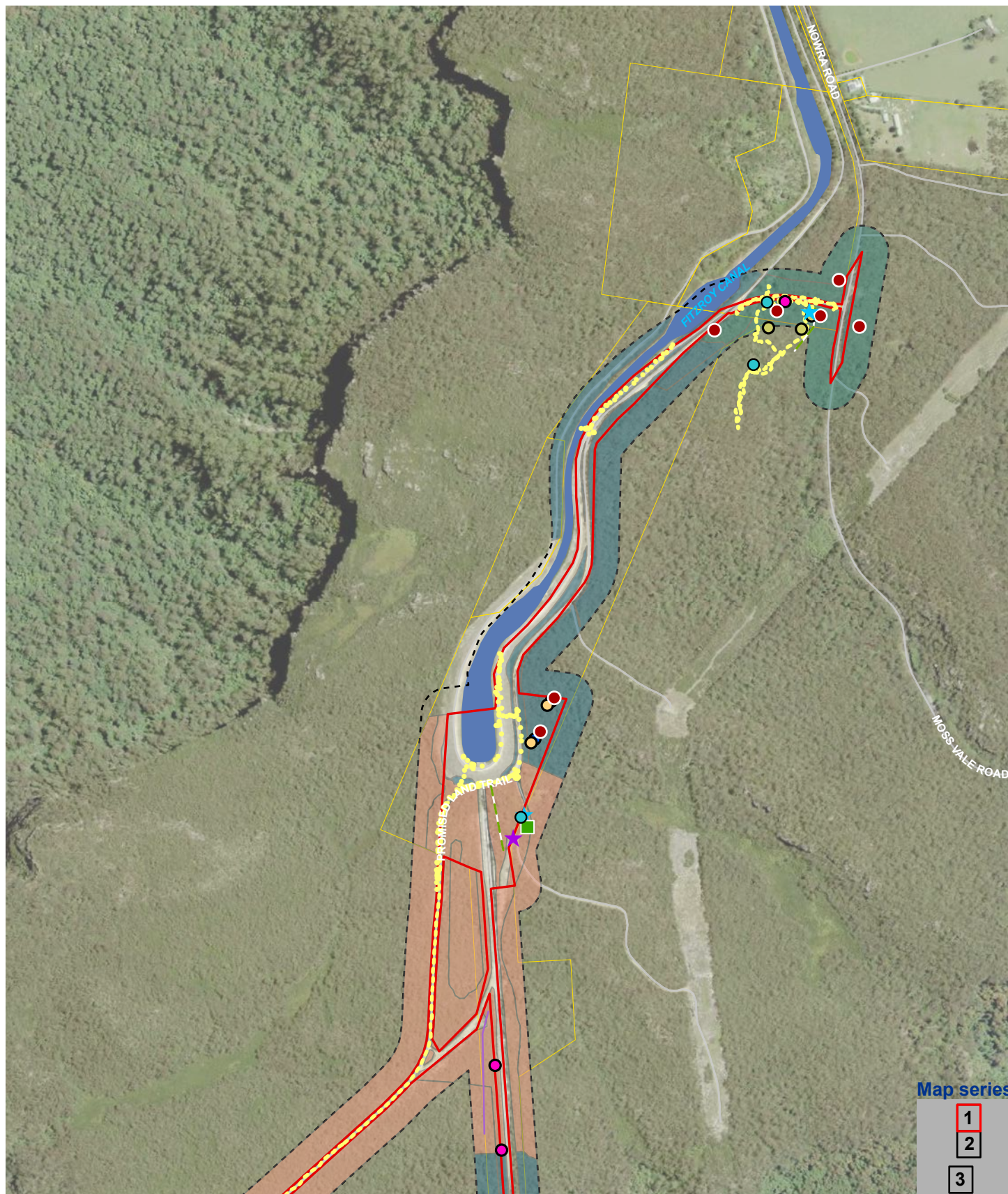
A summary of the timing and weather conditions of all fauna surveys is presented in the following.

- Table 6-19 Weather conditions recorded during fauna surveys

Date	Weather	Moon phase	Wind
Round 1 (2019)			
18/2/19	Warm sunny, max 29 degrees. Evening 18 degrees, cloudy. RH 88%	Full	20km/hr northerly Light winds overnight
19/2/19	Scattered cloud, max 21 degrees. Evening 15 degrees, Overcast. RH 96%	Waning g 99% full. 5.35pm rise	12km/hr southerly Light winds overnight
20/2/19	Cloudy. max 20 degrees. Evening: 16 degrees. overcast light shower. RH 96%	Waning g 99% full. 8.26pm rise	15km/hr easterly Light winds overnight
21/2/19	Cloudy, light showers. max 22 degrees. Evening: 15 degrees, overcast light shower. RH 96%	Waning g 95% full. 9.05pm rise	16km/hr easterly Light winds overnight
22/2/19	Cloudy, light showers. max 23 degrees.	-	-
Round 2 (2019)			
17/3/19	Rain. max 25 degrees. Evening: 17 degrees, light showers. overnight min 15 degrees. RH 99%	Waxing G. 82% 4:39pm rise	20km/hr west
18/3/19	Overcast, rain showers max 26 degrees Evening: 20 degrees, showers. overnight min 16 degrees. RH 99%	Waxing G. 91% 5:29pm rise	13km/hr south east
19/3/19	Overcast, rain showers max 25 degrees Evening: 19 degrees, showers clearing. overnight min 17 degrees. RH 100%	Waxing G. 96% 6:15pm rise	5km/hr south west
20/3/19	Overcast, showers. max 25 degrees. Evening: 18 degrees, mostly clear. overnight min 15 degrees. RH 100%	Waxing G. 99% 6:56pm rise	15km/hr south east
21/3/19	Partly cloudy, brief showers, max 26 degrees. Evening 18 degrees, partly cloudy. overnight min 17degrees. RH 100%	Full moon. Rise 7:34pm	5km/hr south east
22/3/19	Partly cloudy, brief showers 27 degrees.	-	Light winds
Round 3 (2021)			
6/12/21	Cloudy, max 22 degrees Evening: overcast 16 degrees. RH 83%	Waxing crescent 7%. rise at 7:03am. Set 10:22pm	Northeast wind 15 km/hr, easing to 9km per hour
7/12/21	Mostly cloudy, 28 degrees Evening: Overcast, 19 degrees. RH 100%	Waxing crescent 14%. rise at 8:10am. Set 11:19pm	Wind west 20km / hr. Southerly 14km / hr in evening.
8/12/21	Cloudy, light showers 19 degrees max. Evening: Overcast, 14 degrees. RH 95%	Waxing crescent 23%. rise at 8:10am. No set	Southerly 18km / hr. No wind in in evening.
Round 4 (2022)			
15/8/22	Cloudy, max 12 degrees, dusk – mod winds 54 km/h, 8 degrees, no rain, RH 72%	Waning gibbous 85% rise at 8:56pm, set 8:38am	Mod winds 54km/hr at dusk
16/8/22	Cloudy, max 13 degrees, dusk – light winds 23 km/hr, 11 degrees, no rain, RH57%	Waning gibbous 76% rise 9:59pm set 9:07am	Light winds 23 km/hr at dusk
17/8/22	Cloudy, max 16 degrees, dusk light winds 15 km/hr, 15 degrees, RH46%	Waning gibbous 67%, set 10:05am	Lights winds 15km/hr at dusk
18/8/22	Clear skies, max 16 degrees, dusk light winds 22km/hr, 13 degrees, no rain, RH61%	Waning gibbous 57% set 10:37am	Light winds 22 km/hr at dusk
22/8/22	Cloudy max 15 degrees, dusk mod winds 33 km/hr, 13 degrees, no rain, RH47%	Waning crescent 20% rise 2:57am, set 12:38pm	Mod winds 33km/hr at dusk

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Date	Weather	Moon phase	Wind
23/8/22	Cloudy, max 14 degrees, dusk rain mod winds 28km/hr, 3 degrees low, high RH95%, 10mm rain overnight	Waning crescent 13% rise 3:50am, set 1:28pm	Mod winds 28km/hr at dusk
Round 5 (2022)			
17/10/22	Overcast, max 18 degrees, RH 80%	Waxing crescent 40%	Mod S wind 30km/hr
18/10/22	Overcast becoming sunny, max 21 degrees, RH 70%	First quarter	mod NE wind 41 km/hr
19/10/22	Scattered cloud, max 25 degrees RH 60%	Waxing gibbous 52%	mod SSE wind 37 km/hr
20/10/22	Overcast, showers developing late. Max 22 degrees RH 79%	Waxing gibbous 58%	Light 16kms



- Bird point survey
- AnaBat detector
- ★ Harp Trap (2021)
- ★ Harp trap (2019)
- Koala SAT plot
- Ground-based camera 2019
- Ground-based camera 2021/2022
- Tree-mounted camera 2019
- Tree-mounted camera 2021/2022
- Broad-headed Snake survey transect
- Tree Elliot trap transect
- Spotlight survey
- Development site
- Assessment area
- Waterbody
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Map series

1
2
3

Data sources¹

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Department of Planning and Environment 2022
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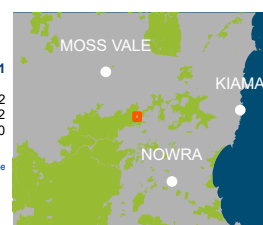


Figure 6-3 Fauna survey sites

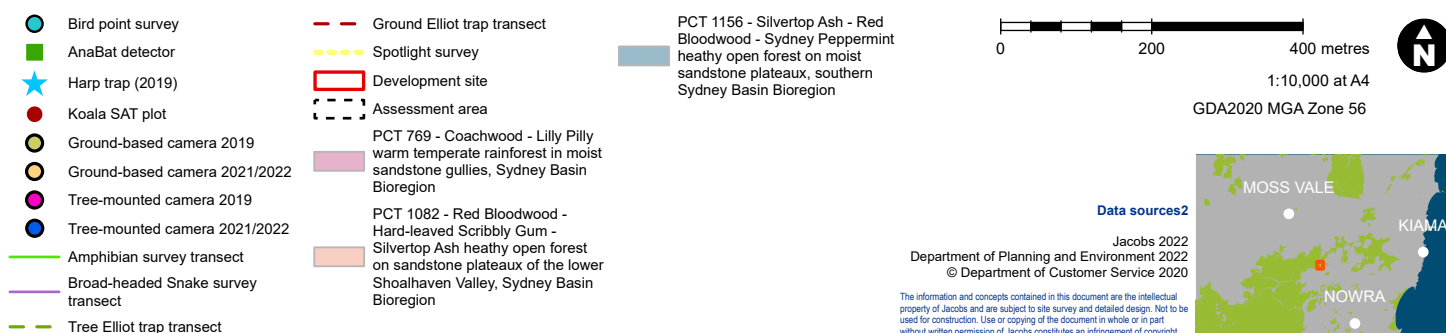
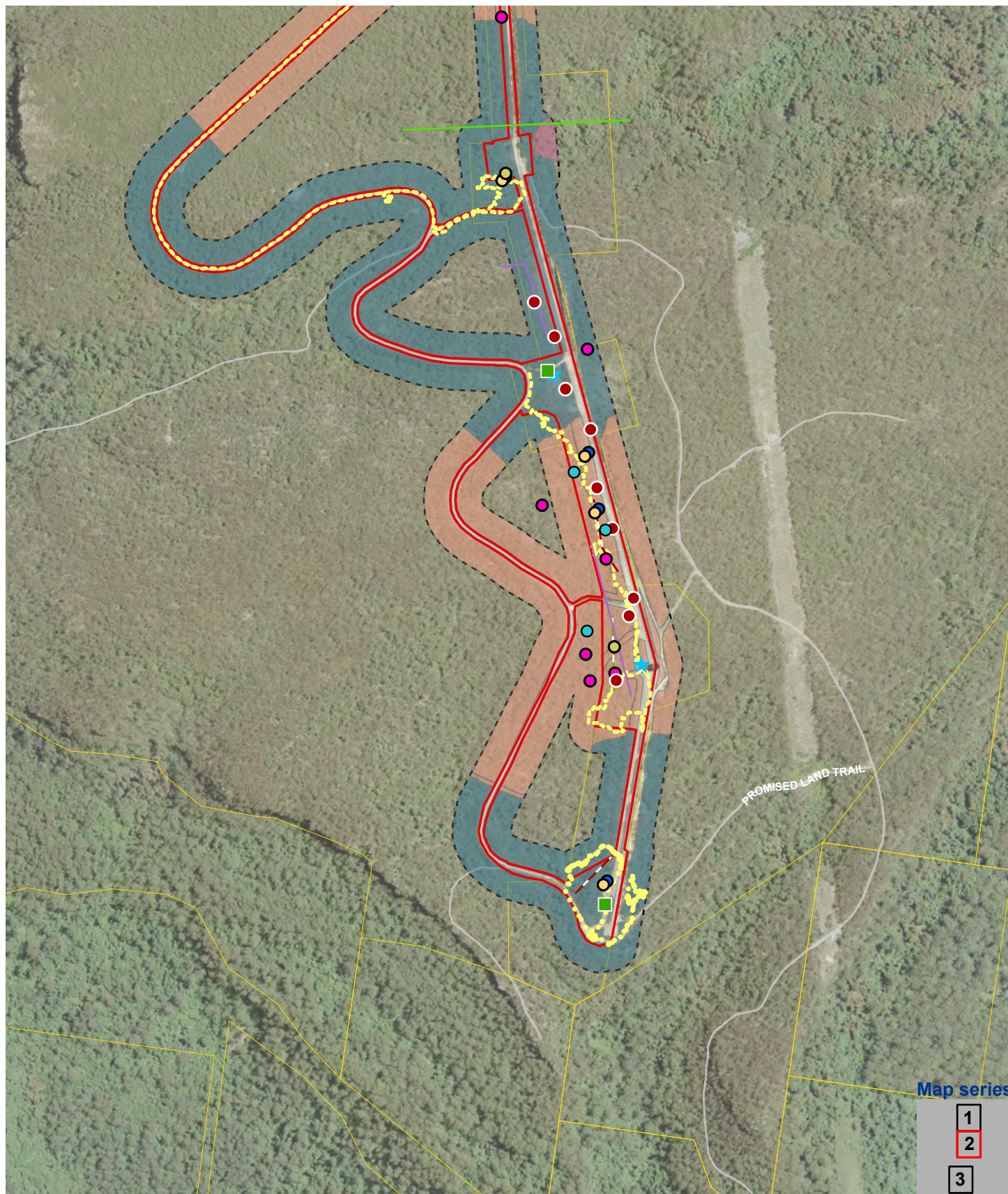
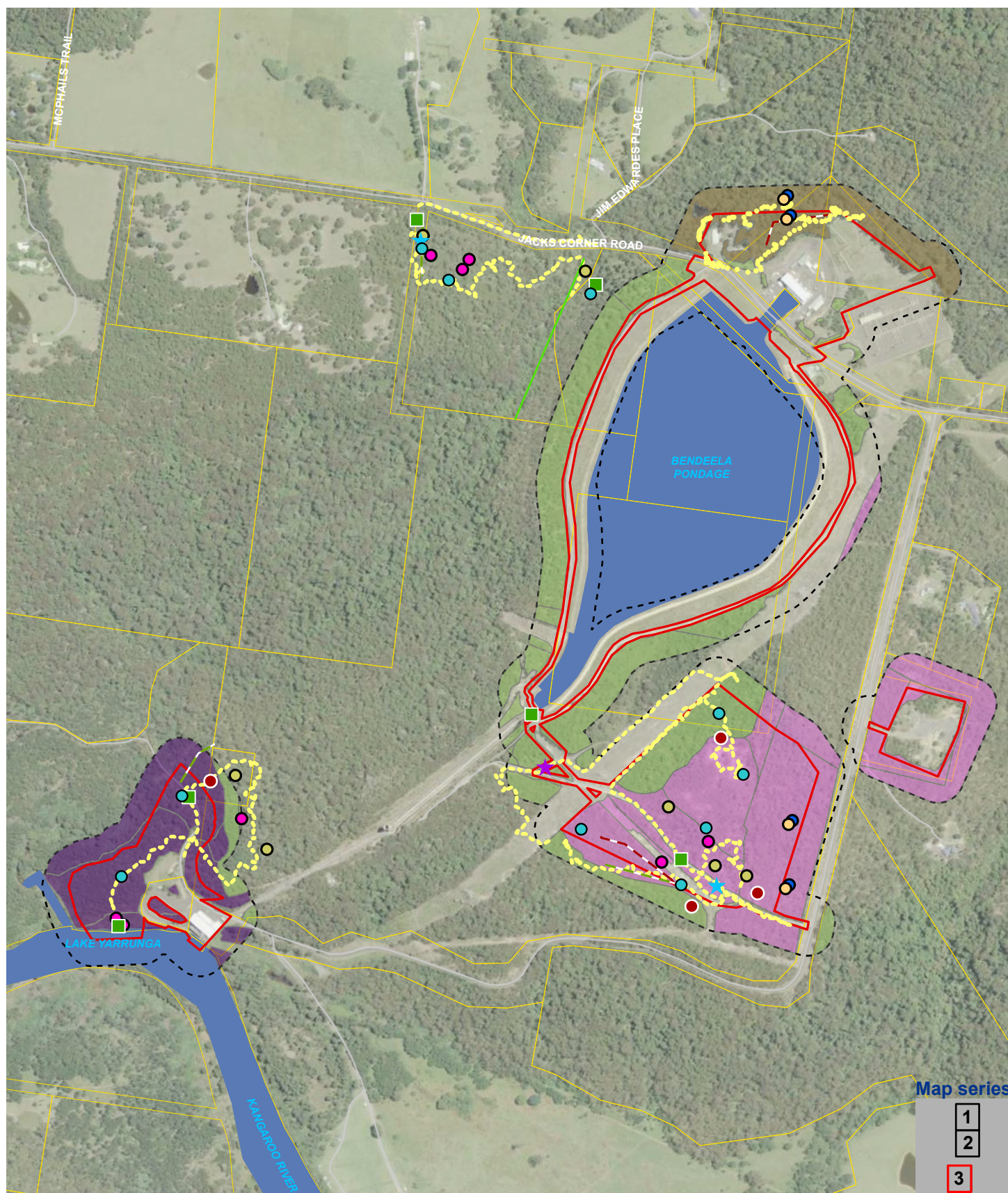


Figure 6-3 Fauna survey sites



- Bird point survey
- AnaBat detector
- ★ Harp Trap (2021)
- ★ Harp trap (2019)
- Koala SAT plot
- Ground-based camera 2019
- Ground-based camera 2021/2022
- Tree-mounted camera 2019
- Tree-mounted camera 2021/2022
- Amphibian survey transect
- Tree Elliot trap transect
- Ground Elliot trap transect
- Spotlight survey
- Development site
- Assessment area
- Waterbody
- PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
- PCT 1108 - River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

- PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
- PCT 1283 - Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources³

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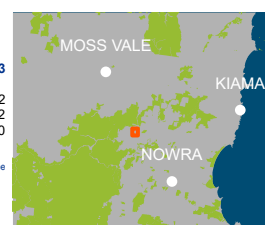


Figure 6-3 Fauna survey sites

6.4 Threatened species survey results

6.4.1 Threatened plants

Multiple targeted surveys were conducted for threatened plants in proposed impact areas of the project, during spring, summer and autumn seasons. As discussed, the seasonal survey requirements for all target species were covered by these surveys, except for *Genoplesium baueri* which may have finished flowering before the autumn surveys (see below) due to delays associated with high rainfall events and site access constraints. The discussion below provides details of the threatened flora species that were positively identified or assumed present within the assessment area.

Scrub Turpentine (*Rhodamnia rubescens*)

Six *Rhodamnia rubescens* were recorded within and adjacent to the development site amongst moderate condition PCT 1245 to the west of Kangaroo Valley Power Station (this vegetation is regrowth >45 years old). Two plants are within the development site boundary at the proposed tunnel exit portal adjacent to the KV power station and are likely to be impacted. A further four plants were recorded outside the development site between approximately 100 m from the construction area and will not be impacted (See **Figure 6-4**). The two plants to be removed have high-level infection with Myrtle rust (*Austropuccinia psidii*) and appear to be consistently shedding, with unknown reproductive capacity. The four plants outside the development site were also infected but at lower levels however the reproductive capacity of these is also unknown. The abundance of this species in the wider locality is unknown and surveys of the surrounding escarpment areas were not undertaken due to time constraints and private property restrictions. There are multiple plants recorded approximately 1 km west at McPhail's Fire Trail (NSW BioNet).

Hibbertia puberula

Three small *Hibbertia* plants were found during the December 2021 surveys near Bendeela Rd, in an area of high condition PCT 1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (Vegetation zone 12). Samples were sent to the Australian National Herbarium for assistance with identification. David Albrecht from CSIRO replied (email dated 22 Dec) with confirmation that the samples were *Hibbertia puberula*. Despite comprehensive survey in the surrounding areas of the assessment area, no other individuals were found during that same survey. Follow up survey in Autumn 2022 did not record any other similar looking *Hibbertia* in the areas of PCT 1083. The locations of these plants are provided in **Figure 6-4**.

Bauer's Midge Orchid (*Genoplesium baueri*)

Surveys for this species were delayed by high rainfall and site access constraints and may have missed the 2022 flowering season which likely occurred between January and March in the Shoalhaven (communication with DPE Threatened species officer). The surveys in April were deemed to be outside the survey window and as a result this species has been assumed present in accordance with the BAM. According to the BioNet TBDC, suitable habitat for this species includes associated PCTs; Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083) and Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082). However, the geographical constraint in the BAM-C is '20km from Nowra', which means the valley portions of the development site are included but the plateau portions are outside the species range (20km distance). Given the plateau portion is also in Moss Vale IBRA subregion (which doesn't contain *Genoplesium baueri* range in the BAM-C) the plateau areas of PCT 1082 (associated PCT) are not included in the assumption of presence. Currently, the areas of habitat for *Genoplesium baueri* include all vegetation zones of PCT 1083, and totals 9.5 hectares. Further surveys for this species are proposed in 2023. Records of this species are clustered around Nowra and Jervis Bay, although a single record exists to the north of Bomaderry (Generalised to 10km by NSW DPI), (NSW BioNet Atlas).

Other threatened orchids

The target surveys for spring and summer flowering orchids (*Pterostylis vernalis*, *Caladenia tessellata*, *Calochilus pulchellus*, *Rhizanthella slateri* and *Cryptostylis hunteriana*) coincided with generally ideal conditions. Rainfall had been above average during spring, as well as during preceding winter months (see **Section 6.3.1**). Temperatures were mild to hot and a high abundance of common orchids (*Cryptostylis erecta*,

Cryptostylis subulata, *Caladenia carnea* and *Corybas* sp) was recorded in the assessment area. Seasonal conditions were agreed to be suitable during correspondence with a DPE Senior Biodiversity Conservation Officer (email dated 4th February 2022). The cryptic *Calochilus pulchellus* was also confirmed to be flowering in late spring (according to a Senior Threatened Species Officer (correspondence dated 10th November 2021).

Autumn surveys occurred during similar weather conditions with above average rainfall, although slightly colder average temperatures. Surveys for *Pterostylis ventricosa* were undertaken during 20th to 21st April and 4th– 6th May 2022 following confirmation of flowering of the St Georges Basin population (which was checked by Jacobs ecologists on 19th April 2022). Autumn surveys did not record *Pterostylis ventricosa* (or the similar, common species *Pterostylis parviflora*) within the assessment area (and only common species *Pterostylis longifolia* was recorded).

6.4.2 Threatened animals

As described in **Section 6.2.1**, the assessment area and Development site contain a variety of broad habitat types including dry sclerophyll, wet sclerophyll and riverine forests. Despite historical clearing and disturbance for the original hydro scheme, and grazing land in the valley, development site contains approximately 29.5 hectares of native vegetation (comprised of approximately 22.5 hectares regrowth forms and 7.3 hectares of remnant vegetation). The areas of remnant vegetation (and high condition class vegetation zones) contain mature eucalypts, with tree hollows (sometimes large diameter) with diverse mid-layer and ground-layer flora (often containing important flowering plants such as Proteaceae). These areas also include ground habitat features such as hollow logs, sandstone rocks and wood debris. The historically cleared and disturbed areas of the assessment area contain moderate condition regrowth forms of PCTs, which are characterized by semi-mature and young eucalypt trees with variable mid-layer vegetation densities ranging from sparse to very dense shrub regrowth. Previously cleared areas generally lack habitat features such as hollow-bearing trees, ground logs and sandstone rock. Lower condition vegetation zones such as 'shrub-regrowth' and 'derived grassland' are also considered poor quality fauna habitat. In general, target fauna surveys prioritised the remnant and old-regrowth areas of vegetation due to suitability of habitats for target species.

Breeding Cockatoos (Glossy Black-Cockatoo and Gang-gang Cockatoo)

Three Glossy Black- Cockatoos were recorded adjacent to the Promised Lands Track in February 2019 (in PCT1082) and a further 4 birds were recorded adjacent to the Promised Lands Track on 17 August 2022 (also in PCT1082) this latter observation was of an adult pair with two juveniles indicating breeding does occur in Morton National Park. Suitable habitat containing *Allocasuarina littoralis* (food tree) is available in most PCTs within development site, and the mature habitats present are considered suitable for multiple birds and resident breeding pairs.

To determine the potential impact on breeding habitat for this species identification of potential nest sites was conducted and a search of each tree within the breeding period. A total of 344 hollow-bearing trees were mapped from a 200 m buffer of development site, each of these met the criteria as 'potential' nesting hollows for this species. All potential nest trees were located in older, remnant forest and the dedicated survey identified an absence of 'potential' nest sites from large areas of regrowth buffering the project (Refer **Figure 6-4**). Of the 344 trees identified, 10 are located directly in development site.

The dedicated hollow tree mapping was conducted in mid-August 2022 in the last month of the breeding period for this species. None of the trees were occupied by Glossy Black Cockatoo at this time confirming no 'actual' nest trees were present in development site or 200 metre buffer area at this time. Further to this the project team has conducted numerous traverses of development site during targeted flora surveys, also within the breeding season for Glossy Black Cockatoo (April and May 2022) and no actual nest sites were opportunistically recorded at this time.

While there are numerous opportunities for Glossy Black-cockatoo nesting in Morton National Park and a family group was observed in mid-August 2022, nonetheless comprehensive mapping and inspection of all 'potential' nest sites in a 200 m buffer of the development project has not located at nest during the survey periods. According to the BAM a species polygon has not been prepared for a Glossy Black-cockatoo nest site.

The Gang-gang Cockatoo was recorded numerous times during surveys. Observations were usually of a single bird flying over the assessment area, except for one observation of up to 5 birds foraging in the eucalypt canopy near Fitzroy Canal. A dedicated survey was conducted to identify and map all hollow-bearing trees within the development site and a 200 m buffer (344 trees met the criteria as 'potential' nesting hollows), (Refer **Figure 6-4**). Following this, all recorded hollow-bearing trees were surveyed in October 2022 for breeding activity. One adult female and juvenile male were recorded perched and foraging near three suitable hollow-bearing trees at the southern end of the existing pipeline (on the plateau). Whilst not observed entering/exiting the hollows, it was assumed that one of these trees is a potential nest (as a precautionary approach all three trees were deemed actual nest trees). These trees are not within the Development site although are within the 200m buffer. A 200 m buffer was applied to each assumed nest tree using GIS and the buffer area overlaid with the project Development site to determine a species polygon and area of impact on breeding habitat for the species. The total area of impact on Gang-gang Cockatoo breeding habitat was calculated at 1.01 ha and intersects 6 different vegetation zones across two subregions.

Breeding Large Forest Owls (Barking Owl, Masked Owl, Powerful Owl, Sooty Owl)

- Surveys involving call playback, dusk listening, tree hollow stag watching and spotlighting were conducted across all areas of the project targeting each of these large forest owl species. No individuals of the target species was detected during these surveys and no evidence of owl presence from signs, scats or pellets was identified.
- Despite this and on the basis of suitable habitat and associated PCTs it is expected that each of these large forest owl species would occur and as such they are included as ecosystem species.
- To determine the impact on breeding habitat the dedicated search and mapping of hollow-bearing trees identified 89 trees from development site and 100 m buffer that met the criteria as a 'potential' nest site for each species. The base of each tree was also searched for white wash and owl pellets and these signs were not located.
- While many of these trees had hollow cavities that met the criteria, only around 25% were considered high value potential nest sites. These trees in particular were in large mature trees, had large trunk hollows that were high in the canopy >10 metres and were not obscured by dense foliage. The nocturnal survey conducted in August 2022 occurred over 5 nights using two observers and targeted these high value trees by stag watching. Each of the additional 'lower' potential trees was also known by the observers because of their mapped position. The observers were positioned in relative proximity to these trees during the dusk surveys and the survey focused effort on listening for breeding pairs calling to each other after dusk and owl activity associated with these trees. The survey was conducted within the breeding period for each of the target species. The location of 'potential' nest trees is shown on **Figure 6-4**.
- Breeding habitat for these target species is indicated by the presence of suitable habitat (i.e. PCTs) and:
 - The presence of male and female or
 - Calling to each other (duetting) or
 - Nest located or
 - Existing breeding habitat has been identified.

Despite extensive targeted surveys no large forest owl nest trees were identified. According to the BAM a species polygon is not required for impacts to breeding habitat for these species due to confirmed absence of a nest tree in the disturbance buffer.

Breeding diurnal raptors (White-bellied Sea Eagle, Square-tailed Kite and Little Eagle)

Breeding habitat for the White-bellied Sea-Eagle is indicated by live large old trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines that contain a large stick nest within the tree canopy. Breeding habitat for this species can also be indicated by an adult with nest material, or adults observed duetting within the breeding period. The survey for the White-bellied Sea-Eagle focused on locating potential nest sites.

The White-bellied Seas-Eagle is known to occur in the locality and has been recorded flying above Kangaroo River, adjacent to development site. This species is also a regular occurrence along the Shoalhaven River and nearby coastal districts. While foraging habitat is present in adjacent areas or power station dams, the White-bellied Sea-Eagle was not recorded in development site during the surveys and no large trees containing large stick nests were located within development site or 200 m buffer. This suggests that breeding habitat for the White-bellied Sea-Eagle is not present in development site.

To identify breeding habitat for the Square-tailed Kite it is necessary to locate a Square-tailed Kite sitting on a stick nest or in attendance of a stick nest. The survey for the Square-tailed Kite focused on locating potential nest sites. There are no records of the Square-tailed Kite near the assessment area and this species was not recorded during the surveys. No large trees containing large stick nests were located within development site or 200 m buffer. This suggests that breeding habitat for the Square-tailed Kite is not present in development site.

Breeding habitat for the Little Eagle is indicated by live (occasionally dead) large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy. The survey for the Little Eagle focused on locating potential nest sites.

The Little Eagle is known to occur in the locality having been recorded near Fitzroy Falls and Kangaroo Valley. While foraging habitat is present, the Little Eagle was not recorded in development site during the surveys and no large trees containing large stick nests were located within the assessment area or 200 m buffer. This suggests that breeding habitat for the Little Eagle is not present in development site.

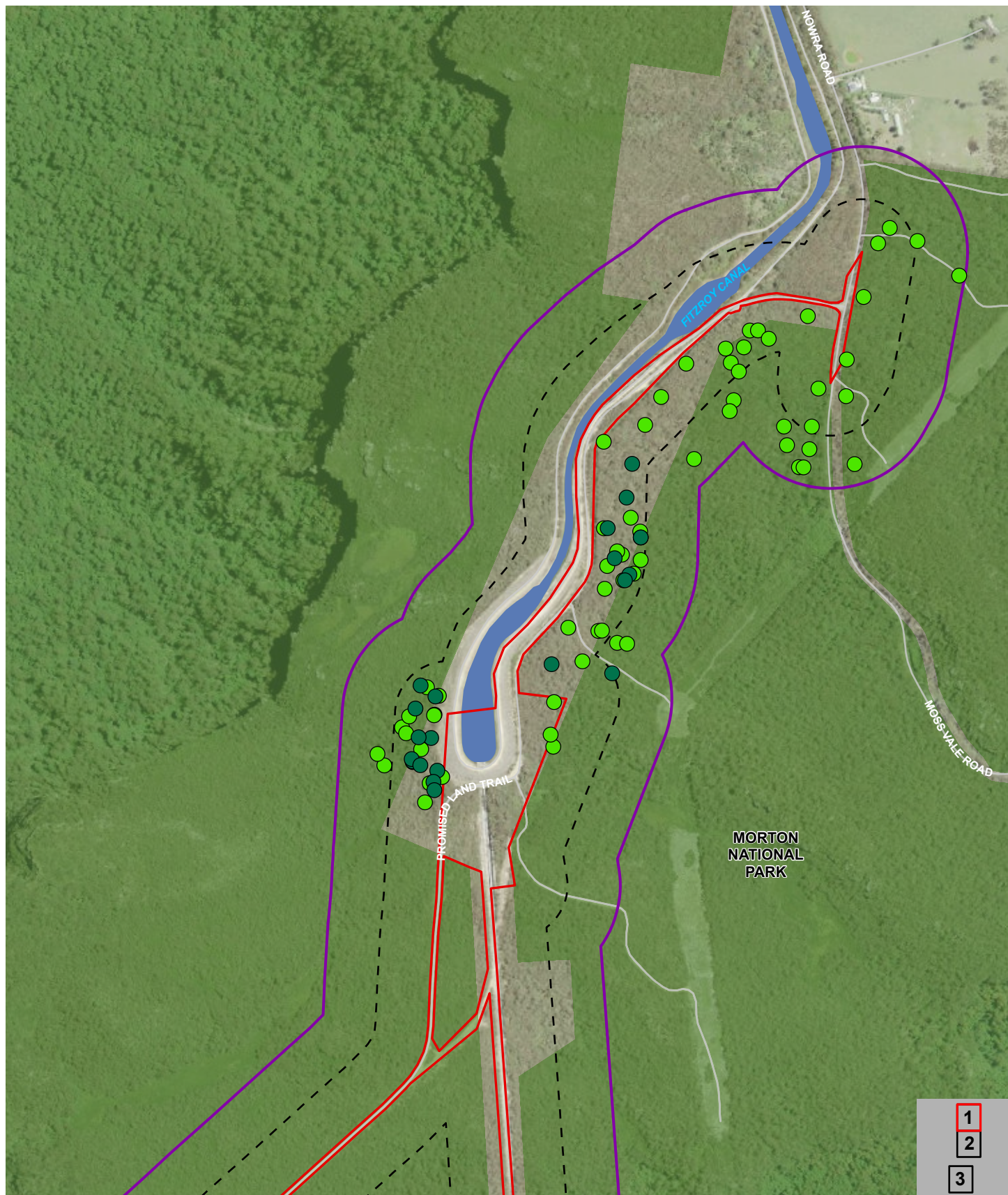
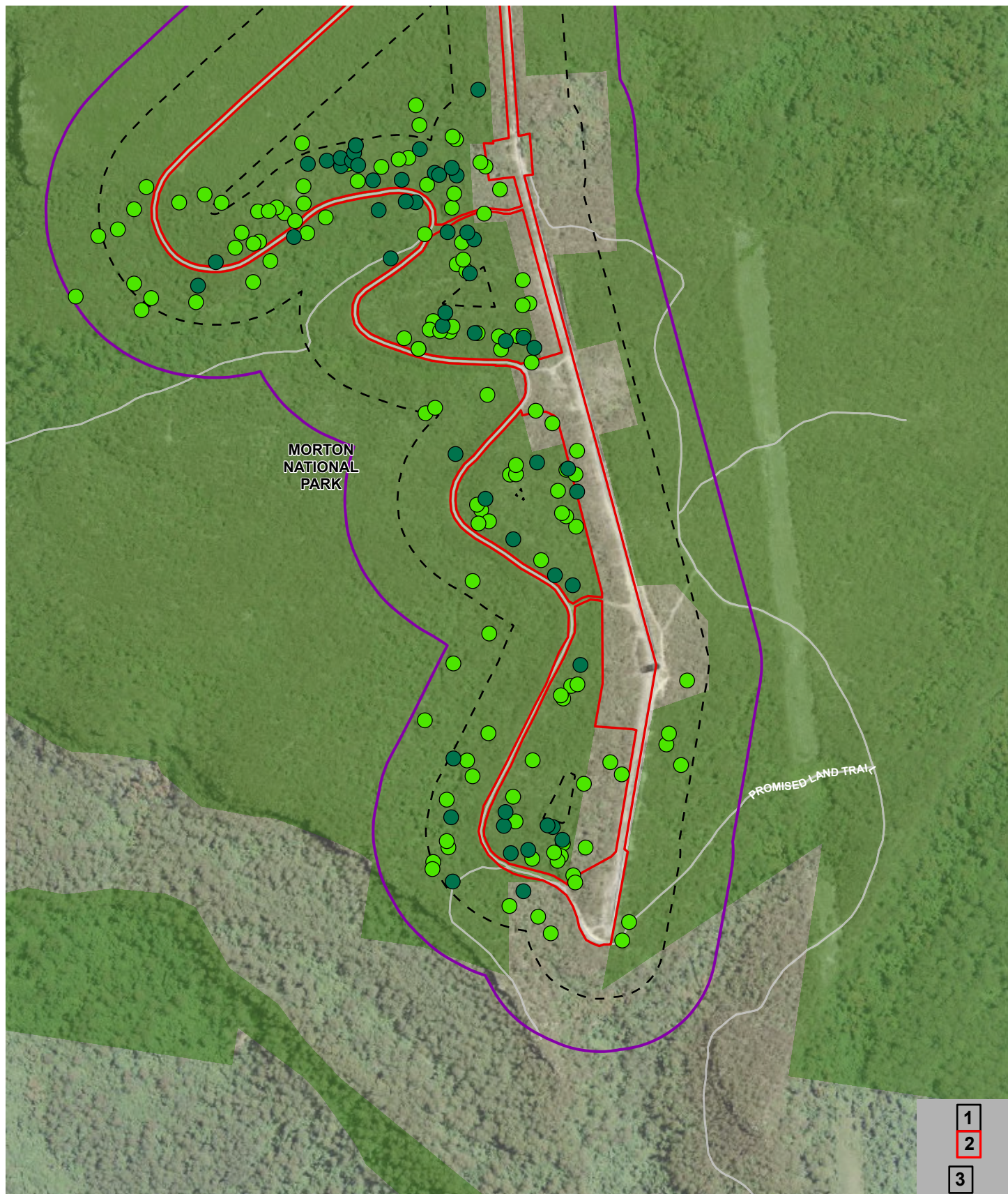


Figure 6-4 Distribution of hollow-bearing trees and opportunities for nesting cockatoos and large forest owls

Data sources¹
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- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Development site
- 100m buffer
- 200m buffer
- Road
- NPWS Reserve

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources2

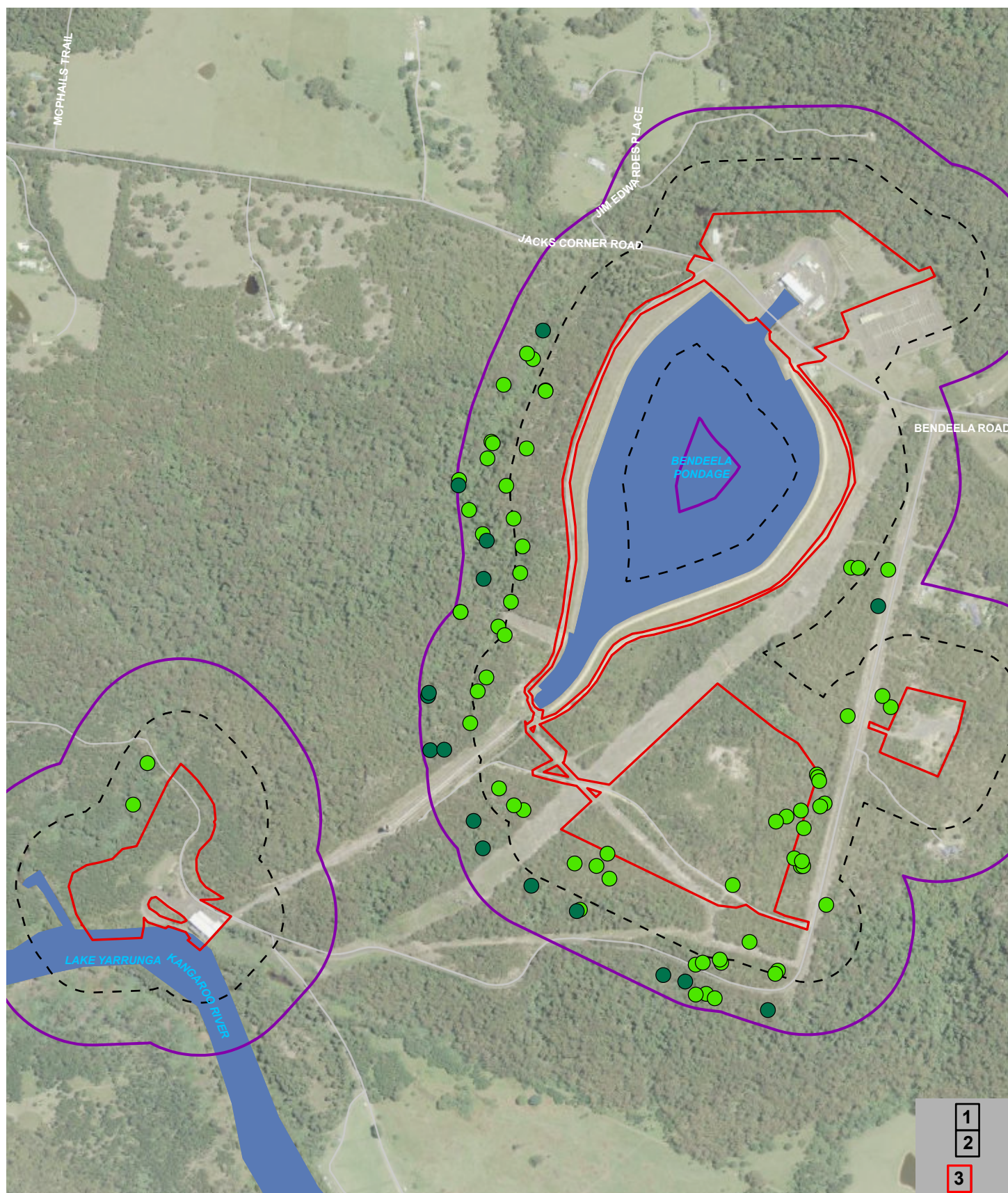
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Figure 6-4

Distribution of hollow-bearing trees and opportunities for nesting cockatoos and large forest owls



- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Development site
- 100m buffer
- 200m buffer
- Road
- Waterway
- Waterbody

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56

Data sources3

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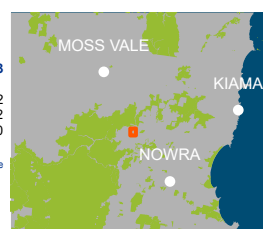


Figure 6-4

Distribution of hollow-bearing trees and opportunities for nesting cockatoos and large forest owls

Arboreal mammals (Greater Glider, Eastern Pygmy Possum, Squirrel Glider and Koala)

The Greater Glider was recorded five times within the plateau section of the assessment area during the 2019, 2021 and 2022 spotlighting surveys. One observation was a pair in PCT 1254, approximately 80 metres from development site near a large hollow-bearing tree (likely den tree), (near Nowra / Moss Vale Road). Another possible den tree was also recorded nearby to a single Greater Glider in PCT 1156 (30m outside development site near Fitzroy Canal). Both den trees are outside development site and will not be impacted. This species was not recorded in the valley section of development site, despite suitable habitat existing (however large hollow-bearing trees are scarce in the valley assessment area). The location of Greater Glider and records and den trees are presented in **Figure 6-5**.

The Eastern Pygmy Possum was recorded in development site three times, at one camera location on the Plateau (it is unknown if this was a single or multiple individuals). The records were made in December 2021 and January 2022, in vegetation zone MV5 (PCT 1082 'Moderate_old_regrowth'). This location featured regrowth *Eucalyptus sieberi* with a moderately dense midstorey of *Leptospermum* and *Hakea* spp, and sparse groundcover. This location is in close proximity to high condition forest patches (both PCT 1082 and PCT 1156), which contained mature Eucalypt trees with a diverse midstorey (including *Banksia* and *Lambertia* species) and shelter features such as small – medium tree hollows and hollow-ground logs. It is likely that all vegetation zones within the plateau portion of the assessment area are suitable as habitat (including shrub-regrowth condition classes). The Eastern Pygmy Possum has not been recorded in the valley portions of the assessment area during comprehensive camera surveys, arboreal Elliot trapping and spotlighting. This species is widespread in eastern NSW and has been recorded frequently along the Shoalhaven coast and ranges (and Southern Highlands). Records in Kangaroo Valley are very scarce although there is a 2019 record near Tallowa Dam Rd (NSW BioNet), and also two records on the plateau near Fitzroy Falls. Given suitable habitat also exists in the valley areas (primarily in PCT 1082 which contains Proteaceae species), this species is assumed to occur in all associated PCTs (TBDC) within development site (all PCTs except for PCT 1108).

The Squirrel Glider was not recorded within the assessment area despite targeted surveys such as arboreal Elliot trapping, tree-mounted infrared cameras, spotlighting and call playback. Previous records for the Squirrel Glider are scarce in the bushland areas surrounding the assessment area and Kangaroo Valley, however, a cluster of records occurs in Bundanoon (15 km west of assessment area). A single record of this species also occurs to the south of Kangaroo River, approximately 5km from the assessment area (NSW BioNet). The closely related Sugar Glider (*Petaurus breviceps*) was recorded from camera traps on the plateau.

The Koala was not recorded within the project area despite targeted searches. Records of the Koala are scarce within the locality. The nearest records are one to the south of the Kangaroo River (approximately 4km from the assessment area), and one near Myravale (approximately 3km to the north). Beyond this location there are only isolated Koala records existing from Morton National Park, Burrier, Nowra and Robertson localities. The Development site and locality are not recognised as a major Koala population centre. Surveys for Koalas in 2019 involved application of the Spot Assessment Technique (SAT), (Phillips and Callaghan (2011)) and spotlighting survey. A SAT plot is approximately 40x40m wide and located around a centrally located tree (suitable koala feed tree, koala scratches tree or koala observation tree). The ground beneath all suitable trees in the plot was checked for presence/absence of Koala faecal pellets. SAT plots were undertaken in potential Koala habitats (containing a canopy of Eucalypt trees), however excluded vegetation zones which lacked Eucalypts such as shrub-regrowth and derived grass land condition classes). After excluding non-habitat vegetation zones, potentially suitable Koala habitat in development site totalled approximately 22.5 hectares. According to the 2022 *Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide*, an area of this size requires a minimum of 10 SAT plots to be surveyed. The surveys within the assessment area used 20 SAT plots (including 344 trees). No evidence of Koalas was recorded and given that database records in the locality are sparse, this species is considered unlikely to occur. Separate spotlighting surveys were undertaken in 12 locations (2 persons for average 2 hrs) and totalled approximately 48 person hours. Spotlighting was undertaken before release of the 2022 guidelines and specified 200m transect measurements were not recorded, however distances of spotlight meanders generally exceeded 200m. Spotlighting surveys on the plateau also included driven spotlighting surveys along 5.2 km of the Promised Lands Track on three occasions.

Terrestrial mammals (Southern Brown Bandicoot and Brush-tailed Rock Wallaby)

The Southern Brown Bandicoot was not recorded in the assessment area despite targeted surveys. According to the TBDC, the species is generally found in heath or open forest with a heathy understorey on sandy or friable soils. Such habitat is present within the assessment area, particularly within PCT 1082 and 1083. The best time to survey is late summer/autumn, when juveniles are recruited into the population – meaning that the survey timing for this BDAR was optimal. The targeted surveys for this species involved spotlighting and ground-based camera monitoring across the various vegetation classes within the assessment area. The surveys were unsuccessful in detecting this species. According to the OEH BioNet Atlas, records of this species are scarce in the Shoalhaven LGA, with the nearest records located near Cambewarra, approximately 12km to the south-east.

The Brush-tailed Rock Wallaby was not recorded in the assessment area, this species has been recorded in Kangaroo Valley, mainly to the south of Kangaroo River and towards Nowra. A cluster of records occurs within the rocky sections of Kangaroo River near Kangaroo valley township. There is one historical record near Fitzroy Falls (made in 1970), (Atlas of Living Australia, 2022). According to TBDC, this species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. The Development site avoids cliff lines and rocky escarpments. Some rocky habitats occur in the wider assessment area; however these were small in size and were generally highly shaded by a canopy of eucalypts. The sandstone cuttings along the existing pipeline corridor (within development site) have engineered/smooth faces and do not contain suitable features for this species. Camera surveys in vegetation near sandstone features of the plateau areas, as well as in the valley were undertaken in February 2019, March 2019 and between December and March 2022. This species was also not detected opportunistically during seasonal flora surveys which covered vast areas of the plateau and valley. The large plateau escarpments nearby to the plateau sections of development site are mostly southward facing and are therefore unlikely to be high quality habitat. The cliffs along the plateau edges were not surveyed due to safety and access constraints (these features are at least 100m outside the development site). The sections of Kangaroo River in the assessment area contain no exposed rock features and are not suitable for this species.

Birds (Eastern Bristlebird and Pink Robin)

The Eastern Bristlebird was not recorded in the assessment area. According to the TBDC the distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. The estimated population size is less than 2000 individuals occupying a total area of about 120 sq km. The Project is approximately 15km from the known Budderoo population, and 40km from the Bherwerre Peninsula population. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey, which is available in some areas of the assessment area, particularly PCT 1082, PCT 1083 and PCT 1156. Targeted diurnal and nocturnal bird surveys have not recorded this species. Furthermore, multiple intensive flora surveys through all vegetation of the assessment area (over three years) has never revealed this ground-based species (i.e. flushed from vegetation).

The Pink Robin was not recorded during targeted diurnal bird surveys in February and March 2019, or opportunistically during all other surveys (such as comprehensive flora surveys in spring, summer 2021 and autumn 2022). This species favours rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. The small patches of PCT 1245 and PCT 1254 in development site (approximately 1.5 ha in total) provide potentially suitable habitat. However, given the large expanses of similar (unburnt) habitat in Kangaroo Valley, development site would unlikely form important habitat for this species.

Large-eared Pied Bat

The Large-eared Pied Bat was recorded as 'probable' using AnaBat detectors. The record was made in PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion, to the east of Bendeela Pondage (within development site).

Breeding and roosting habitat for this species consists of Sandstone cliffs with caves or shelter features. Foraging habitat includes fertile woodland valley habitat within close proximity to cliffs and caves. The recorded individual(s) was likely foraging throughout an expansive home range. The Development site does

not contain any cliff lines or suitable breeding habitats; however, such features are available in the surrounding areas of Kangaroo Valley escarpment (and along the plateau edges). Numerous cliff lines occur in close proximity to development site (some within 100m distance). The large cliffs on the edges of the plateau could not be explored due to safety constraints. Some smaller cliffs on top of the plateau and adjacent to development site were investigated, and small crevasses were searched for roosting bats. Man-made features such as concrete culverts and tunnels were also checked. The sandstone cuttings along the existing pipeline corridor (within development site) have engineered/smooth faces and do not contain any crevasses or caves suitable for this species.

According to the NSW Bionet profile for this species, foraging habitat within development site includes all native forest within 100m of cliff lines or breeding habitat features. The PCTs occurring on development site and within 100m of cliff lines include: PCT 1156, PCT 1082, PCT 1083 and PCT 1283. The species polygon encompasses all vegetation within 100m of suitable cliff lines that is intersected by development site. The species polygon results in a total impact of 0.87 ha.

Breeding cave-roosting bats (Southern Myotis, Large Bent-winged Bat and Little Bent-winged Bat)

The Southern Myotis was recorded as a 'possible' detection using AnaBat detectors. The parameters of the echolocation 'call' of the Southern Myotis are very similar to those of *Nyctophilus* species and therefore definite identification cannot be certain. Nonetheless, the location of the possible record for this species is within the riparian areas of Kings Creek, which transects a narrow portion of the assessment area to the West of Kangaroo Valley power station. It should be noted that the corresponding harp trap surveys conducted within 500m of Kings Creek captured both *Nyctophilus geoffroyi* and *Nyctophilus gouldii* during the surveys.

The Southern Myotis is dependent on waterways with pools of 3 m wide or greater for foraging (TBDC). Riparian habitat surrounding waterways is used for breeding and roosting. This species roosts in hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone. The aquatic features of Kings Creek (3 m wide pools) are actually avoided by development site, and Kings Creek is only an ephemeral drainage line where it transects the development site. However the 200 m riparian buffer of pools does include some areas of PCT 1245 and PCT 1283 within the development site. The narrow portion of the assessment area adjacent to Kings Creek did not contain any significant roost opportunities for this species (affected areas of PCT 1245 and 1283 were found to lack HBTs). However, these PCTs are included in a species polygon. Likewise, the riparian areas of Kangaroo River have also been included for the purposes of this assessment (and it is likely that Southern Myotis forage above Kangaroo River). The species polygon was developed using 200 m riparian buffer on expected habitat and equates to an area of 9.69 ha.

This species was not recorded in the Plateau areas of development site despite AnaBat and harp trapping Surveys. Trimble Creek (on the Plateau) which crosses the assessment area does not contain pools >3m wide and is not considered to be habitat for determining the species polygon.

The man-made power station dams Fitzroy Canal and Bendeela Pondage are also likely to provide foraging opportunity for Southern Myotis and PCTs within a 100m radius of these waterbodies have been included in the species polygon.

Neither the Large Bent-winged Bat or Little Bent-winged Bat were recorded from the targeted surveys. No potential cave roosting sites were recorded within development site, and the project will not impact on the potential breeding habitat for these species. A species polygon was not prepared.

Grey-headed Flying-fox (Breeding)

The assessment area and adjacent forested areas do not contain any Grey-headed Flying-fox camps and therefore there is no breeding habitat for this species. The closest Grey-headed Flying-fox colony is located within the town of Kangaroo Valley, approximately 4km from the southern portion of the assessment area. This species was not recorded within the assessment area during the spotlighting surveys.

Threatened Frogs

Giant Burrowing Frog

The Giant Burrowing Frog was not recorded from surveys of development site which targeted natural creek lines Trimbles Creek and Kings Creek (as well as various first order streams on the plateau). Frequent inspections of creeks for Giant Burrowing Frog tadpoles did not record this species. However, the amphibian surveys carried out in February and March 2019, and December 2021 did not meet the duration of 8 repeat surveys following heavy rainfall as recommended in the NSW Survey Guide for Threatened Frogs (DPIE, 2020). Whilst survey effort was 6 nights, with 4 surveys during light to moderate rainfall, the rainfall amounts did not meet the >50 mm in 24 hours OR >100 mm over three days guidelines. Therefore, due to a potential survey gap, and suitable habitats within or adjacent to development site, the presence of this species remains unknown, and it is assumed present for the purposes of this assessment. Opportunity to survey during high rainfall events was restricted due to frequent closures of the Shoalhaven Special Areas catchment by WaterNSW (due to flooding risk). There are no historical records of this species in Kangaroo Valley or the plateau areas. The nearest records occur between Fitzroy Reservoir and Budderoo National Park (approximately 15km east of the development site). A small number of records also occur in forest areas in Nowra (approximately 10km south of the development site). The nearest records to the west are near Bundanoon (approximately 20km from Kangaroo Valley).

According to the NSW Survey Guide for Threatened Frogs suitable habitat is described as (DPIE, 2020); *ephemeral flowing streams that have permanent pools, or in upland swamps, and are located within native vegetation. Most typically breeding occurs in streams with a bed width of up to five metres (e.g. 2nd order and 3rd order streams) and upland swamps located on suitable geologies. Non-breeding habitat is native vegetation adjacent to the breeding sites.*

This species is associated with five PCTs occurring in the development site; PCT 1156, PCT 1082, PCT 1083, PCT 1245 and PCT 1254. Determining an area of potential habitat requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats). The 300m buffer was applied to all nearby 1st order streams on the plateau and the valley to develop the species polygon. Some 1st order streams within the assessment area were visited during surveys and found to be small drainage ditches with no water, which makes them unsuitable habitat for this species which requires ephemeral flowing streams with permanent pools according to the TBDC (and for this reason some drainage lines in the assessment area were not mapped all the way to their start point). Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks). Trimbles Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is an abundance of similar suitable habitats in the surrounding plateau and escarpment areas.

Man-made power station dams are considered to be poor habitat due to their steep banks (sandstone vertical walls or rock scree) as well as their highly fluctuating water levels and temperatures. Inspection of these dams revealed no tadpoles or frogs calling (apart from Common Eastern Froglet (*Crinia signifera*) on one occasion). The dams also lack emergent aquatic vegetation.

Littlejohn's Tree Frog

This species was not recorded during amphibian surveys of development site which targeted natural creek lines, Trimbles Creek and Kings Creek. However, the amphibian surveys carried out in February and March 2019, and December 2021 are outside the recommended survey period for this species (July – November, according to the NSW Survey Guide for Threatened Frogs (DPIE, 2020)). However, according to the SPRAT Profile, Lemckert (2004) presents evidence that calling can occur at any time of year with a possible peak from February to April. Opportunity to survey during high rainfall events was restricted due to frequent closures of the Shoalhaven Special Areas catchment by WaterNSW (due to flooding risk). Due to a potential survey gap, and suitable habitats within or adjacent to the development site, the presence of this species remains unknown, and it is assumed present for the purposes of this assessment. There are no historical records of this species in Kangaroo Valley or the plateau areas. The highest density of records occurs in Budderoo National Park (approximately 15km east of the development site). A small number of records also occur in forest areas east of Fitzroy reservoir (approximately 7km north-east of development site). The nearest records to the south are west of South Nowra (approximately 30km from Kangaroo Valley).

According to the NSW Survey Guide for Threatened Frogs (DPIE, 2020); *Suitable breeding habitat consists of a range of still or slow-moving waterbodies including permanent streams, pools, ponds, swamps and dams, located within areas of suitable native vegetation. Non-breeding habitat is native vegetation located within 300 metres of breeding sites, through which the species can migrate to locate non-breeding habitat.*

Non-breeding habitat is heath-based forests and woodlands where individuals shelter under leaf litter and low vegetation. This species is associated with three PCTs occurring in development site; PCT 1156, PCT 1082 and PCT 1083. Determining an area of potential habitat (i.e. species polygon) requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats). Within the development site, potential habitat includes vegetation within 300 meters from suitable watercourses (Kings Creek, Trimble Creek and numerous streams containing permanent pools or swamps). The 300m buffer was applied to all nearby 1st order streams on the plateau and the valley to develop the species polygon. Some 1st order streams within the assessment area were visited during surveys and found to be small drainage ditches with no water, which makes them unsuitable habitat for this species which requires ephemeral flowing streams or swampy areas according to the TBDC (and for this reason some drainage lines in the assessment area were not mapped all the way to their start point). Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks). Trimble Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is an abundance of similar suitable habitats in the surrounding plateau and escarpment areas. The species polygon for this species equates to an area of 12.10 ha.

Kangaroo River (and riparian areas of PCT 1108) are not considered to be suitable habitat for this species (PCT 1108 is not an associated PCT for this species). Man-made power station dams are considered to be poor habitat due to their steep banks (sandstone vertical walls or rock scree) as well as their highly fluctuating water levels and temperatures. Inspection of these dams revealed no tadpoles or frogs calling (apart from Common Eastern Froglet (*Crinia signifera*) on one occasion). The dams also lack emergent aquatic vegetation.

Stuttering Frog

The Stuttering Frog was not recorded from the targeted surveys. The species breeds in streams during summer after heavy rain. Suitable habitat is limited to Trimble Creek on the plateau and Kings Creek in the valley (and potentially some other 1st order drainage lines off site). Kings Creek is outside development site and amphibian habitats will be avoided. Trimble Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). The February and March 2019 surveys for amphibians were undertaken during optimal breeding conditions (with high rainfall amounts), however were unsuccessful in recording this species. There are scattered previous records of the Stuttering Frog nearby to the assessment area, the closest being one near Brown's Mountain (approx. 9km to the south) and one near Bundanoon (approx. 15km to the west). A species polygon is not required for the stuttering Frog due to confirmed absence.

Red-crowned Toadlet

The Red-crowned Toadlet was not recorded and a species polygon is not required for the Red-crowned toadlet due to confirmed absence. The assessment area is outside the species range for Red-crowned Toadlet, with the nearest (and most southern) records of this species occurring in Macquarie Pass National Park, approximately 19km to north east to the assessment area. Despite this, dedicated survey and habitat assessment was undertaken for this species, particularly within the ephemeral sandstone drainage lines of the plateau portion of the assessment area (including Trimble Creek). Spotlighting transects and call-playback during rainfall did not reveal any evidence of this species within the assessment area. Tadpole surveys were undertaken in Trimble Creek on multiple occasions, with no occurrences. Survey timing in February and March 2019 was considered optimal due to rainfall events and water pooling in ephemeral drainage features. Follow up survey near Fitzroy reservoir in December 2021 did not record any during light rainfall. This species can be detected all year, with breeding congregations occurring in dense vegetation and debris beside ephemeral creeks and gutters. A species polygon is not required for the Red-crowned Toadlet due to confirmed absence.

Green and Golden Bell Frog

This species was not recorded during spotlighting and call playback surveys of permanent waterbodies in February and March 2019, or December 2021. A species polygon is not required for the Green and Golden Bell Frog due to confirmed absence.

According to the NSW BioNet species profile, suitable habitat for this species is.

- marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spike rushes (*Eleocharis* spp.)
- water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.

The 1st order streams in the assessment area (including Trimbles Creek and Kings Creek) lack unshaded pools and dams and emergent aquatic vegetation. These are also ephemeral and become fast-flowing streams during rainfall. Man-made power station dams are considered to be poor habitat due to their steep banks (sandstone vertical walls or rock scree) as well as their highly fluctuating water levels and temperatures. Inspection of these dams revealed no tadpoles or frogs calling (apart from Common Eastern Froglet (*Crinia signifera*) on one occasion). The dams lack emergent aquatic vegetation which is an important component of Green and Golden Bell Frog habitat. Predatory *Gambusia holbrooki* also occur in these waterways.

Kangaroo River is unlikely to be suitable habitat as it is often flowing and lacks emergent vegetation along the banks. Predatory *Gambusia holbrooki* also occur in these waterways. A species polygon is not required for the Green and Golden Bell Frog due to confirmed absence.

Reptiles (Broad-headed Snake)

The broad-headed snake was not recorded. The lack of discovery of any broad-headed snakes was largely attributed to the lack of suitable habitat in the assessment area. The species was targeted by direct searches and habitat assessment with reference to various literature on the habitat requirements of the species. A total of 127 rocks were searched over three transects, with only six rocks being deemed suitable. The main reason for this low number is that most rocks (95%, n=121) searched were positioned directly on the sand/soil, and not on bare rock. Additionally, a smaller number (16%, n=20) of rocks searched had a higher amount of leaf litter and other debris underneath. In addition to the lack of suitable rock-on-rock habitat, the general aspect of the ridge lines in the assessment area were not west-facing, as is preferred by the broad-headed snake. Canopy cover varied across the three transect locations, averaging 24% at transect 2 and 51% at transect 3. However, this did not consider the cover provided by the midstory, which would increase the percentage cover at each site. A species polygon is not required for the Broad-headed Snake due to confirmed absence.



Legend

- Development site
- Project area
- Waterbody
- ✈ Gang-gang Cockatoo (*Callocephalon fimbriatum*) – group of 5 foraging (Endangered)

- ✈ Gang-gang Cockatoo (*Callocephalon fimbriatum*) – individual bird (Endangered)
- Greater Glider (*Petauroides Volans*), (Vulnerable)
- Greater Glider den tree

0 200 400 metres

1:10,000 at A4

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Map series

- 1
- 2
- 3

Data sources¹

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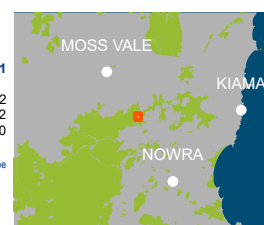
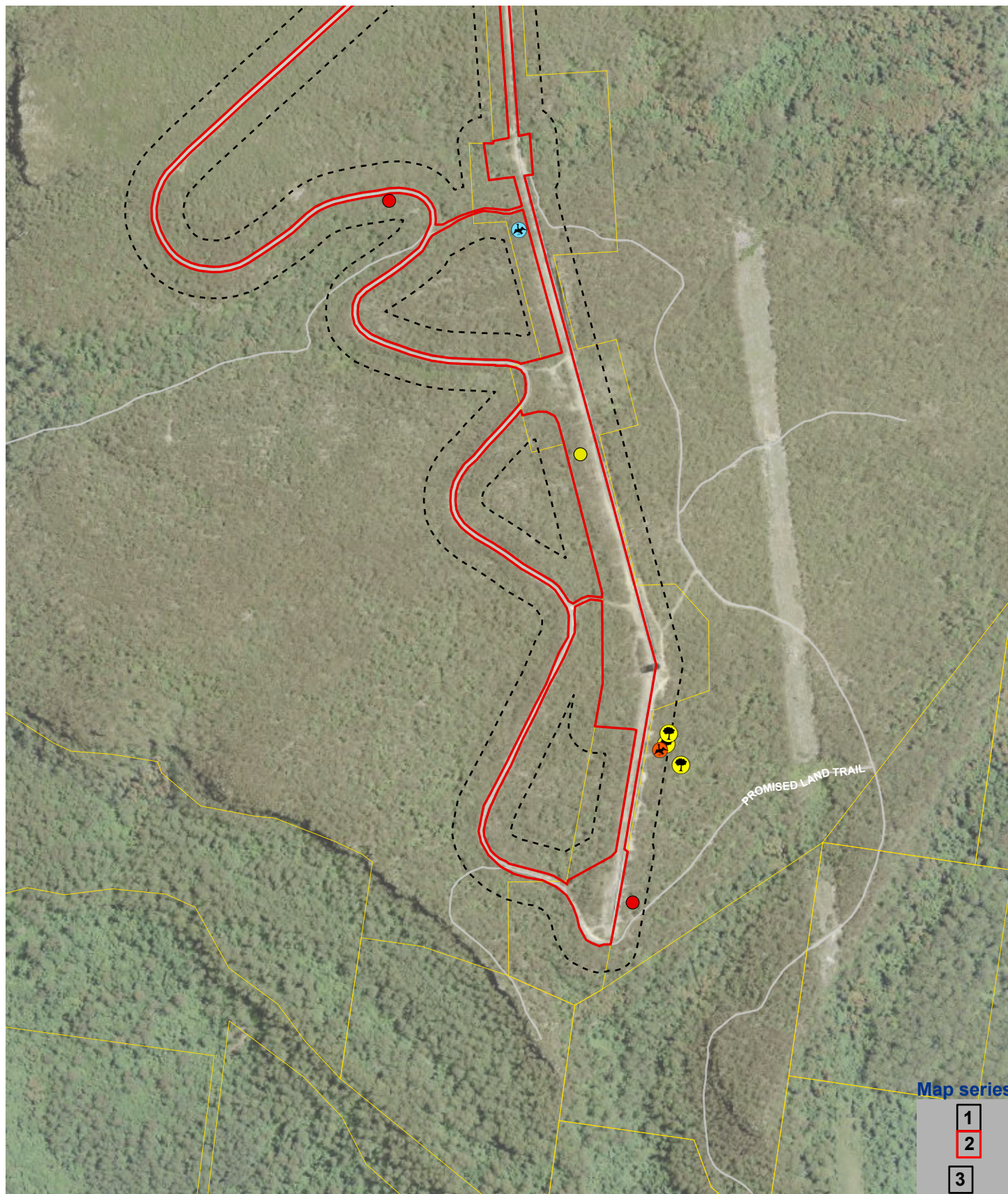


Figure 6-5 Threatened species recorded



Legend

- Development site
- Project area
- Gang-gang Cockatoo (*Callocephalon fimbriatum*) – individual bird (Endangered)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*) - mother and juvenile (Endangered)
- Gang-gang Cockatoo nest trees
- Greater Glider (*Petauroides Volans*), (Vulnerable)
- Eastern Pygmy Possum (*Cercartetus nanus*), (Vulnerable)

0 200 400 metres

1:10,000 at A4

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Data sources2

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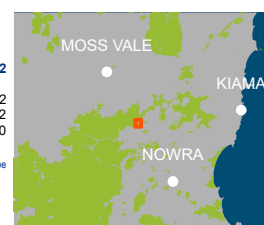
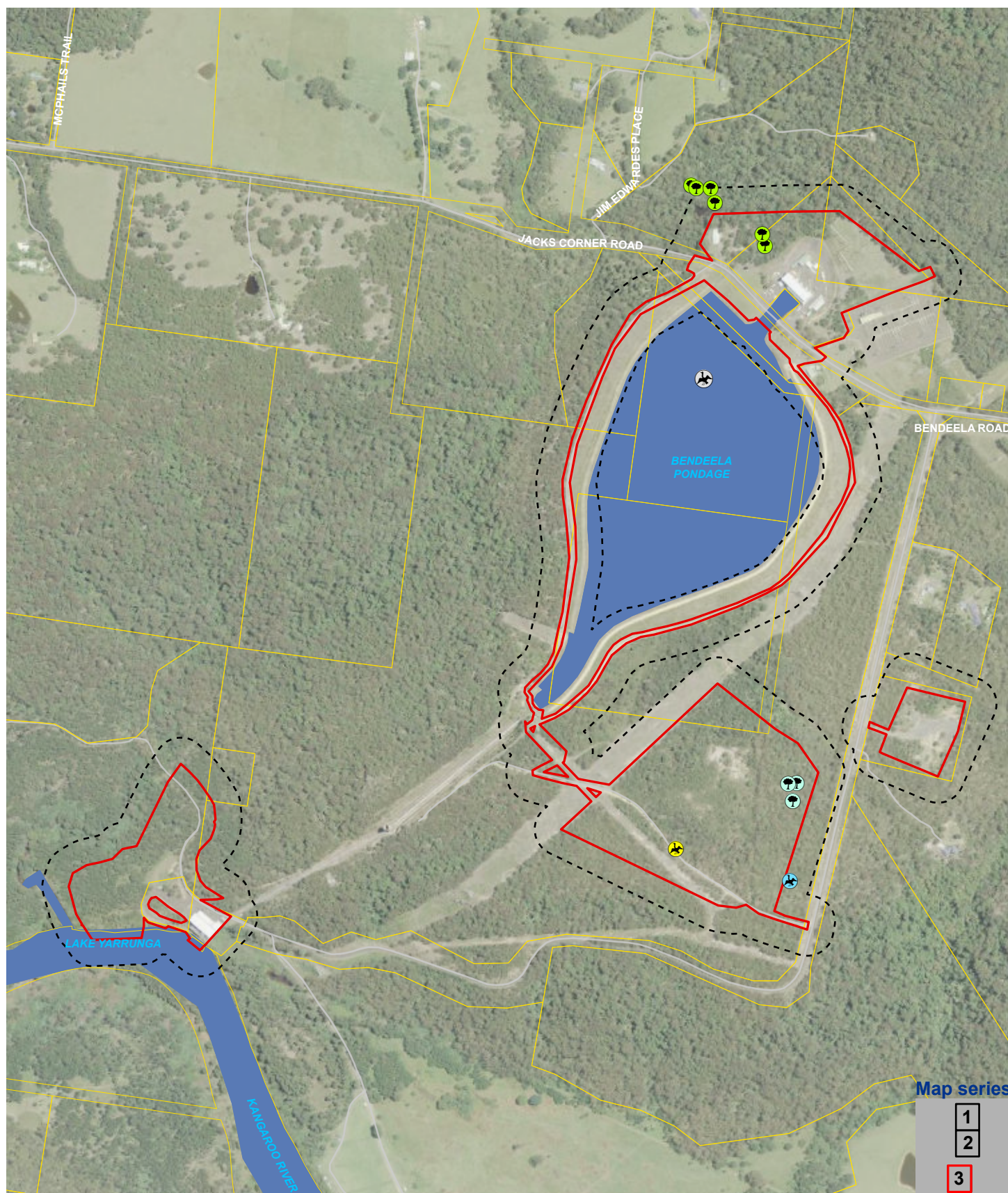


Figure 6-5 Threatened species recorded



Legend

- Development site
- Project area
- Waterbody

● Gang-gang Cockatoo (*Callocephalon fimbriatum*) – individual bird (Endangered)

● Large-eared Pied Bat (*Chalinolobus dwyeri*), (Vulnerable)

● White-bellied Sea-Eagle (*Haliaeetus leucogaster*), (Vulnerable)

● Scrub Turpentine (*Rhodamnia rubescens*), (Critically endangered)

● *Hibbertia puberula* (Endangered)

0 200 400 metres

1:10,000 at A4

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Data sources3

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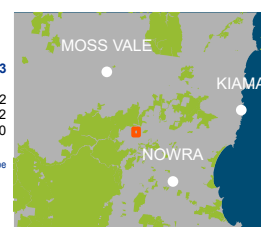


Figure 6-5 Threatened species recorded

6.5 Aquatic Assessment

Aquatic habitats within the Project Site and broader locality were assessed against the Policy and guidelines for fish habitat conservation and management – Update 2013 (NSW Department of Primary Industries, 2013) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Lincoln Smith, 2003) was used to guide the level of aquatic assessment required. There is enough existing information to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments to be impacted by the development. As such, this assessment was based on a review of existing information and a habitat assessment.

Searches of databases, existing mapping and other literature were used to identify the locations of sensitive receptors. Sources included:

- Fisheries NSW Spatial Data Portal
- Protected Matters Search Tool
- Atlas of GDEs (Bureau of Meteorology, 2017)
- SEED – NSW Wetlands mapping
- SEPP (Coastal Management) 2018 – Interactive map viewer
- Australian Wetlands Database (Department of the Environment and Energy, 2019).

6.5.1 Existing environment

The assessment area contains 4 main waterbodies.

- Kangaroo River
- Fitzroy Canal
- Bendeela Pondage
- Trimble Creek (plateau).

Kings Creek (flows into Kangaroo River). The aquatic environments of Kings Creek are outside development site and within development site, Kings Creek exists as an ephemeral drainage line (which is often dry).

The surrounding landscape contains numerous 1st and 2nd order streams (Strahler, 1952) (See **Figure 6-5**). Some 1st order streams within the assessment area were visited during surveys (and rainfall events) and found to be small drainage ditches with no water, which makes them unsuitable for aquatic species (which would require at least small permanent pools). Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks).

6.5.2 Key Fish Habitat

The NSW Department of Primary Industries Key Fish Habitat mapping indicates that Fitzroy Canal, Bendeela Pondage and Kangaroo River are categorized as Key Fish Habitat – of the southern rivers. Kings Creek (which occurs to the west of the valley portions of the assessment area) is also mapped as KFH (under the NSW Fisheries Management Act 1994). All such habitats are already affected by the existing hydro scheme and the proposed action (which expands on the existing infrastructure) will require a range of mitigation measures to prevent further impacts or habitat degradation.

6.5.3 Threatened aquatic species

6.5.3.1 Fitzroy Falls Spiny Crayfish (*Euastacus dharawalus*)

Fitzroy Falls Spiny Crayfish has only been recorded above (Shull et al. 2005) and below the Fitzroy Falls Reservoir (DPI 2011). The species is restricted to 12km of waterway of Wildes Meadow Creek NSW and less than 1km of this stretch is of good water quality (DPI n.d.).

Fitzroy Falls Spiny Crayfish is found mostly borrowing in soft stream bed habitat under the waterline, however they have been seen foraging on substratum (DPI 2012; DPI 2011). They require flowing streams hence their disappearance in Fitzroy Falls Reservoir when its habitat became static water (DPI 2012). The crayfish is most

active during late afternoon and early evening (DPI 2012). The maximum size recorded is 86mm occipital carapace length and 300 grams (DPI 2012). The life cycle length for Fitzroy Falls Spiny Crayfish is nine years (McCormack, R. B. 2016). Eggs are fertilized between May and June and the female holds the eggs and larvae under her abdomen until December when the juveniles disperse. Not all females will breed every year (DPI 2011).

An aquatic survey targeted at identifying the Fitzroy Falls Spiny Crayfish within the Fitzroy Falls Reservoir was undertaken on 19 February 2019. The purpose of the survey was to assess the aquatic habitat, flora, fauna and water quality at selected monitoring locations around Fitzroy Falls Reservoir and confirm the presence or absence of Fitzroy Falls Spiny Crayfish at these sites.

No Fitzroy Falls Spiny Crayfish specimens were caught during the survey program undertaken in February 2019. This is consistent with findings presented in the desktop review and therefore it is reasonable to suggest that the Fitzroy Falls Crayfish is unlikely to inhabit the Fitzroy Falls Reservoir.

Given this and considering that impacts of the Project on water quality, flow and water level would be avoided at Fitzroy Falls Reservoir, it is unlikely that the critically endangered Fitzroy Falls Spiny Crayfish would be impacted by the Project.

6.5.3.2 Macquarie Perch (*Macquaria australasica*)

Macquarie Perch is a member of the family Percichthyidae, which contains the Australian freshwater basses and cods. Macquarie Perch has several genetic divergent forms/species across its range, with three taxa now recognised (but not formally described) (Lintermans et al. 2019):

- The Murray-Darling Basin Macquarie Perch (MDB subspecies) is a moderately sized, deep-bodied, laterally-compressed fish, reaching up to 550 millimetres in length. The species is relatively long-lived, having been known to live up to the age of 17 years (DPI, 2016b). The MDB subspecies is relatively well researched and is formally described
- The Kangaroo River Macquarie Perch is only known from a single catchment and is thought to potentially have recently become extinct (Lintermans et al. 2019)
- The Hawkesbury-Nepean Macquarie Perch (HN subspecies) is known to occupy the Hawkesbury-Nepean catchment, and is expected to occupy the Avon Dam and upper tributaries.

The Macquarie perch is a riverine species, typically found in the cool upper reaches of the Murray Darling River system. The fish prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks (DPI, 2016b).

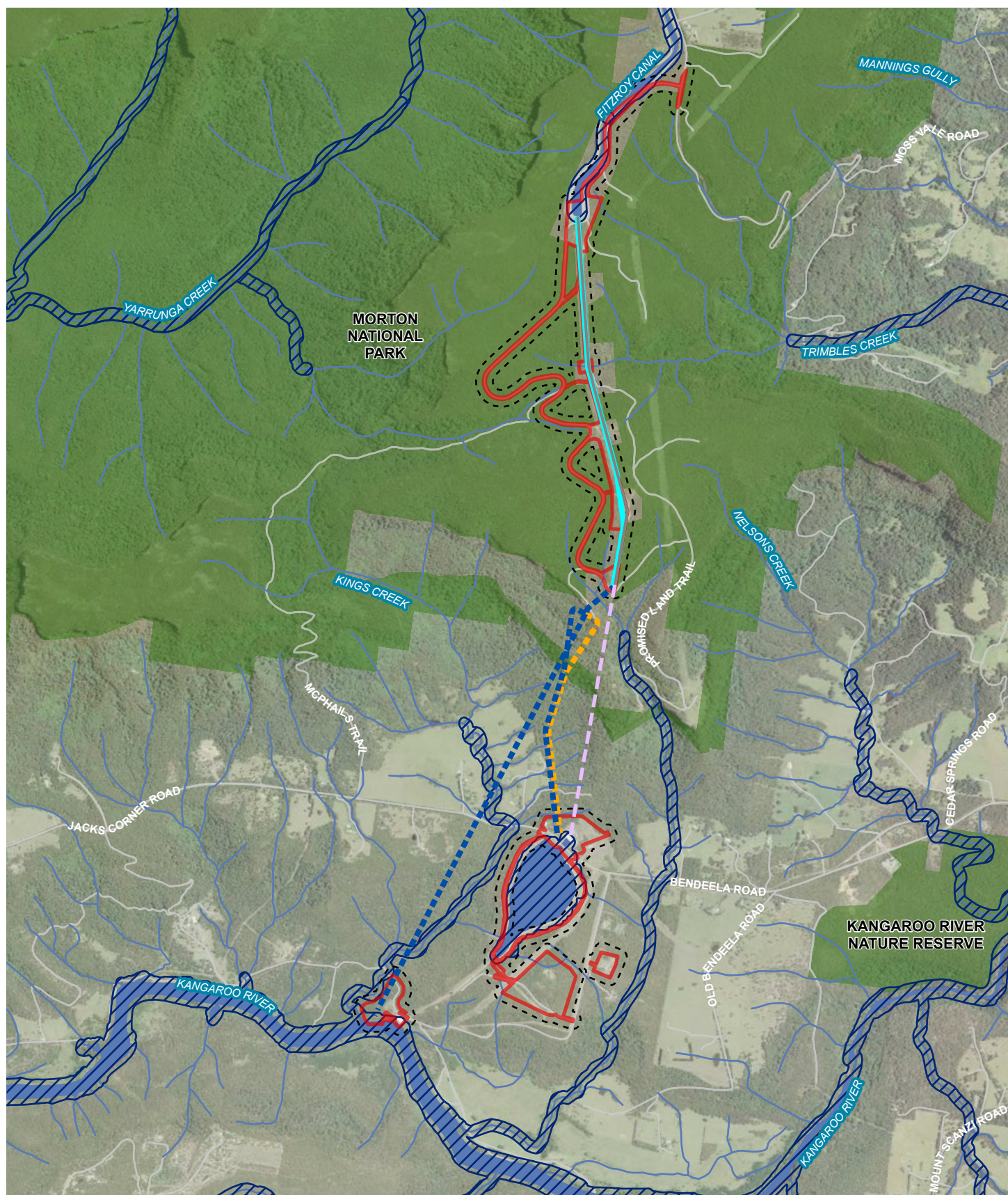
According to database records this species has not been recorded in the Fitzroy reservoir or upstream tributaries and is unlikely to occur within the plateau portions of the development site (southern end of Fitzroy Canal).

The Atlas of Living Australia refers to the lower Shoalhaven catchment being suitable habitat for this species (below Tallowa Dam). Whilst this species could potentially occur above the dam in Kangaroo River, this is considered unlikely (particularly given its assumed extinction here as noted above). Any Macquarie Perch occurring in Kangaroo River would unlikely be impacted by the proposed action, as the proposed action will only replicate the existing hydro power scheme, which would be already affecting Kangaroo River at the Bendeela Power Station and pipeline outlet. A range of mitigation strategies will be required to ensure impacts to Kangaroo River water quality and aquatic habitats are not exacerbated.

No surveys were undertaken for this species in Kangaroo River or the artificial dams (Bendeela Pondage and Fitzroy Reservoir).

6.5.3.3 Australian Grayling (*Prototroctes maraena*)

The Australian Grayling generally occupies coastal seas and rivers that are tidally influenced as larvae/juveniles before migrating to freshwater reaches for the remainder of their lives. During the freshwater phase of their lifecycle, individuals inhabit lower altitude reaches of large rivers and smaller streams (DPI, 2015). Kangaroo River (which borders the southern boundary of the development site) is not suitable habitat for this species, as the river is dammed and not linked to coastal rivers or the sea. This species would not occur within aquatic habitats of the assessment area.



- Existing KV tunnel alignment
- Existing scheme pipeline
- Indicative above ground pipeline
- Indicative tunnel alignment
- Indicative access tunnel
- Development site
- Assessment area (50m buffer of Development site)
- NPWS estate
- Road
- Waterways
- Key Fish Habitat (NSW DPI)
- Waterbody

0 1 2 km



1:35,000 at A4

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Data sources

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Figure 6-6 Aquatic habitats

7. Matters of national environmental significance

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined as matters of national environmental significance as follows (as applicable to the project):

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species.

For EPBC Act listed matters identified or considered to have potential habitat within the assessment area, or considered moderately likely to occur, significance assessments have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013) (Appendix D) where these species have not already been assessed in accordance with the BC Act. Assessments have been included for some species where non-detection may not mean absence (Spotted-tailed Quoll, Pilotbird). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

The results of the Protected Matters Search Tool (using a 10km buffer of development site) identify the following MNES as known or predicted to occur based on previous records or habitat modelling, (see also Appendix C):

- Eleven listed threatened ecological communities
- Sixty-eight listed threatened species
- Seventeen listed migratory species
- Twenty-two listed marine species
- Two listed fish species.
- One listed crustacean.

These species are listed in Appendix A along with an assessment of their likelihood of occurrence in the habitats within the assessment area. Further details on recorded presence in the assessment area from the targeted surveys is described in **Section 7.3 to 7.5**.

7.1 World heritage properties and national heritage places

The assessment area contains no World Heritage Properties or National Heritage Places according to the PMST.

7.2 Wetlands of international importance

The assessment area and the 500 m landscape buffer does not contain any wetlands of international or national importance. The nearest wetlands of international importance are the Budderoo National Park Heath Swamps, the Wingecarribee Swamp and the Shoalhaven/Crookhaven Estuary. These wetlands of international importance are located outside of the 10km buffer of the assessment area and are considered unlikely to impacted directly or indirectly by the development.

7.3 Threatened ecological communities

According to the PMST, the following EPBC Act listed TECs have been identified as 'may occur or likely to occur' within the broader assessment area:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Endangered) – may occur within the locality

- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (Endangered) – likely occur within the locality
- Illawarra and south coast lowland forest and woodland ecological community (Critically Endangered) – likely occur within the locality
- Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion (Critically Endangered) – likely occur within the locality
- Natural Temperate Grassland of the South Eastern Highlands (Critically Endangered) – may occur within the locality
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (Critically Endangered) – likely occur within the locality
- Robertson Rainforest in the Sydney Basin Bioregion (Critically Endangered) – likely occur within the locality
- Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion (Critically Endangered) – likely occur within the locality
- Temperate Highland Peat Swamps on Sandstone (Endangered) – may occur within the locality
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (Endangered) – likely occur within the locality
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered) – may occur within the locality.

7.3.1 Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion

The presence of the above ecological communities were considered in the PCT classification, mapping and vegetation integrity survey of development site. These surveys confirmed the presence of the 'Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion (Critically Endangered Ecological Community)'.

Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254) corresponds to this CEEC and was recorded in the far-northern end of the development site, surrounding the edges of Promised Lands Track, Nowra/Moss Vale Rd and Fitzroy Canal. Approximately **0.23 hectares** occurs within development site. Using available vegetation mapping, the vegetation recorded within the edges of the development site is part of a large patch (patch size) of around 22 hectares. The CEEC is considered present if it meets the key diagnostic characteristics and condition thresholds in the listing advice (Threatened Species Scientific Committee, 2012), details of these criteria and justification for including as a MNES is provided in **Table 7-1**.

Table 7-1 Justification for presence of Southern Highlands Shale Forest and Woodland of the Sydney Basin

TEC name	Listing status	Source	Criteria	Justification	Consistent
Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254)					
<i>Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion</i>	CEEC	DAWE 2015	<p>The key diagnostic characteristics of this ecological community are:</p> <ul style="list-style-type: none"> ▪ Occurs in the Southern Highlands in the Sydney Basin Bioregion (IBRA v7). ▪ Occurs at elevations between 470 m – 830 m ASL on clay soils derived from Wianamatta shale. ▪ Is an open forest or woodland with a canopy dominated by one or more eucalypt species listed in Table 1 (of the Conservation Advice). ▪ Has a ground layer including native grasses and/or other herbs (although it may vary in development and composition (refer Appendix A, Tables A1 and A2 of Conservation Advice). 	<ul style="list-style-type: none"> ▪ The assessment area is within the Southern Highlands in the Sydney Basin Bioregion ▪ The upper end of the scheme (on the plateau) has an elevation of 600 m ASL and the western end of the project is on clay soils derived from Wianamatta shale ▪ PCT 1254 in the assessment area is an open forest structure with a canopy dominated by one or more eucalypts listed on the conservation advice, namely <i>Eucalyptus piperita</i>, <i>Eucalyptus globoides</i> and <i>Eucalyptus cypellocarpa</i> ▪ PCT1254 has a ground layer including native grasses and / or other herbs including the grass <i>Microlaena stipoides</i> with several herbs / forbs including <i>Dichondra repens</i>, <i>Glycine clandestina</i>, <i>Hydrocotyle</i> 	<p>Yes</p> <p>The areas of PCT 1254 occurring in the northern end of the assessment area were found to meet the above key diagnostic characteristics for the CEEC.</p>

Biodiversity development assessment report

TEC name	Listing status	Source	Criteria	Justification	Consistent
				<i>sibthorpioides</i> and <i>Viola hederacea</i> .	
			<p>The condition categories, classes and thresholds for the Southern Highlands Shale Forest and woodland relate to:</p> <ul style="list-style-type: none"> • Patch size • Percentage of vegetation cover in the understorey that is native • Percentage of native species represented in the understorey 	<p>The Vegetation Integrity assessments for PCT1254 confirms patches of this vegetation on site meet the 'High Condition' thresholds outlined in the Conservation Advice. Specifically, the vegetation has:</p> <ul style="list-style-type: none"> ▪ Patch size > 2 ha ▪ At least 50% of the perennial understorey vegetation cover is made up of native species, or: ▪ > 30 native understorey species per ha 	Yes

Given the landscape position of this vegetation, as well as the characteristic plant species recorded, the areas of PCT 1254 in the assessment area conform to the Southern Highlands Shale Woodlands in the Sydney Basin Bioregion EEC. There is 0.23 hectares of this community within development site (see **Figure 5-1** and **Table 5-11**).



Photo 7.1 PCT 1254 at the entrance to Promised Lands Track will require minor widening (far northern end of development site).

7.3.2 River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

As there are proximal areas of the Kangaroo River floodplain containing eucalypt forest, a detailed assessment of the potential presence of an additional TEC/MNES was conducted, namely the '*River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*'. Refer **Section 5.7** for detailed assessment, a summary of the discussion is provided below in **Table 7-2**.

Table 7-2 Justification for absence of River-flat eucalypt forest of southern NSW and eastern Victoria

TEC name	Listing status	Source	Criteria	Justification	Consistent
PCT 1108 (River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion)					
<i>River-flat eucalypt forest on coastal floodplains of southern New South Wales and</i>	CEEC	DAWE 2020	<p>The key diagnostic characteristics of this ecological community are:</p> <ul style="list-style-type: none"> ▪ Occurs in the Southeast Corner and Sydney Basin IBRA7 Bioregions, in eastern Victoria and southeastern New South Wales. 	<ul style="list-style-type: none"> ▪ The assessment area is within the Southern Highlands in the Sydney Basin Bioregion ▪ The project is within the catchment of the Shoalhaven River on the eastern watershed of the Great Dividing Range 	<p>No</p> <p>The areas of PCT 1108 occurring the assessment area do not occur on alluvial</p>

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TEC name	Listing status	Source	Criteria	Justification	Consistent
<i>eastern Victoria'</i>			<ul style="list-style-type: none"> Occurs within catchments of the eastern and southern watershed of the Great Dividing Range. Occurs at elevations up to 250 metres above sea-level (ASL), but most typically below 50 metres ASL. Occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, riverbanks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans Occurs on alluvial soils of various textures including silts, clay loams, sandy loams, gravel and cobbles. Does not occur on soils that are primarily marine sands, or aeolian sands. Occurs as a tall closed-forest, tall open-forest, closed forest, open forest, tall woodland, or woodland. The canopy has a crown cover of at least 20 % Has a canopy dominated by one or a combination of the following species: <i>Angophora floribunda</i>, <i>A. subvelutina</i>, <i>Eucalyptus amplifolia</i>, <i>E. baueriana</i>, <i>E. benthamii</i>, <i>E. bosistoana</i>, <i>E. botryoides</i>, <i>E. botryoides</i> x <i>E. saligna</i> 14, <i>E. elata</i>, <i>E. grandis</i>, <i>E. longifolia</i>, <i>E. moluccana</i>, <i>E. ovata</i>, <i>E. saligna</i>, <i>E. tereticornis</i>, <i>E. viminalis</i>. 	<ul style="list-style-type: none"> The area of PCT 1108 within the assessment area occurs 600 metres elevation The areas of PCT 1108 on the development site do not occur on any of these alluvial landform types. The PCT is elevated well above Kangaroo River by steep banks, approx. 10 m tall (see Photo 7.2 and Photo 7.3). Behind the steep banks, the land is sloped and does not represent a river terrace (i.e. no flat benches). Similarly, the land adjacent to Kings Creek is sloping. The gradient of slopes increases to the north and towards the northern boundary of the Bendeela development site segment. Recent surveys during summer and autumn 2022 coincided with highly above average rainfall conditions, and subsequent flooding events of Kangaroo River. The patches of PCT 1108 were not inundated during these times, nor was any transient water accumulated on the ground. Water is likely to run down-slope directly into Kings Creek or off the steep banks into Kangaroo River below. The development site in this location would not occasionally flood and would not retain transient water. The species composition of PCT 1108 generally matches the species assemblage for the CEEC (mainly regarding canopy species), 	floodplain landform that is periodically flooded or inundated
			<p>The condition categories, classes and thresholds for the Southern Highlands Shale Forest and woodland relate to:</p> <ul style="list-style-type: none"> Patch size Percentage of vegetation cover in the understorey that is native Percentage of native species represented in the understorey Tree density Presence of arboreal mammals 	As the areas of PCT 1108 do not meet the key diagnostic characteristics of the CEEC, the condition categories do not apply	No

As described in **Table 7-2**, according to the Conservation Advice for this TEC; the ecological community occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, riverbanks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans. Floodplains may be occasionally or more often saturated, water-logged or inundated.

The areas of PCT 1108 on the development site do not occur on any of the above landform types. The site is elevated above kangaroo river by steep banks, approximately 10 meters tall (see **Photo 7.2** and **Photo 7.3**).

Behind the steep banks, the land is sloped and does not represent a river terrace (i.e. no flat benches). Similarly, the land adjacent to Kings Creek is sloping. The gradient of slopes increases to the north and towards the northern boundary of the Bendeela development site segment. Recent surveys during Summer and Autumn 2022 coincided with highly above average rainfall conditions, and subsequent flooding events of Kangaroo River. The patches of PCT 1108 were not inundated during these times, nor was any transient water accumulated on the ground. Water is likely to run down-slope directly into Kings Creek or off the steep banks into Kangaroo River below. The development site in this location would not occasionally flood and would not retain transient water.

As a result, the areas of PCT 1108 in the development site are considered not to constitute the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria. No Assessment of Significance has been prepared for this TEC.

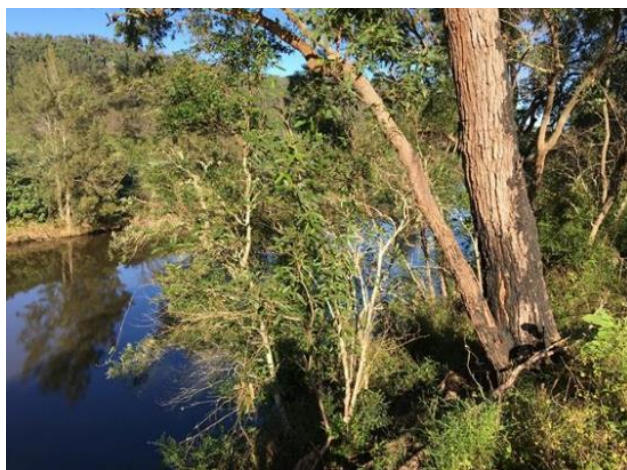


Photo 7.2 View from above 10m high bank of Kangaroo River (with moderate condition PCT 1108 - *Angophora floribunda* trees).



Photo 7.3 View from above 10m high bank of Kangaroo River (with moderate condition PCT 1108 - *Angophora floribunda* trees).

7.4 Threatened flora

The desktop review (PMST report, BAM C candidate species and NSW BioNet Atlas data) identified thirty-six nationally listed plant species (MNES) with potential to occur in the locality based on previous records or modelled habitat (refer Appendix A for list and likelihood of occurrence assessment). Of these, eighteen species were targeted during surveys to determine presence or absence within development site, (refer to **Section 6.3** for details of survey methods and effort which was compliant with the BAM).

One threatened species, *Genoplesium baueri* (Bauer's Midge Orchid), was assumed present as surveys were likely outside of the flowering season of this species (surveys were delayed due to high rainfall and site access constraints). The threatened flora species recorded during surveys or assumed present within the assessment area, include:

- *Rhodamnia rubescens* (Scrub Turpentine) – critically endangered under EPBC Act (recorded)
- *Genoplesium baueri* (Bauer's Midge Orchid) – endangered (moderately likely / assumed present).

Habitat descriptions and likelihood of occurrence assessment for the other threatened plant species (MNES) considered as part of this BDAR is in Appendix A. Considering the bilateral agreement, the survey and assessment undertaken in accordance with the BAM is considered adequate for assessing these species. None of the remaining 16 species were identified from the surveys or considered highly likely to occur and no assessments of significance have been completed. The surveys have determined that there are no other populations of threatened plants in the assessment area and no habitat critical for survival for a threatened plant species listed under the EPBC Act.

Assessment of significance have been conducted for the threatened *Rhodamnia rubescens* (Scrub Turpentine) and *Genoplesium baueri* (Bauer's Midge Orchid) species, which were recorded in the assessment area during field surveys or were identified as having a moderate or higher potential to occur in the

assessment area, based on the presence of habitat. The conclusions of these assessments were that the proposed activity is not expected to have a significant impact on these MNES.

7.4.1 *Rhodamnia rubescens* (Scrub Turpentine)

Rhodamnia rubescens is known to occur from coastal districts of NSW north from Batemans Bay to Bundaberg in Queensland. The distribution of *R. rubescens* occasionally extends inland onto the escarpment up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm (Benson & McDougall 1998).

Six *Rhodamnia rubescens* were recorded in one small part of the assessment area during the 2021/22 surveys. Two of these specimens are within the development site (approximately 300m west of the Kangaroo Valley Power Station) and are likely to be impacted by the project. These plants all occur in Illawarra Escarpment Blue Gum wet forest (PCT 1245). Nearby areas of Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283) are also suitable habitat for this species (according to the BioNet threatened species description for the species (DPE, 2022)). Given the abundance of forests remaining on the surrounding escarpments (containing the same PCTs and geology), suitable habitat for *Rhodamnia rubescens* is likely to be widespread in the locality (with other plants records within 1km west of the development site (near McPhail's fire trail), (Atlas of Living Australia, 2022).



Photo 7.4 One of the small *Rhodamnia rubescens* trees showing signs of *Austropuccinia psidii* (Myrtle Rust) infection (dropped leaves on ground)

The project would remove approximately 4 ha of suitable habitat (PCT 1245 and 1283 in varying conditions) in the development site. This would equal the removal of about 0.001% of the area of occupancy of the species in NSW. This vegetation removal affects mostly regrowth vegetation on the edges of existing clearings, and may increase the risk of weed and pathogen encroachment to a minor extent. The likely removal of two individual plants would have an unknown impact on breeding potential as both plants are in very poor health due to Myrtle rust and flowering capacity may already be lost. No flowers or fruit have been observed on either plant during 2021 season). Without evidence of the reproductive capacity of the two individuals to be removed, it is unknown if the project would disrupt the breeding cycle of the local population of the species. Whilst the species will suffer a minor decline of two infected plants, the project is

unlikely to result in a significant impact to the *Rhodamnia rubescens*. Four nearby plants which are in better health will be avoided by the proposed action.

7.4.2 *Genoplesium baueri* (Bauer's Midge Orchid)

Genoplesium baueri is endemic to NSW and has a distribution spanning between the Hunter Valley in the north to Ulladulla in the south (OEH 2017). Generally, the species occurs within coastal areas, although it has been recorded from as far west as Woodford in the Blue Mountains, Bargo in Southern Sydney and Penrose State Forest in the southern highlands. Across its range, this species has a patchy distribution and is currently known from a small number of sites (OEH 2017). *Genoplesium baueri* only flowers intermittently when conditions are suitable, and even when seasonal growing conditions are favourable, some plants can remain dormant. This means that quantifying the numbers of the population is difficult. The species may be nearly impossible to detect in areas that have not been burnt for several years, but conservatively estimates a minimum population size of 488 individuals (Copeland, 2008). 162 individuals of this species were recorded within the Shoalhaven area in 2016 (ELA 2017).

This is a leafless orchid species and can only be detected if it happens to be flowering (which is between February and March according to the NSW Bionet TBDC). Due to the difficulty in counting the population size of *Genoplesium baueri*, it is suitable to measure the area of suitable habitat as opposed to trying to count individuals.

Given the 2022 surveys for late summer-early autumn flowering orchids were outside the recommended February-March survey window (by two or three weeks approximately), the species will be assumed present in accordance with the NSW Biodiversity Assessment Method. However, by applying the geographical constraint (20km distance from Nowra as specified in the BAM-C) only the valley portions of development site will be considered as suitable habitat. According to the TBDC, suitable habitat within the development site is PCT 1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion. Lower-intensity flora surveys in February 2019 (which do not meet the 2020 *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method*) did not detect this species.

7.5 Threatened fauna

The desktop review (PMST report and NSW BioNet Atlas data) identified 33 animal species (EPBC Act) with potential to occur in the locality. The list of species and likelihood of occurrence assessment is provided in Appendix A. Of these, four species were recorded, and four species are considered to have a moderate likelihood of occurring (based on suitable habitat or known nearby records) and includes:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) – endangered under EPBC Act (recorded)
- Glossy Black-cockatoo (*Calyptrorhynchus lathami lathami*) vulnerable under EPBC Act (recorded)
- Greater Glider (*Petauroides volans*) – endangered under EPBC Act (recorded)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – vulnerable under EPBC Act (recorded 'probable')
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – vulnerable under EPBC Act (recorded)
- Spotted-tailed Quoll (*Dasyurus maculatus*) – endangered under EPBC Act (moderately likely)
- Littlejohn's Tree Frog (*Litoria littlejohni*) - endangered under EPBC Act (moderately likely)
- Giant Burrowing Frog (*Heleioporus australiacus*) – vulnerable under EPBC Act (moderately likely)
- Pilotbird (*Pycnoptilus floccosus*) - vulnerable under EPBC Act (moderately likely).

The following is a brief discussion on the assessment results for these threatened species listed under the EPBC Act, which are considered at least moderately likely to occur within the assessment area.

7.5.1 Gang-gang Cockatoo

The Gang-gang Cockatoo was recorded numerous times during surveys. Observations were usually of a single bird flying over the assessment area, except for one observation of up to 5 birds foraging in the eucalypt canopy near Fitzroy Canal. A dedicated survey was conducted to identify and map all hollow-bearing trees within the development site and a 200 m buffer. Following this, all recorded hollow-bearing trees were surveyed in October 2022 for breeding activity. One adult female and juvenile male were recorded perched and foraging near three suitable hollow-bearing trees at the southern end of the existing pipeline (on the plateau). Whilst not observed entering/exiting the hollows, it was assumed that one of these trees is a potential nest (as a precautionary approach all three trees were deemed actual nest trees).

The Gang-gang Cockatoo is part of a single population across south-eastern Australia, and is a highly mobile species, which migrates between altitudes during different seasons. The Gang-gang Cockatoos are able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the forest patches surrounding the existing pipeline and power stations.

The species favours old growth forest and woodland attributes for nesting and roosting. The vegetation within the assessment area contains fruiting eucalypts, which constitutes suitable foraging resources for this species. There is approximately 29.5 hectares of native vegetation located within the development site, suitable for the Gang-Gang Cockatoo, containing approximately 22.2 hectares of regrowth and 7.3 hectares of potentially remnant native vegetation (along the edges of existing cleared corridors). Importantly, similar foraging habitat is widespread in the surrounding areas of Morton National Park and Kangaroo Valley.

Favourable breeding habitat for the Gang-gang Cockatoo includes tree hollows, which are at least five metres above the ground, containing an entrance with a diameter greater than nine centimetres and 20-centimetre diameter of internal space. There are twelve hollow-bearing trees which are potentially suitable as breeding habitat within the development site. A further 332 hollow-bearing trees were recorded within the adjacent forest areas out to 200 metres from the edge of the project, these trees will not be directly impacted, and indirect impacts will be limited to the construction period.

7.5.2 Glossy Black-Cockatoo

Three Glossy Black- Cockatoos were recorded adjacent to the Promised Lands Track in February 2019 (in PCT1082) and a further 4 birds were recorded adjacent to the Promised Lands Track on 17 August 2022 (also in PCT1082) this latter observation was of an adult pair with two juveniles indicating breeding does occur in Morton National Park. Suitable habitat containing *Allocasuarina littoralis* (food tree) is available in most PCTs within development site, and the mature habitats present are considered suitable for multiple birds and resident breeding pairs.

To determine the potential impact on breeding habitat for this species identification of potential nest sites was conducted and a search of each tree within the breeding period. A total of 344 hollow-bearing trees were mapped from a 200 m buffer of development site, each of these met the criteria as 'potential' nesting hollows for this species. All potential nest trees were located in older, remnant forest and the dedicated survey identified an absence of 'potential' nest sites from large areas of regrowth buffering the project (Refer **Figure 6-4**). Of the 344 trees identified, 10 are located directly in development site.

The dedicated hollow tree mapping was conducted in mid-August 2022 in the last month of the breeding period for this species. None of the trees were occupied by Glossy Black Cockatoo at this time confirming no 'actual' nest trees were present in development site or buffer area at this time. Further to this the project team has conducted numerous traverses of development site during targeted flora surveys, also within the breeding season for Glossy Black Cockatoo (April and May 2022) and no actual nest sites were opportunistically recorded at this time.

While there are numerous opportunities for Glossy Black-cockatoo nesting in Morton National Park and a family group was observed in mid-August 2022, nonetheless comprehensive mapping and inspection of all 'potential' nest sites in a 200 m buffer of the development project has not located at nest during the survey periods. According to the BAM a species polygon has not been prepared for a Glossy Black-cockatoo nest site.

7.5.3 Greater Glider

The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. They feed exclusively on eucalypt leaves, buds, flowers and mistletoe. Greater Gliders shelter during the day in tree hollows and will use up to 18 hollows in their home range and occupy a relatively small home range with an average size of one to three hectares.

This species was recorded four times within the plateau section of the assessment area during the surveys undertaken for the BDAR. Two likely den trees were also recorded nearby to Greater Glider sightings (large hollow-bearing trees). Greater Glider individuals were identified during the 2019 spotlighting surveys at two different locations. One individual was detected in Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion, 50 metres from development site, with a den tree located

nearby, approximately 80 metres from development site. The other individual was detected in Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion within development site and den tree located 20 metres from development site. During further surveys in December 2021, two more individuals were recorded, both in the southern areas of the plateau, in Silvertop Ash - Red Bloodwood - Sydney Peppermint Forest. Both records were in forest adjacent to the pipeline and Promised Lands Track (and outside the current development site). Despite suitable habitat located within the valley section of the development site, this species was not recorded. Impacts to this species includes vegetation clearing of all PCTs within the plateau portion of development site. This includes approximately 12.3 hectares, made up of PCT 1254 (0.23ha), PCT 1156 (5.5ha) and PCT 1082 (6.54ha).

Whilst the vegetation in the valley may be suitable, this species has not been recorded below the plateau areas, and impacts for this species are considered confined to the upper scheme area of the project associated with the habitats on the plateau.

7.5.4 Large-eared Pied Bat

Calls were recorded with a 'probable' confidence level during surveys via acoustic recording in areas of PCT 1083 to the east of Bendeela Pondage. This species was not trapped during harp trapping. Potential breeding habitat for this species is defined as: "The PCTs associated with the species (as per the BioNet TBDC (DPIE, 2020) within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old underground mines, tunnels, culverts, derelict concrete buildings" by the 'Species Credit' Threatened Bats and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method (OEH, 2018).

The development site does not contain any cliff lines or suitable breeding habitats; however, such features are available in the surrounding areas of Kangaroo Valley escarpment (and along the plateau edges). Numerous cliff lines occur in close proximity to the development site (some within 100m distance). The large cliffs on the edges of the plateau could not be explored due to safety reasons. Some smaller cliffs on top of the plateau and adjacent to the development site were investigated, and small crevasses were searched for roosting bats. Man-made features such as concrete culverts and tunnels were also checked. The sandstone cuttings along the existing pipeline corridor have engineered/smooth faces and do not contain any crevasses or caves suitable for this species.

The PCTs occurring on the development site and within 100m of cliff lines include:

- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156)
- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083)
- Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283).

0.87 ha of vegetation within the assessment area is within a 100 m cliff line buffer (see chapter 11 of the BDAR) – this translates to total impact to *Chalinolobus dwyeri*. There are no historical records of this species in Kangaroo Valley, however regular records occur to the south around Nowra and the Shoalhaven River, as well as Illawarra coastal districts. Along with these records, the species is also known to occur throughout the southern highlands. A lack of records in Kangaroo Valley and on the plateau, areas is likely due to a lack of survey more than an absence of the species.

7.5.5 Grey-headed Flying-fox

The Grey-headed Flying-fox exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. They are particularly well adapted to accessing widely spaced habitat resources given their mobility and preference for seasonal fruits and blossom in differing parts of the landscape. This species typically exhibits very large home ranges and Grey-headed Flying-fox is known to travel distances of at least 50 km from roost sites to access seasonal foraging resources.

The Grey-headed Flying-fox was identified in the development site during the surveys. All forest and woodland habitat in the survey area is considered foraging habitat, critical to the survival of the species. However, no breeding or roosting was recorded within the assessment area, and the nearest known maternity camp is in Kangaroo Valley township, located approximately four kilometres from the project.

The Grey-headed Flying-fox was recorded within the development site foraging in Eucalypt trees during spotlighting surveys in 2019. Most of the forest areas of Kangaroo Valley provide foraging habitat for this species which feeds on nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. All PCTs occurring within the assessment area provide foraging habitat for this species, totalling approximately 29.5 hectares of native vegetation.

7.5.6 Spotted-tailed Quoll

The Spotted-tailed Quoll has a preference for mature wet forest habitat (Belcher, 2000; Green & Scarborough, 1990; Watt, 1993). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). Habitat within the Morton National Park is intact with very little disturbance, suggesting that it may be critical for the survival of this species in the region. Therefore, the assessment area is likely to contain an important population of this species within suitable habitat.

The Spotted-tailed Quoll is considered likely to occur based on the presence of large expanses of forested habitat extending within Morton National Park and west from Kangaroo Valley. Within the development site, there is approximately 29.5 hectares of suitable habitat present for the Spotted-tailed Quoll. However, this species was not recorded during comprehensive camera monitoring surveys and spotlighting.

This species occupies very large areas of habitat. Whilst this species was not recorded within the development site, it is likely to occur within adjacent areas of Morton National Park and would likely frequent the site during foraging and dispersal.

7.5.7 Littlejohn's Tree Frog and Watson's Tree Frog

A recent taxonomic revision divided *L. littlejohni* s.l. into two species: *L. littlejohni* s.s. (Littlejohn's Tree Frog) and *L. watsoni* (Watson's Tree Frog) (Mahony et al. 2020). Following a taxonomic revision, the distribution of Littlejohn's Tree Frog is now confined to the Sydney Basin Bioregion, New South Wales (NSW) (Mahony et al. 2020). *Litoria littlejohni* is 'found over a distance of roughly 180 km, from the Watagan Mountains (90 km north of Sydney) to just north of Kangaroo Valley (90 km south of Sydney)' (Mahony et al. 2020). The distribution of *Litoria watsoni* is to the south of *Litoria littlejohni* and extends to Victoria. This means that Kangaroo Valley is an intergrade of the two species' distributions. For the purposes of this assessment the historical records of *Litoria littlejohni* (to the north and south of Kangaroo Valley) have been used, with the southern records now assumed as *Litoria watsoni*. Records are taken from NSW BioNet and Atlas of Living Australia. The species are discussed as one species in text below (due to their similar habitat requirements).

This species was not recorded during amphibian surveys of the development site which targeted natural creek lines, Trimbles Creek and Kings Creek. However, the amphibian surveys carried out in February and March 2019, and December 2021 are outside the recommended survey period for this species (July – November, according to the NSW Survey Guide for Threatened Frogs (DPIE, 2020)). Follow-up target surveys were not undertaken as the Shoalhaven Special Areas catchment was frequently closed during high rainfall events (suitable survey conditions) in 2021/2022 (WaterNSW do not permit access due to safety concerns). Therefore, due to a potential survey gap, and suitable habitats within or adjacent to the proposed action, the presence of this species remains unknown, and has been assumed present for this assessment.

The distribution of the Littlejohn's Tree Frog includes the plateaus and eastern slopes of the Great Dividing Range. It breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath-based forests and woodlands where it shelters under leaf litter and low vegetation. There are some records of the Littlejohn's Tree Frog to the north and east of the assessment area within Budderoo National Park. There is suitable habitat modelled around Fitzroy Falls and predicted habitat in Kangaroo Valley.

Littlejohn's Tree Frog is associated with the following plant communities located within the development site:

- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)

- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083)
- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156).

According to the NSW Survey Guide for Threatened Frogs (DPIE, 2020); Suitable breeding habitat consists of a range of still or slow-moving waterbodies including permanent streams, pools, ponds, swamps and dams, located within areas of suitable native vegetation. Non-breeding habitat is native vegetation located within 300 meters of breeding sites, through which the species can migrate to locate non-breeding habitat.

Determining an area of potential habitat requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats). Within the development site, potential habitat includes vegetation within 300 meters from suitable watercourses (Kings Creek, Trimble Creek and numerous streams containing permanent pools or swamps). The 300m buffer was applied to all nearby 1st order streams on the plateau and the valley. Some 1st order streams within the assessment area were visited during surveys and found to be small drainage ditches with no water, which makes them unsuitable habitat for this species which requires ephemeral flowing streams or swampy areas according to the TBDC (and for this reason some drainage lines in the assessment area were not mapped all the way to their start point). Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks). Trimble Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is an abundance of similar suitable habitats in the surrounding plateau and escarpment areas.

Kangaroo River (and riparian areas of PCT 1108) are not considered to be suitable habitat for this species (PCT 1108 is not an associated PCT for this species). Man-made power station dams are considered to be poor habitat due to their steep banks (sandstone vertical walls or rock scree) as well as their highly fluctuating water levels and temperatures. Inspection of these dams revealed no tadpoles or frogs calling (apart from Common Eastern Froglet (*Crinia signifera*) on one occasion). The dams also lack emergent aquatic vegetation.

7.5.8 Giant Burrowing Frog

This species was not recorded during amphibian surveys of the development site, which targeted natural creek lines Trimble Creek and Kings Creek (as well as various other micro habitats). However, the amphibian surveys carried out in February and March 2019, and December 2021 did not meet the duration of eight repeat surveys following heavy rainfall as recommended in the NSW Survey Guide for Threatened Frogs (DPIE, 2020). Follow-up target surveys were not undertaken as the Shoalhaven Special Areas catchment was frequently closed during high rainfall events (suitable survey conditions) in 2021/2022 (WaterNSW do not permit access due to safety concerns). Therefore, due to a potential survey gap, and suitable habitats within or adjacent to the proposed action, the presence of this species remains unknown, and has been assumed present for this assessment.

Determining an area of potential habitat requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats). The Giant Burrowing Frog spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Individuals move into the breeding site either immediately before or following heavy rain and occupy these sites for up to 10 days. Breeding habitat of this species is generally soaks or pools within first or second order streams.

This species is associated with five PCTs occurring within the development site including:

- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156)
- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083)
- Illawarra Escarpment Blue Gum wet forest (PCT 1245)
- Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254)

- Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283).

There are no historical records of this species in Kangaroo Valley or the plateau areas. The nearest records occur between Fitzroy Reservoir and Budderoo National Park (approximately 15km east of the development site). A small number of records also occur in forest areas in Nowra (approximately 10km south of the development site). The nearest records to the west are near Bundanoon (approximately 20km from Kangaroo Valley).

7.5.9 Pilotbird

Pilotbirds are endemic to south-east Australia. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the Australian Capital Territory, and in the Snowy Mountains in New South Wales and north - east Victoria (Higgins & Peter 2002; Loyn et al. 2021). Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne (Higgins & Peter 2002; Loyn et al. 2021).

The development site contains suitable habitats for this species, particularly the wetter sclerophyll vegetation types and may also use drier vegetation types. Given this, the majority of vegetation within the development site is deemed as potential habitat for this species. Pilotbirds are likely to occur in surrounding unburnt forest areas of Morton national Park, Kangaroo Valley and vast forest areas to the north such as Budderoo National Park. Previous records are frequent in Fitzroy Falls, Budderoo NP, and a 2003 record exists near Bendeela (approximately 100m east of the assessment area).

This species was not recorded within the assessment area, despite repeated survey throughout suitable habitats in February and March 2019, October and December 2021 and April and May 2022. Targeted bird surveys were undertaken, however this species was also likely to be detectable throughout all other surveys. The call of this species was not heard during extensive flora and fauna surveys, despite common occurrences of Superb Lyrebird (often associated with Pilotbird presence).

The presence of an important population within the development site is unlikely. The wider expanses of (unburnt) forests surrounding the development site in Morton National Park, Kangaroo Valley and Budderoo National Park would contain a proportion of the total population and considering the recent decreases in population numbers and area of occupancy due to bushfires, would be an important population.

The following species were surveyed and later excluded due to lack of recordings or lack of suitable habitat:

7.5.10 Koala

Surveys for Koalas in 2019 involved application of the Spot Assessment Technique (SAT), (Phillips and Callaghan (2011)) to assign threshold values for low, medium (normal) and high Koala activity. A SAT plot is approximately 40x40m wide and located around a centrally located tree (suitable koala feed tree, koala scratches tree or koala observation tree). The ground beneath all suitable trees in the plot are checked for presence/absence of Koala faecal pellets. The surveys within the assessment area used 20 SAT plots (including 344 trees), combined with spotlighting and opportunistic surveys throughout. No evidence of Koalas was recorded and given that database records in the locality are sparse, this species is considered unlikely to occur.

7.5.11 Broad headed Snake

Habitat for the Broad headed Snake was assessed in the plateau areas of the development site. A total of 127 rocks were searched over three transects, with only six rocks being deemed suitable. The main reason for this low number is that most rocks (95%, n=121) searched were positioned directly on the sand/soil, and not on bare rock. Additionally, a smaller number (16%, n=20) of rocks searched had a higher amount of leaf litter and other debris underneath. In addition to the lack of suitable rock-on-rock habitat, the general aspect of the ridge lines in the assessment area were not west-facing, as is preferred by the broad-headed snake. Canopy cover varied across the three transect locations, averaging 24% at transect 2 and 51% at transect 3. However, this did not consider the cover provided by the midstory, which would increase the percentage

cover at each site. The lack of discovery of any broad-headed snakes was largely attributed to the lack of suitable habitat in the assessment area.

7.6 Threatened aquatic fauna

7.6.1 Fitzroy Falls Spiny Crayfish

Fitzroy Falls Spiny Crayfish has only been recorded above (Shull et al. 2005) and below the Fitzroy Falls Reservoir (DPI 2011). The species is restricted to 12km of waterway of Wildes Meadow Creek NSW and less than 1km of this stretch is of good water quality (DPI n.d.).

Fitzroy Falls Spiny Crayfish is found mostly borrowing in soft stream bed habitat under the waterline, however they have been seen foraging on substratum (DPI 2012; DPI 2011). They require flowing streams hence their disappearance in Fitzroy Falls Reservoir when its habitat became static water (DPI 2012). The crayfish is most active during late afternoon and early evening (DPI 2012). The maximum size recorded is 86mm occipital carapace length and 300 grams (DPI 2012). The life cycle length for Fitzroy Falls Spiny Crayfish is nine years (McCormack, R. B. 2016). Eggs are fertilized between May and June and the female holds the eggs and larvae under her abdomen until December when the juveniles disperse. Not all females will breed every year (DPI 2011).

An aquatic survey targeted at identifying the Fitzroy Falls Spiny Crayfish within the Fitzroy Falls Reservoir was undertaken on 19 February 2019. The purpose of the survey was to assess the aquatic habitat, flora, fauna and water quality at selected monitoring locations around Fitzroy Falls Reservoir and confirm the presence or absence of Fitzroy Falls Spiny Crayfish at these sites.

No Fitzroy Falls Spiny Crayfish specimens were caught during the survey program undertaken in February 2019. This is consistent with findings presented in the desktop review and therefore it is reasonable to suggest that the Fitzroy Falls Crayfish is unlikely to inhabit the Fitzroy Falls Reservoir.

Given this and considering that impacts of the Project on water quality, flow and water level would be avoided at Fitzroy Falls Reservoir, it is unlikely that the critically endangered Fitzroy Falls Spiny Crayfish would be impacted by the Project.

7.6.2 Macquarie Perch

Macquarie Perch is a member of the family Percichthyidae, which contains the Australian freshwater basses and cods. Macquarie Perch has several genetic divergent forms/species across its range, with three taxa now recognised (but not formally described) (Lintermans et al. 2019):

- The Murray-Darling Basin Macquarie Perch (MDB subspecies) is a moderately sized, deep-bodied, laterally-compressed fish, reaching up to 550 millimetres in length. The species is relatively long-lived, having been known to live up to the age of 17 years (DPI, 2016b). The MDB subspecies is relatively well researched and is formally described
- The Kangaroo River Macquarie Perch is only known from a single catchment and is thought to potentially have recently become extinct (Lintermans et al. 2019)
- The Hawkesbury-Nepean Macquarie Perch (HN subspecies) is known to occupy the Hawkesbury-Nepean catchment, and is expected to occupy the Avon Dam and upper tributaries.

The Macquarie perch is a riverine species, typically found in the cool upper reaches of the Murray Darling River system. The fish prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks (DPI, 2016b).

According to database records this species has not been recorded in the Fitzroy reservoir or upstream tributaries and is unlikely to occur within the plateau portions of the development site (southern end of Fitzroy Canal).

The Atlas of Living Australia refers to the lower Shoalhaven catchment being suitable habitat for this species (below Tallowa Dam). Whilst this species could potentially occur above the dam in Kangaroo River, this is considered unlikely (particularly given its assumed extinction here as noted above). Any Macquarie Perch occurring in Kangaroo River would unlikely be impacted by the proposed action, as the proposed action will

only replicate the existing hydro power scheme, which would be already affecting Kangaroo River at the Bendeela Power Station and pipeline outlet. A range of mitigation strategies will be required to ensure impacts to Kangaroo River water quality and aquatic habitats are not exacerbated.

No surveys were undertaken for this species in Kangaroo River or the artificial dams (Bendeela Pondage and Fitzroy Reservoir).

7.6.3 Australian Grayling

The Australian Grayling generally occupies coastal seas and rivers that are tidally influenced as larvae/juveniles before migrating to freshwater reaches for the remainder of their lives. During the freshwater phase of their lifecycle, individuals inhabit lower altitude reaches of large rivers and smaller streams (DPI, 2015). Kangaroo River (which borders the southern boundary of the development site) is not suitable habitat for this species, as the river is dammed and not linked to coastal rivers or the sea. This species would not occur within aquatic habitats of the assessment area.

7.7 Summary of assessment of significance

An Assessment of Significance has been conducted for threatened ecological communities and species that have been positively identified within the development site or that are considered to have a moderate or high likelihood of occurring in the development site due to the presence of suitable habitat.

Significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DoE, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (DoE, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (DoE, 2013). This advice has been considered while undertaking the assessments.

The outcomes of the assessment are summarised in **Table 7.3** and conclude that there will be no significant impact on MNES. Habitat assessment and likelihood of occurrence assessment for the threatened animal species considered as part of this BDAR are provided in **Appendix A**.

Biodiversity development assessment report

Table 7-3 Summary findings and conclusions of the EPBC Act significance assessments

EPBC listed entity	Potential Impact	*Assessment of significance questions									Important Population+	Likely Significant Impact
		1	2	3	4	5	6	7	8	9		
Threatened ecological communities												
Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion - critically endangered ecological community under EPBC Act (recorded)	Removal of 0.23 ha of this community from 22 ha patch (~1% of patch). This equates to around 0.03% of the estimated total extent of the community in moderate to high condition remaining. Removal from the perimeter of access tracks.	Y	Y	N	N	N	N	Y	NA	NA	NA	No
Threatened flora												
Scrub Turpentine (<i>Rhodamnia rubescens</i>)	Removal of two individuals from six identified within the broader study area. Two individuals to be removed are infected with Myrtle Rust, and so it is unknown whether they are capable of reproducing. Removal of approximately 4 ha of suitable habitat (in varying conditions) from the development site (equates to about 0.001% of the area of occupancy of the species in NSW).	Y	Y	N	N	?	Y	N	N	Y	NA	No
Bauer's Midge Orchid (<i>Genoplesium baueri</i>)	No individuals recorded, species only visible when flowering and only flower sporadically. Recent surveys likely missed flowering - assumed present for purposes of NSW Biodiversity Offset Strategy. Direct clearing and disturbance to about 10.21 ha of potential habitat for this species.	?	Y	N	N	N	N	N	N	Y	NA	No
Threatened fauna												
Greater Glider (<i>Petauroides Volans</i>)	Species observed within the study area on four separate occasions, two potential den trees identified outside of the development site but within the broader study area. Removal of 12 ha of known habitat (in the plateau areas) and 17 ha of potentially suitable habitat (in the valley areas).	N	Y	N	N	N	N	N	N	N	Y	No
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	Species recorded numerous times during surveys. Multiple observations of a single bird flying over the Study area, and one observation of up to 5 birds foraging in the eucalypt canopy near Fitzroy Canal. Removal of 29.5 ha of foraging habitat, including up to 22.2 ha of regrowth and 7.3 hectares of potentially remnant native vegetation from the edges of existing cleared corridors.	N	Y	N	N	N	N	N	N	Y	NA	No

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EPBC listed entity	Potential Impact	*Assessment of significance questions										Important Population+	Likely Significant Impact
		1	2	3	4	5	6	7	8	9			
	Removal of hollow-bearing trees which are potentially suitable as breeding habitat.												
Glossy Black-cockatoo (<i>Calyptorhynchus lathami lathami</i>)	Species recorded at different years during surveys. Including an observation of a family group. Removal of 29.5 ha of foraging habitat, including up to 22.2 ha of regrowth and 7.3 hectares of potentially remnant native vegetation from the edges of existing cleared corridors. Removal of hollow-bearing trees which are potentially suitable as breeding habitat. No breeding activity was observed by the species within these trees during field surveys.	N	Y	N	N	N	N	N	N	Y	NA		No
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	Loss of 29.5 ha of foraging habitat. Species forages broadly and significant expanses of foraging habitat outside of the assessment area. No breeding or roosting recorded within the study area, and the nearest known maternity camp is in Kangaroo Valley township (3km distance from development site).	N	N	N	N	N	N	N	N	Y	N		No
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	Loss of 29.5 ha of foraging habitat. Species forages broadly and significant expanses of foraging habitat outside of the assessment area. Will likely continue to forage in cleared areas and forest edges. No breeding or roosting recorded within the study area.	N	N	N	N	N	N	N	N	Y	Y		No
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)	No individuals identified in targeted survey. Loss of 29.5 ha of foraging habitat. Species forages broadly and significant expanses of foraging habitat outside of the assessment area. Species has expansive home range. No suitable den sites identified within the assessment area.	N	N	N	N	N	N	N	N	Y	NA		No
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	No individuals identified within the assessment area. Proposed removal of approximately 3 ha of non-breeding habitat. There is an abundance of suitable habitats in the surrounding plateau and escarpment areas.	?	N	N	N	N	N	N	N	Y	Y		No
Littlejohn's Tree Frog (<i>Litoria littlejohni</i>) (also <i>Litoria watsoni</i>)	No individuals identified within the assessment area. Proposed removal of approximately 3 ha of potential habitat for the species (mainly within PCT 1156 near Trimble's Creek), however, it is not considered critical habitat. There is extensive preferred habitat surrounding the development site throughout Morton National Park.	?	N	N	N	N	N	N	N	Y	NA		No
Pilotbird (<i>Pycnoptilus floccosus</i>)	This species was not recorded despite multiple surveys, and the presence of an important population within the development site is unlikely. Suitable habitat is abundant in surrounding unburnt areas.	N	Y	N	N	N	N	N	N	N	N		No

7.8 Migratory species

Based on the PMST report and NSW BioNet Atlas records within a 50-km radius of the assessment area, 63 species listed as migratory under the EPBC Act may occur in the broader locality, however, only five are likely to occur within the assessment area (see **Table 7-4**). Surveys for migratory birds were undertaken as part of the field surveys (see **Section 6.3.2** for details). The surveys included time-based area surveys (around two hectares for 20 minutes). Surveys were undertaken across all PCTs and habitat variations.

'Important habitat' for a migratory species is defined as (DoE, 2013):

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

One marine species - White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and two migratory species - Black-faced Monarch (*Monarcha melanopsis*), Rufous Fantail (*Rhipidura rufifrons*), listed under the EPBC Act have been recorded in the development site during surveys. Satin Flycatcher (*Myiagra cyanoleuca*) and Spectacled Monarch (*Monarcha trivirgatus*) are considered likely to occur based on favourable habitats.

A White-bellied Sea Eagle was observed flying above Bendeela Pondage (potentially foraging), though no nest were observed during repeat surveys over multiple years. Black-faced Monarch individuals were observed on two occasions in January and March 2019. Additionally, individuals of the Rufous Fantail (*Rhipidura rufifrons*) were observed on two occasions in January and March 2019.

Both the Satin Flycatcher (*Myiagra cyanoleuca*) and Spectacled Monarch (*Monarcha trivirgatus*) were not recorded; however, these species are likely to utilise the vegetation within the assessment area, at least on an occasional basis.

An assessment of the likely occurrence of these species and the presence of important habitat is included in Appendix A and in **Table 7-4**. The assessment of significance for migratory species has been completed in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). While some other migratory bird species may occur in the locality (50-km radius around assessment area), the habitats that will be directly or indirectly impacted by the project would not be classed as 'important habitat'. A nationally significant proportion of a population would not be supported by the assessment area. Similar forest habitats are widespread in the locality and the habitat within the assessment area would be only a fraction of what is available for these species.

The project would not substantially modify, destroy, or isolate an area of important habitat for the migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds. Given the project is largely linear, the habitats within the disturbance area will only be a minor proportion of what is available (with large areas of forest flanking the proposed disturbance areas). Migratory species are all highly mobile and will be able to cross over the cleared alignment easily while dispersing through forest habitats.

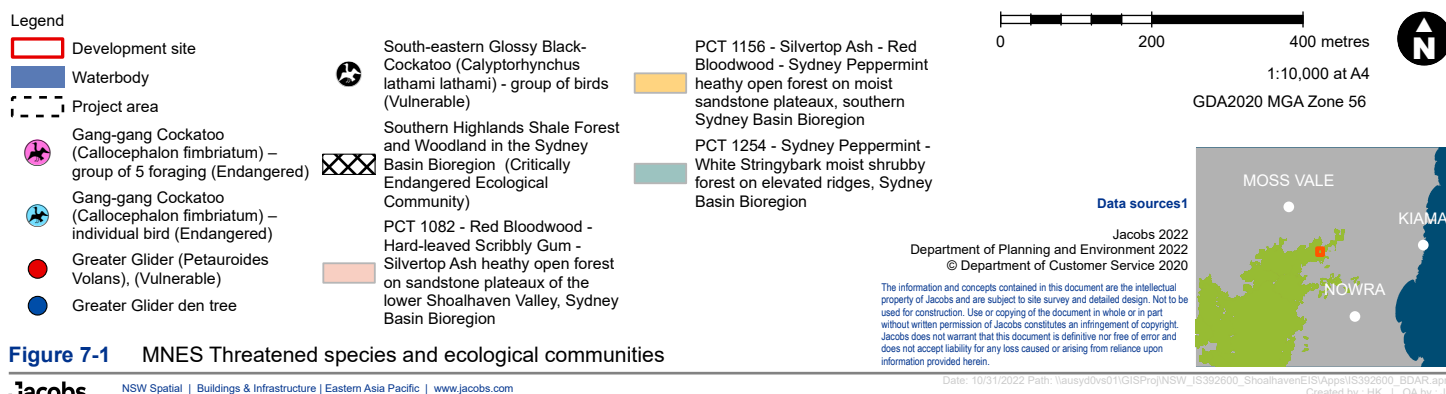
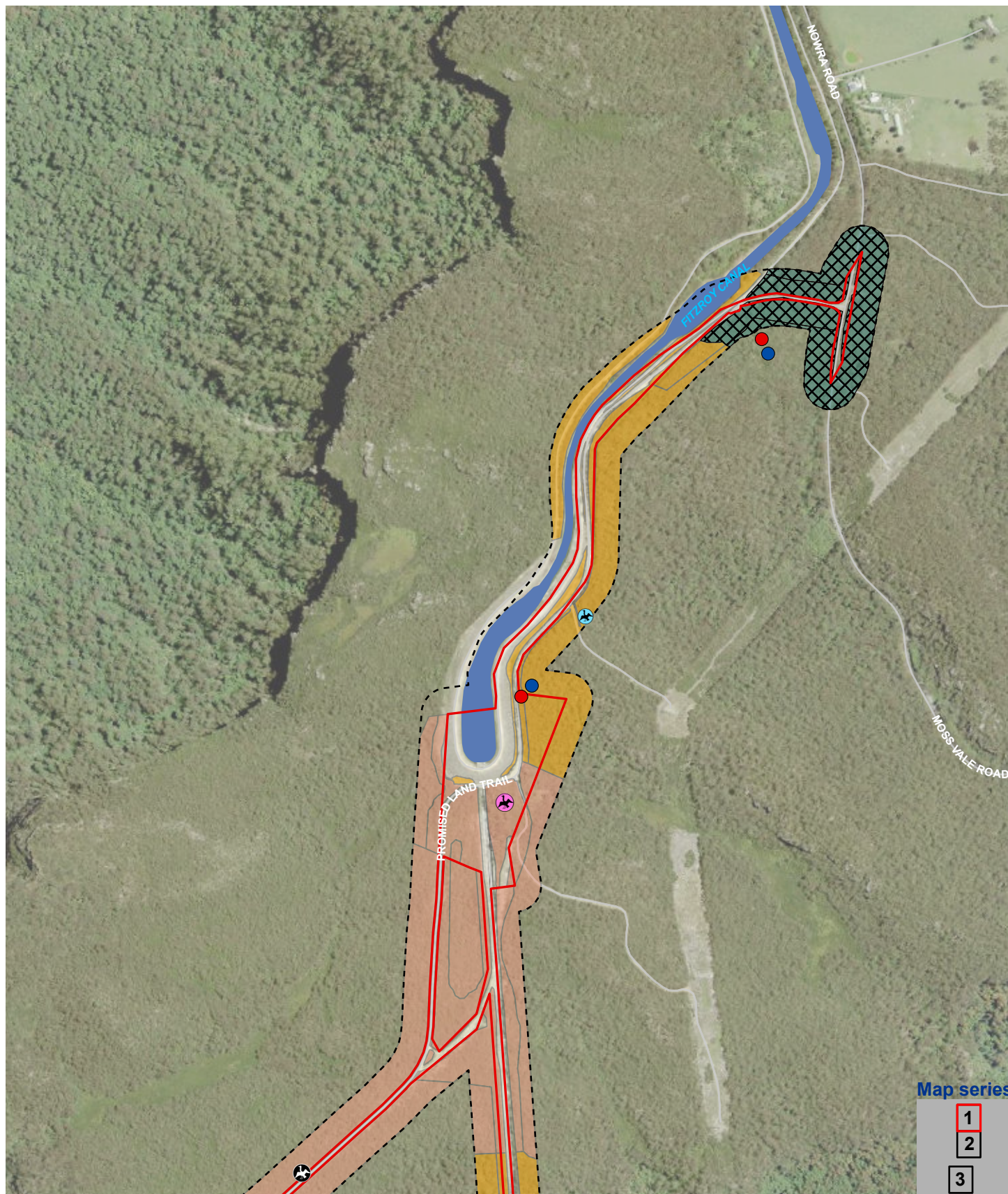
No migratory wetland bird species are considered likely or moderately likely to occur based on the absence of suitable habitats. The man-made dams are not suitable for such species as they are surrounded by steep concrete or rock scree edges, with highly fluctuating water levels. No aquatic vegetation or foraging habitat is available in the dams.

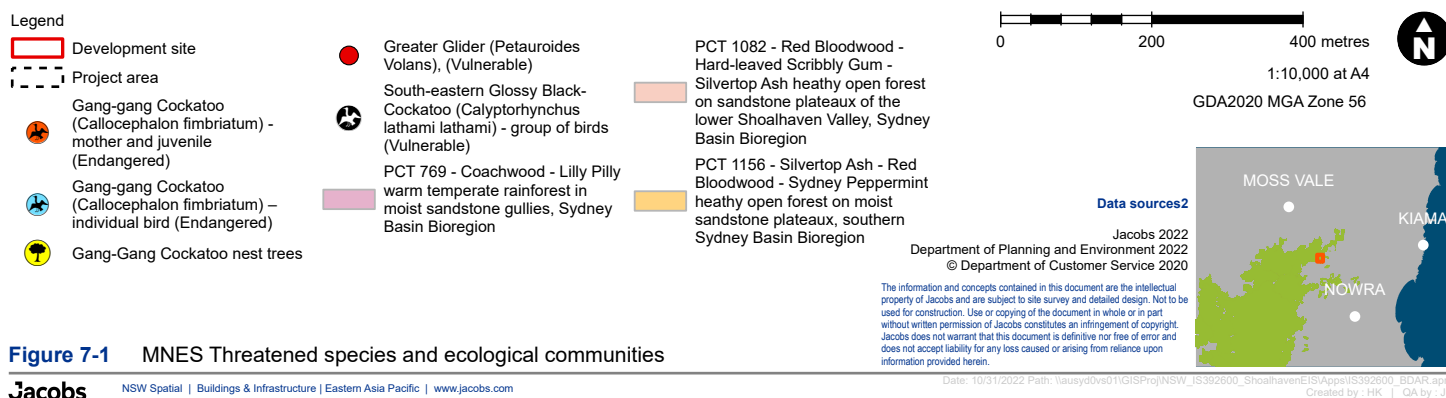
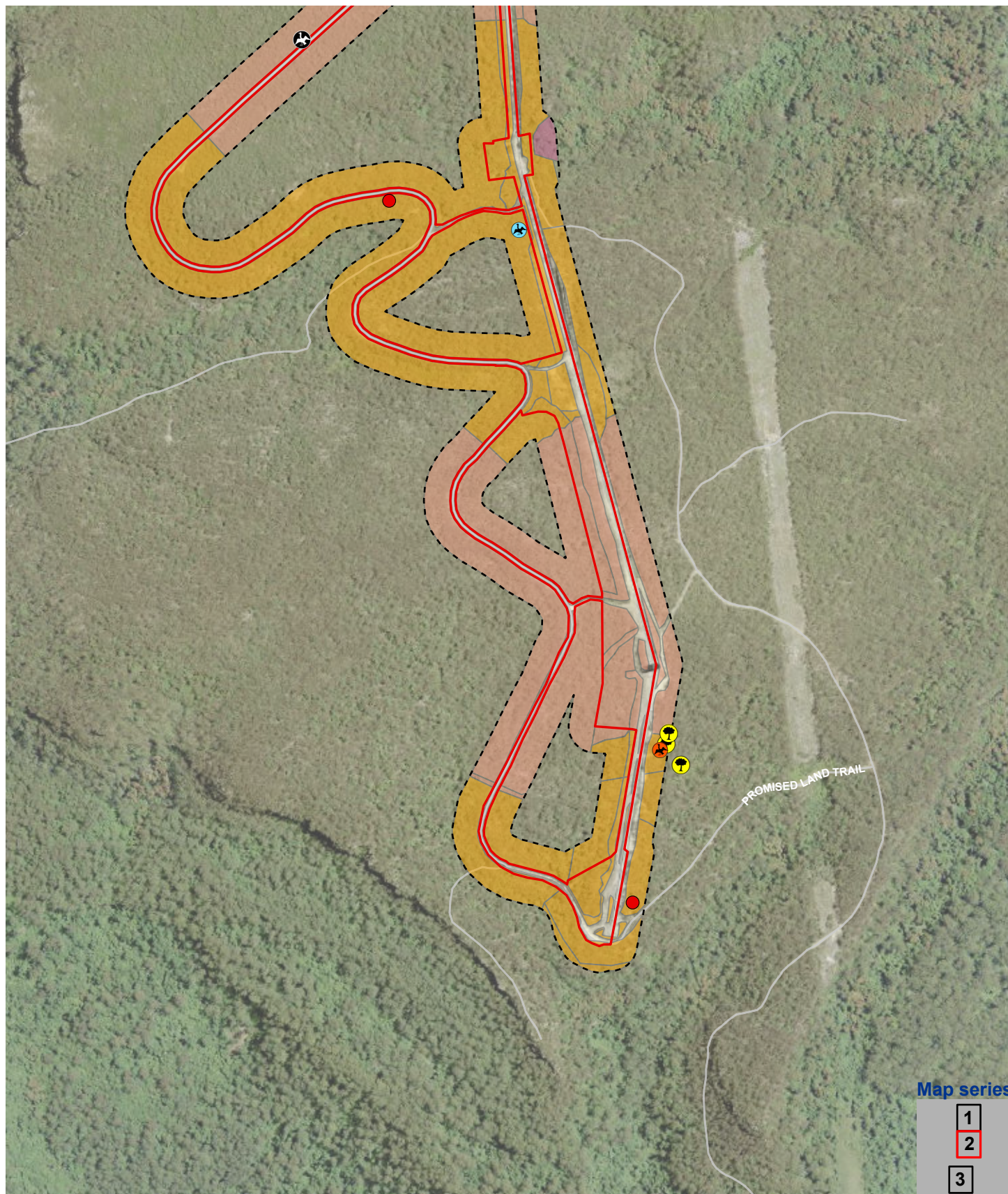
Table 7-4 EPBC Act listed Migratory species that are considered likely to occur near the development site

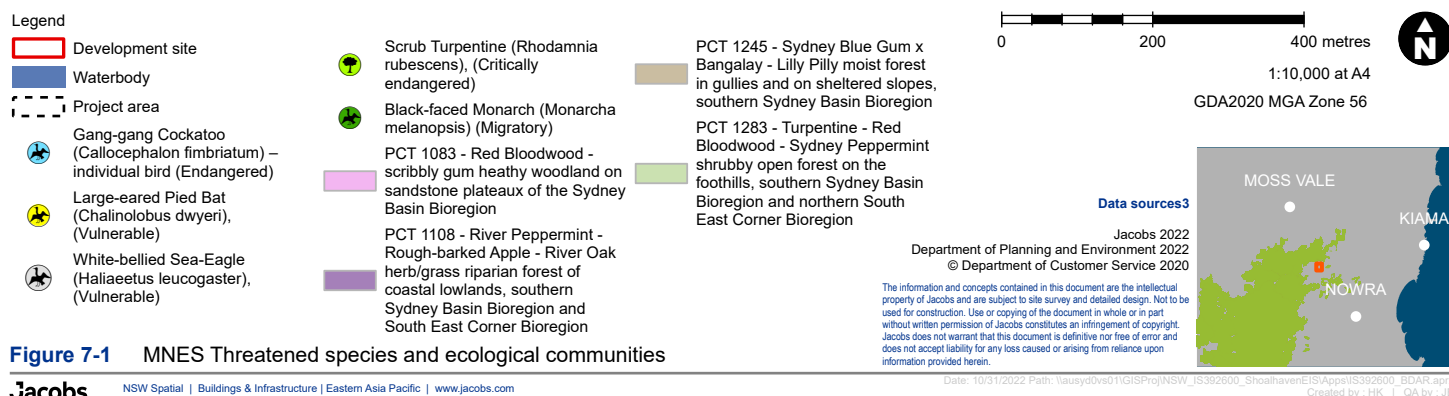
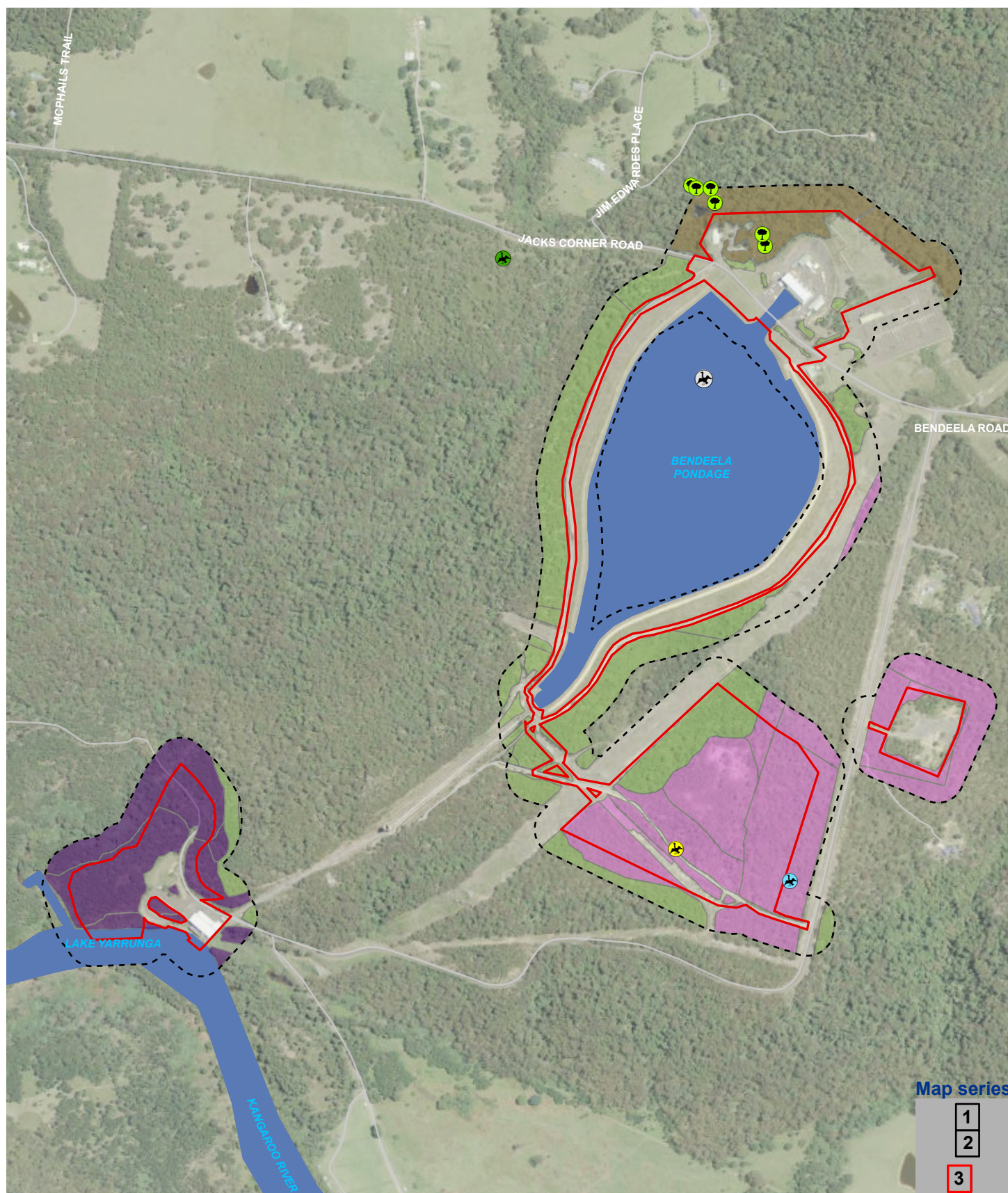
Species	Distribution and habitat	Habitat present / records in the assessment area	Important habitat present?
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially Eucalyptus species), bushes, mangroves, cliffs, rocky outcrops, crevices, on the ground or even on artificial structures.	BAM – C 5 – BioNet This species is likely to hunt and nest in the broader assessment area along Trimbles Creek, Kings Creek, Lake Yarrunga, Bendeela Pondage and Lake Yarrunga. Included as a candidate and predicted species for assessment.	No
<i>Monarcha melanopsis</i> (Black-faced Monarch)	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.	PMST Suitable habitat occurs in wet sclerophyll forest including Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion and Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion. Included in migratory species assessment.	No
<i>Monarcha trivirgatus</i> (Spectacled Monarch)	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges. The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. The Spectacled Monarch feeds on insects, foraging mostly below the canopy in foliage and on tree trunks or vines. The Spectacled Monarch builds a small cup nest of fine bark, plant fibres, moss and spider web in a tree fork or in hanging vines, 1 m - 6 m above the ground, often near water.	PMST All plant community types present would provide potential woodland and forest habitats for this species. Included in migratory species assessment.	No
<i>Myiagra cyanoleuca</i> (Satin Flycatcher)	Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests	PMST Suitable habitat is widespread. This species occupies many tall forest habitats and would often frequent the assessment area and surrounding forest areas. All plant community types present would provide potential woodland and	No

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Species	Distribution and habitat	Habitat present / records in the assessment area	Important habitat present?
		forest habitats for this species. Included in migratory species assessment.	
<i>Rhipidura rufifrons</i> (Rufous Fantail)	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>); usually with a dense shrubby understorey often including ferns.	PMST Suitable habitat for this species is widespread. This species often inhabits wet sclerophyll forests and gullies dominated by Eucalypts which are present throughout the assessment area and surrounding forests. Suitable habitat occurs in intact forests with good cover. Many regrowth vegetation communities in the assessment area also provide good shelter for this species. Included in migratory species assessment.	No







8. Impact avoidance and minimisation

This section of the BDAR demonstrates the efforts taken to avoid and minimise impacts on biodiversity values in accordance with Section 7 of the BAM.

Combined with appropriate mitigation measures and safeguards during construction and operation of the project, the siting and planning of the project is expected to be sufficient to ensure that the requirements to avoid and minimise impacts on biodiversity values as set out in Section 7 of the BAM are met.

A key part of Origin's management of biodiversity for this project is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

- 1) Avoid and minimise impacts as the highest priority
- 2) Mitigate impacts where avoidance is not feasible or practicable in the circumstance
- 3) Offset where residual, significant unavoidable impacts would occur (if required).

8.1 Avoiding and minimising direct and indirect impacts during project planning

8.1.1 Design development

The project infrastructure has been intentionally placed adjacent to the original scheme and access will be along previously cleared tracks, within minimal clearing of regrowth required to upgrade. Additionally previously cleared land (with current regrowth) will be used for spoil stockpile, and a significant portion of the project will be placed underground and involve tunnelling. As such, the project will result in minimal clearing of native vegetation of up to 29.5 ha, of which 25% is regrowth vegetation previously disturbed. This is required to allow the construction of, and ongoing operational maintenance of the asset for the life of the project.

The Development site layout has been frequently adjusted since the preliminary design stages in 2018. Numerous biodiversity constraints assessments as well as avoidance advice has been provided to Origin Energy by Jacobs ecologists. Numerous locations with high biodiversity conservation value have now been excluded from the design. This was informed by field surveys, including the PCT mapping survey. The constraints assessment also identified disturbed sites with young- regrowth vegetation or exotic vegetation, as opportunities to move stockpiles and construction laydown areas to avoid high biodiversity values. Much of the current Development site is situated on areas previously cleared and disturbed for the original construction of the Power stations and pipeline (see **Figure 8-1**). Approximately 22.2 hectares of the native vegetation to be impacted is regrowth status, with approximately 7.3 hectares being likely remnant status.

Importantly, the impacts to Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion CEEC have been significantly reduced at the intersection of Promised Lands fire trail and Nowra/Moss Vale Rd (in the north of the development site). The original design for major clearing and lane-widening at this location (for truck access and laydowns) has been refined to only 0.23 hectares of vegetation impacts (along road edges).

Locations of threatened plants and habitat features of threatened fauna species have also been avoided where possible. The current Development site has been refined to fit within the original clearing footprints of the existing hydro scheme as much as possible, as evident in **Figure 8-1**. Detailed design stages may be able to further avoid some areas of native vegetation and fauna habitat features. As discussed, this BDAR as well as the MNES Assessments of Significance for threatened entities assume the current worst case scenario Development site.



Photo 8.1 Proposed second pipeline will follow the existing cleared easement.



Photo 8.2 Proposed vertical shaft entry point (on plateau) affects land already disturbed by Promised Lands Trail and the existing pipeline tunnel.



Photo 8.3 Existing council depot on Bendeela road to be used for equipment laydown areas.



Photo 8.4 The existing Promised Lands Track will be used for construction vehicle access. Track may be widened back to its former footprint



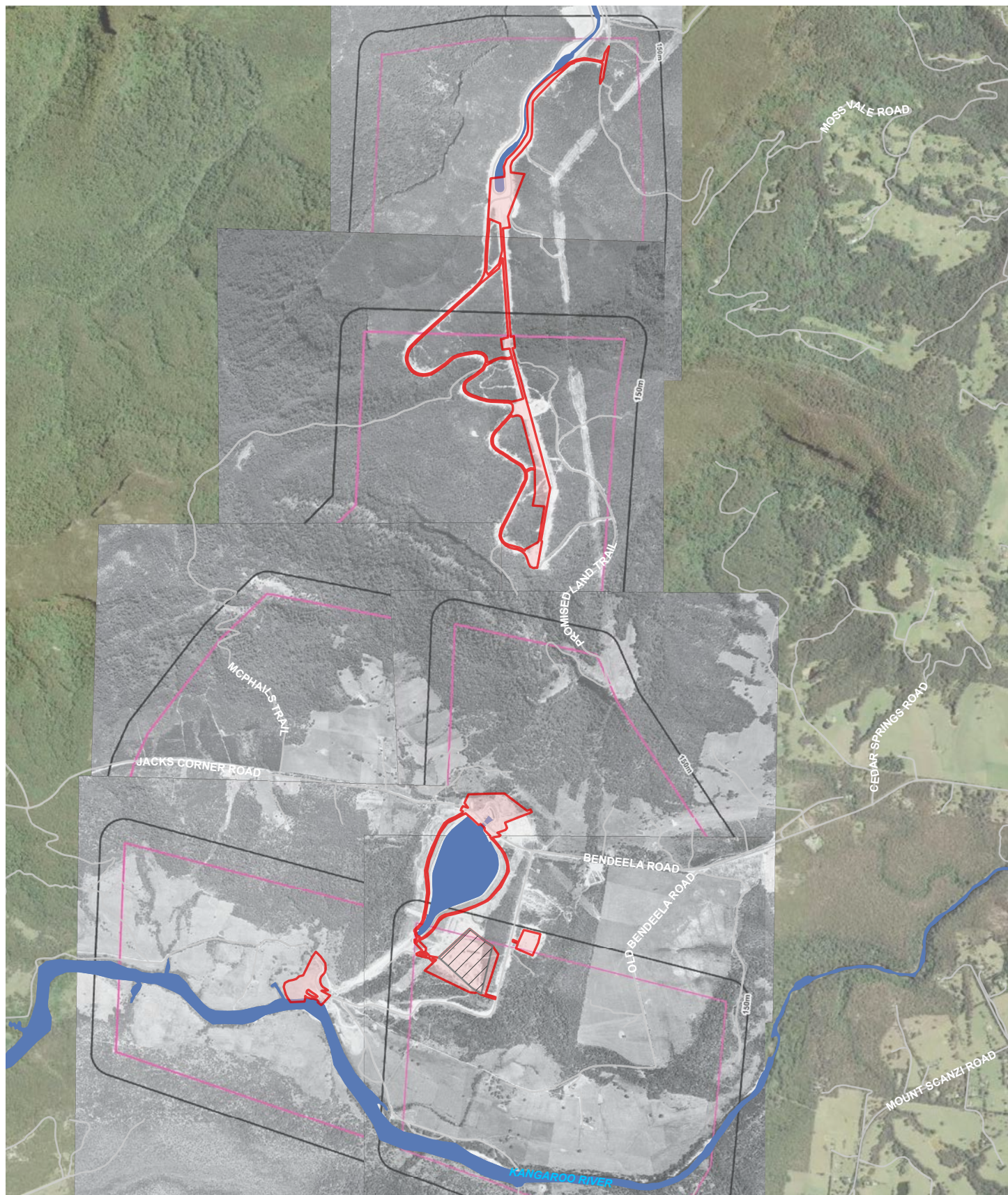
Photo 8.5 Existing cleared areas surrounding Bendeela Power Station to be used for equipment laydown areas.



Photo 8.6 Previously cleared and regrowth PCT areas have been prioritised for the locations of excavation material stockpiles (to east of Bendeela pondage).

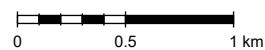


Photo 8.7 Cleared grounds surrounding Kangaroo Valley Power Station to be used for equipment laydown areas



Legend

- Development site
- Spoil site
- Road
- Waterbody



1:35,000 at A4

GDA2020 MGA Zone 56



Data sources

Jacobs 2022
Department of Planning and Environment 2022
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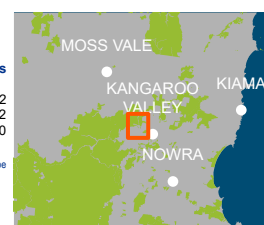


Figure 8-1 Historical site context (1974)

8.1.2 Avoiding and minimising prescribed impacts during project planning

Some types of projects may have impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical.

Chapter 6 of the BAM (2020) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme as per clause 6.1 of the BC Regulation. Such prescribed impacts (including direct and indirect impacts) are impacts:

- a. on the habitat of threatened species or ecological communities associated with:
 - i. karst, caves, crevices, cliffs, and other geological features of significance, or
 - ii. rocks, or
 - iii. human made structures, or
 - iv. non-native vegetation
- b. on areas connecting threatened species habitat, such as movement corridors
- c. that affect water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or upsidence resulting from underground mining)
- d. on threatened and protected animals from turbine strikes from a wind farm
- e. on threatened species or fauna that are part of a TEC from vehicle strikes.

8.1.3 Human made structures

The project would involve modifications to some man-made concrete culverts and buildings as part of the power station expansion. An inspection of the existing structures were conducted during the targeted surveys and did not observe any fauna or threatened species utilising the structures for roosting or shelter.



Photo 8.8 The pre-constructed intake for the proposed new pipeline (below Fitzroy canal). This structure has no roosting bats and no grip-points for roosting bats.



Photo 8.9 A concrete culvert diverts Trimble Creek beneath the existing pipeline corridor. This culvert was checked for roosting bats however the smooth-round ceiling provides little roosting opportunity.

8.1.4 Habitat connectivity and fauna movement

The vegetation on the plateau is largely contiguous as much of this is preserved within Morton National Park. The plan to position and design the surface penstock adjoining the existing scheme penstock in the plateau portion of the project is an important consideration for avoiding and minimising impacts to habitat connectivity and fauna movement. In the upper scheme, all infrastructure, including pipes and surge tank, construction areas and access will be placed adjacent to existing infrastructure within cleared sections of forest. Similarly, the track upgrade required for access will occur on an existing track and will not widen the track significantly, such that the project will not create any new barriers to fauna movement and impacts to current movement opportunities would be considered low. In the valley portions of the project habitat connectivity has been historically reduced and fragmented by clearing for agriculture and infrastructure, including existing powerline easements. The project has been placed in previously disturbed areas or

adjacent to existing infrastructure and therefore will not result in significant breaking up of a continuous vegetated landscape or creating new barriers to fauna movement.

8.1.5 Water bodies, water quality and hydrological processes

Permanent water sources are limited to man-made dams (Fitzroy canal and Bendeela pondage), Trimbles Creek (passes beneath surface penstock on plateau) and Kangaroo River (adjacent to the southern edge of the site). Kings Creek flows into Kangaroo River from the escarpment and is approximately 50 m west of development site. There will be no construction or direct impact within these waterways, however, a section of Trimbles Creek will be disturbed for the construction of the second penstock. Sediment and erosion controls will be used to avoid impacts on water quality in Trimbles Creek. Numerous small, ephemeral drainage lines exist, which would receive flow during high rainfall events. Sediment and erosion controls are all proposed for any ephemeral drainage lines crossed by the project, and indirect impacts to the natural creeks in the assessment area is not expected and can be managed appropriately.

The natural streams of Trimbles Creek and Kings Creek provide potential habitat for threatened species; Littlejohn's Tree Frog (*Litoria littlejohni*) and Giant Burrowing Frog (*Heleioporus australiacus*) which were assumed present (due to survey gaps). The aquatic environs of Kings Creek are outside development site, however the ephemeral headwaters are within the proposed location of the headrace tunnel and impacts to this drainage depression will need to be mitigated during excavation and construction to avoid downstream impacts to Kings Creek. Trimbles Creek has already been altered from its natural state by its diversion through a concrete culvert beneath the existing plateau penstock. Further modifications to the creek line are required for construction of the new pipeline and mitigation measures will be required to protect in-stream habitats and downstream environments from erosion and sedimentation during construction.

The constructed Fitzroy canal and Bendeela pondage provide poor and minimal habitat value for frogs due to their steep man-made banks (sandstone walls or rock scree) as well as their highly fluctuating water levels, temperatures and flow and lack of any emergent aquatic vegetation or shallow breeding areas. Indeed inspection of these dams revealed no tadpoles or frogs calling (apart from Common Eastern Froglet (*Crinia signifera*) on one occasion). The dams also lack emergent aquatic vegetation and do not provide habitat for the threatened frog species assessed in this BDAR. As discussed in 6.5.3, the Fitzroy Falls Spiny Crayfish (*Euastacus dharawalus*) has not been recorded in the artificial dams of development site. Indirect impacts to the water quality of the man-made dams is not anticipated.



Photo 8.10 Fitzroy canal contains steep rock walls and no emergent vegetation. Water levels are deep and highly fluctuating



Photo 8.11 Kangaroo River is adjacent to the Bendeela portion of the assessment area. The river bank here is almost vertical and approximately 10m above the water edge. The bank contains some native trees with dense weeds and no rock or emergent vegetation habitat features.



Photo 8.12 Trimble Creek crosses the plateau pipeline corridor. This creek is ephemeral with small pools and minor rock riffles. The creek flows downstream of the assessment area, where permanent pools exist.

8.1.6 Turbine strike

The impacts of wind turbines are not applicable to this Project.

8.1.7 Wildlife vehicle strike

The development site follows existing roads, fire trails and tracks which are routinely accessed by workers. Increased vehicle movements during construction of the project have the potential to result in fauna mortality from vehicle strikes. This includes access tracks in Morton National Park and haulage routes on public roads. Common species such as Wombats are known to be frequently killed by vehicles in the Kangaroo Valley area, including around the existing power station and as such there is an increased risk for this species. The potential impact of vehicle strike on wildlife would be construction risk and is unlikely to increase or remain during operation. This impact can be avoided and managed and will be addressed in the construction environmental management plan (CEMP), and include examples such as maintaining speed limits, restricting haulage trucks to daytime activities, on-site education, identifying and reporting.

9. Impact assessment

9.1 Direct impacts

9.1.1 Residual direct impacts

After all steps have been taken to avoid and minimise impacts as detailed in **Section 8**, residual impacts are likely for the subject land as a result of the project, these impacts are summarised in **Table 9-1**. The direct loss of vegetation equates to 29.5 hectares which includes habitat for ecosystem credit species.

Table 9-1 Summary of residual direct impacts

Direct impact	BC act status	EPBC Act status	SAIL entity	Project phase / timing of impact	Extent (ha, number of individuals)
Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT1254)	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Southern Highland Shale Forest and Woodland in the Sydney Basin Bioregion	Yes	Construction	0.23 ha
Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion (PCT1156)	-	-	No	Construction	5.55 ha
Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT1082)	-	-	No	Construction	6.55 ha
Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion (PCT1283)	-	-	No	Construction	2.65 ha
Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (PCT1245)	-	-	No	Construction	1.41 ha
Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion 9PCT1083)	-	-	No	Construction	9.39 ha
River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion (PCT1108)	-	-	No	Construction	3.68 ha
Total vegetation impact					29.47 ha
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	Critically Endangered	Critically Endangered	Yes	Construction	2 individuals
<i>Genoplesium baueri</i> (Baueri Midge Orchid)	Endangered	Endangered	Yes	Construction	Assumed present over 9.39 ha
<i>Hibbertia puberula</i>	Endangered	Not listed	No	Construction	0.5 ha
Greater Glider (<i>Petauroides volans</i>)	Not listed	Vulnerable	No	Construction	12.33 ha

Direct impact	BC act status	EPBC Act status	SAIL entity	Project phase / timing of impact	Extent (ha, number of individuals)
Eastern Pygmy Possum (<i>Cercartetus nanus</i>)	Vulnerable	Not listed	No	Construction	25.79 ha
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	Vulnerable	Vulnerable	Yes	Construction	0.87 ha
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	Vulnerable	Vulnerable	No	Construction	25.79 ha
Littlejohn's Tree Frog (<i>Litoria littlejohni</i>)	Vulnerable	Vulnerable	No	Construction	12.10 ha
Southern Myotis (<i>Myotis macropus</i>)	Vulnerable	Not listed	No	Construction	9.69 ha
Gang-Gang Cockatoo (breeding)	Vulnerable	Endangered	No	Construction	1.01 ha

9.1.2 Loss of native vegetation

The project will result in the direct removal of 29.5 ha of native vegetation. The breakdown of impacts relating to each PCT and vegetation zone is displayed in **Table 9-2**. The impact is considered a complete loss of vegetation integrity associated with each zones, and there are no provisions for retaining partial impacts. Therefore the future VI score (after development) for all vegetation zones within development site have been set to zero in the BAM-C assuming full use of development site. Future revegetation of laydown and stockpile areas may allow for improved VI scores however these areas cannot be quantified at the time of writing.

Table 9-2 Summary of direct impacts to native vegetation integrity from the project

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	Before development			VI Score (= loss)
				Composition	Structure	Function	
Moss Vale subregion							
MV-1	1254	0.23	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	94.8	67.2	53.1	69.7
MV-2	1156	1.31	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	71.8	66.8	66.3	68.3
MV-3		2.20		81.1	34.6	62.8	56.1
MV-4		1.06		51.5	47	26.4	40
MV-5	1082	2.26	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	80.7	57.2	60.1	65.2
MV-6		4.29		63.6	63.5	48.1	57.9
Illawarra subregion							
ILL-1	1156	0.57	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	71.8	66.8	66.3	68.3
ILL-2		0.32		81.1	34.6	62.8	56.1
ILL-3		0.09		51.5	47	26.4	40
ILL-4	1082	0.004	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	63.6	63.5	48.1	57.9
ILL-5	1283	0.34	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	63	54.2	28	45.7
ILL-6		0.08		47.5	30.4	44.2	40
ILL-7		0.03		71.9	69.4	44.3	60.5
ILL-8	1245	1.41	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	36.9	56.2	47.8	46.3
Ettrema subregion							
ETT-1	1283	2.19	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	63	54.2	28	45.7
ETT-2		0.02		47.5	30.4	44.2	40
ETT-3	1083	2.98		86.8	66	74.2	75.2

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	Before development			VI Score (= loss)
				Composition	Structure	Function	
ETT-4	1108	3.59	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion	31.4	69.4	46.7	46.7
ETT-5		2.82		40.2	42	33	38.2
ETT-6		1.14	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion	79.5	68.3	75.5	74.3
ETT-7		2.54		18.9	57.8	10	22.2

9.2 Indirect impacts

Section 1.2 of the BAM Stage 2 Manual (DPIE 2019b) defines indirect impacts as “development related activities not associated with clearing for the development footprint”. Section 8.2 of the BAM lists potential indirect impacts that may result from construction and/or operation of a new development. The potential indirect impacts that are applicable to this project are discussed below. Note, there are listed Threatened Ecological Communities in the development site, as well as PCTs and habitat for threatened species. Though indirect impacts cannot be quantified, the potential for indirect impacts can be minimised through the application of stringent mitigation measures and monitoring the performance of these. Such measures would be documented in the CEMP.

The types of potential indirect impacts on native vegetation and threatened species (and their habitat) beyond the direct clearing area is summarised in **Table 9-3** and described in more detail in the following sections. The discussion includes an assessment of the extent, duration and consequence of the impact. The summary table below provides reference to the report section where each impact is assessed with the intent of providing a reference to follow the impact to the mitigation section of the BDAR (Chapter 10).

Table 9-3 Summary of potential indirect impacts on native vegetation and habitat for threatened species

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase	Likelihood and consequences
Clearing for construction and access tracks: edge effect, displacement of fauna for life-cycle activities (foraging, shelter, movement, breeding (Section 9.2.1)	Native vegetation associated with mapped PCTs and habitat for threatened species adjoining the site including hollow-bearing habitat trees	The extent of the indirect disturbance buffer adjacent to the project will be minimal as development site largely sits adjacent the existing scheme and will reinstate an existing access.	During clearing only	Long-term	Construction	Negative changes to the structure and function of the adjoining vegetation
Removal and disturbance to rock, including bush rock (Section 9.2.2)	Fauna relying on rocks for sheltering and breeding life-cycle events	Localized and immediately within development site or adjacent to development site	During clearing only	Short-term risk during construction	Construction	Lead to fauna mortality and disrupt breeding
Transport of weeds and pathogens (Section 9.2.3)	Native vegetation associated with mapped PCTs and habitat for threatened species adjoining the site including habitat conserved in a National Park	The extent of the indirect disturbance buffer adjacent to the project will be minimal as the project largely sits adjacent the existing scheme, and will reinstate an existing access	During clearing and post-clearing	Short-term during construction	Construction	Negative changes to the structure and function of the adjoining vegetation
Increase in predators or pest animal species (Section 9.2.4)	Resident fauna populations in Morton National Park or surrounding areas of Kangaroo Valley	May extent beyond the construction areas into adjacent habitats	During clearing only	Short-term risk while construction is occurring	Construction	Increased predation on resident fauna by native and introduced predators
Noise and vibration (Section 9.2.5)	Threatened fauna	Increase in noise and vibration would be localised and near construction areas particularly tunnelling and where heavy machinery is used	During construction only	Increase to noise and vibration likely short-term during construction. (Power station is already operating).	Construction	Disturbance to breeding activity
Dust pollution (Section 9.2.6)	Native vegetation and threatened species	Localised near the construction area	During construction	Short-term during construction	Construction	Negative changes to the structure and function of the adjoining vegetation

9.2.1 Inadvertent impacts on adjacent vegetation and threatened species habitat

Nature, extent and duration of impact

Edge effects refer to the changed abiotic conditions when new edges are created through previously intact vegetation. These indirect impacts can occur in vegetation and habitat retained adjacent to clearing required for development. Edge effects can result in negative changes to the structure and function of retained vegetation from changed abiotic factors such as increased light intensity and duration, increased exposure to wind and weed invasion in edge habitats.

The development has been designed to follow the existing penstock / pipeline, as well as existing tracks and power station infrastructure, and this has greatly reduced the need to clear and open up new areas of vegetation and creating new edges through intact areas. In general, vegetation clearing will occur along edges of existing cleared areas (through widening such areas). Widening of clearings and canopy gaps can push edge effects further into surrounding vegetation areas, however much of this vegetation has already been exposed to similar effects during previous construction phases. Some vegetation areas will be subject to new clearing, such as the proposed laydown areas in the lower scheme area and the underground access area adjacent the existing power station. Importantly, stockpile areas will be located in previously disturbed or cleared areas containing regrowth vegetation (with historically altered abiotic conditions) and in these locations new edges will not be created. Clearing works along the pipeline would only be undertaken to facilitate placement of machinery and construction laydown areas, and would not result in total removal of vegetation. Following construction these areas can be rehabilitated and returned to native vegetation. Access roads are utilising existing tracks to be upgraded, and vegetation is already edge affected. Therefore, the conditions following the clearing of native vegetation for the development are unlikely to dramatically change the abiotic conditions such that retained vegetation adjacent to the development will be substantially modified. Indirect impacts to retained adjacent vegetation and habitat is considered to be minimal and can be minimised and avoided through the implementation of the mitigation measures detailed in **Section 10**.

Mitigation strategies

Pre clearing survey and fauna relocation will occur to avoid and minimise impacts to resident fauna, particularly hollow-dependent mammals and birds. This will be done prior to and during the vegetation clearing activity.

9.2.2 Removal and disturbance of rocks, including bush rock

Nature, extent and duration of impact

Rocky habitats and bush rock is common on the plateau portion of the project and these features provide microhabitat for a range of fauna that includes foraging areas, shelter and breeding opportunities. While the majority of the project will occur in area adjacent to existing cleared areas, and will not directly or indirectly impact on cliff lines, and exposed rock platforms, there is likely to be disturbance of surface rocks in construction areas. This will involve tramping of rocks by machinery and physical disturbance to surface rock. The impact would be on smaller rock sheltering fauna such as reptiles and frogs and would temporary, and only during construction. The Broad-headed Snake was not identified in the assessment area, and is considered unlikely to occur on the basis on unsuitable habitat.

Mitigation strategies

Prior to any clearing, the limits of the disturbance will be identified and physically marked on site to prevent accidental incursion into adjoining areas of undisturbed habitat. The pre-clearing survey and fauna relocation activities during clearing will focus on search of surface rocks that may be disturbed during construction. Surface rocks will be salvaged where possible and placed in areas near the construction or used in post-construction rehabilitation.

9.2.3 Transport of weeds and pathogens

Nature, extent and duration

The activities associated with clearing vegetation and increased human presence including ongoing movements of large machinery during construction have potential to introduce weeds and plant and animal diseases into adjacent vegetation outside the project. Plant and animal disease pathogens can be carried on machinery to construction sites and indirectly impact on native vegetation and habitat for threatened species, this includes the following listed key threatened processes.

- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Introduction and establishment of Exotic Rust Fungi (Myrtle Rust) on plants of the family Myrtaceae
- Infection of native plants by *Phytophthora cinnamomi*.

The potential spread of weeds and pathogens is of particular risk for this project due to:

- The fact that the project borders Morton National Park which is considered a significant area for biodiversity and threatened species
- the presence of the TEC Southern Highlands Shale Forest and Woodland (MNES) adjacent to the access track into the plateau which is an entity at risk of SAIL
- the presence of *Rhodamnia rubescens* (Scrub Turpentine) which is known to be susceptible to Myrtle Rust
- and the presence of potential habitat for threatened frog species which are susceptible to chytrid fungus.

While the site surveys identified a relatively small list of weed species, several 'high threat weeds' were identified, which are known to disperse easily. These species and their dispersal mechanisms are described in **Table 9-4** below to assist in developing strategies for prevention of their spread when developing the project CEMP

Table 9-4 High threat weed species identified from targeted flora survey

Species	Dispersal
<i>Lantana camara</i>	Lantana often invades disturbed areas where vegetation has been cleared. A single plant can produce up to 12,000 fruits (and seeds) in a year. Seeds are spread by water, in soil, and on machinery.
<i>Ligustrum sinense</i>	Mature plants produce up to ten million seeds each growing season. Seeds need to be just below the soil surface or litter layer (to 1 cm) before they grow. It can grow new shoots from root and stem suckers. This creates dense stands of privet. Seeds can spread by flowing water and machinery
<i>Bidens pilosa</i>	The seed is spread by wind, water and can attach to clothing or animal fur.
<i>Araujia sericifera</i>	Spread by seeds. Each fruit can contain up to 400 seeds and the seeds can remain viable for up to 5 years. The fruit split open while still attached to the vine and release the light seeds with silky tufts of hairs. The seed is spread by wind, water and can attach to clothing or animal fur.
<i>Ageratina adenophora</i>	Mature Crofton weed plants can produce between 10 000 and 100 000 seeds per year. Seeds are very light (25 000 seeds/g) and are windborne over long distances to invade previously non-infested areas. The seeds require light to stimulate germination so that invasion commonly takes place on bare, disturbed sites and only rarely on heavily vegetated areas.
<i>Ageratina riparia</i>	Spread by seed. A single plant can produce 10,000 to 100,000 seeds each year. Seeds germinate from late spring to summer. Most of the seeds are dispersed by wind and water. Seeds can also be spread in agricultural produce, sand and gravel and in mud stuck to vehicles, machinery, shoes and clothing.

Mitigation strategies

The list of high threat weeds reported from the development site in **Table 9-4** includes information on the dispersal mechanisms of the plant. This information is provided to assist in developing appropriate weed control advice in the preparation of the CEMP. It is proposed to control the spread of all weed species during construction and conduct ongoing monitoring of weed invasion in adjoining habitat and Morton National Park during construction as a part of an adaptive management plan.

Strict hygiene measures are proposed during construction to prevent the spread of disease pathogens into areas of high biodiversity value, including Morton National Park

9.2.4 Increase in predators or pest animal species

Nature, extent and duration

Predator species and pest animal species can potentially be attracted to the assessment areas during construction and associated with increased human presence and activity. The potential risk in increased where there is accumulation of domestic rubbish and waste around construction compounds and the project corridor itself. This is particularly important given the project is adjacent to Morton National Park.

Mitigation strategies

Appropriate disposal and handling of domestic waste will be managed on site during all periods of construction, with details to be included in the CEMP.

9.2.5 Light, noise and vibration

Nature, extent and duration

Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from passing vehicles), that can have potentially adverse effects on wildlife (Longcore and Rich, 2004).

There are no planned night works that will be associated with the construction of the project. The construction hours will be conducted between 6am to 6pm. During winter, lighting may potentially be required in the early mornings and late afternoons.

During operation, portions of the project around tunnel entry will require security lighting at all hours of the night. The external low-level lighting will be installed in a manner that aims to minimise light spill to areas beyond the power station boundary fence, however there is likely to be some small amount of light pollution projected into the surrounding vegetation. The ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle, such as the Greater Glider and Eastern Pygmy Possum. However, the amount of light spill is expected to be very low and the area around the power station is already exposed to some level of disturbance. It is likely that any nocturnal animals present will habituate over the long-term. Some species such as light tolerant microchiropteran bats may benefit from the lighting due to increased food availability (e.g. insects attracted to lights) around these areas.

Assuming that lighting is designed and installed to limit light spill, the impact of the residual light spill is unlikely to significantly affect any nocturnal species in the area.

There is potential for noise and vibration of the ground during construction which may impact areas adjacent to the proposed tunnelling activities and the vertical shaft at the southern end of the penstock. The timing of these activities may occur during day or night time construction and thus potentially impact on resident fauna, including nocturnal species that occur on habitat adjacent to the project. the duration will be during construction only and the extent of the impact beyond the construction area is unknown, but may occur between 50-100 metres.

A large number of hollow-bearing trees have been mapped in buffer areas surrounding the project and these provide opportunities for sheltering and breeding for hollow-dependent fauna, including threatened species such as Gang-gang Cockatoo, Glossy Black-cockatoo and Greater Glider. Noise and vibration have potential to push fauna further away from the project or disrupt breeding activities through interruption of mate calling, or excessive activity near an important habitat tree.

Mitigation strategies

It is proposed to limit construction and noise activities to specific times, and particularly limit surface works to daytime activities only.

9.2.6 Dust impacts

Nature, extent and duration

Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to the construction area. This has the potential to reduce photosynthesis and transpiration and cause abrasion and radioactive heating

resulting in reduced growth rates and decreases in overall health of the vegetation. Consequently, changes in the structure and composition of plant communities and consequently habitat use by fauna may occur.

Some level of dust is likely to be generated throughout the lifecycle of the project associated with the clearing of vegetation and increased movements of trucks and vehicles along existing access roads. Any resulting dust pollution is likely to be greatest during construction, during periods of earthworks, vegetation clearing, vehicle movements for construction activities and during adverse weather conditions (i.e. high wind). However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary, and is therefore not considered likely to be a major impact of the project.

Mitigation strategies

Adaptive dust management and monitoring programs using industry best practices and standards to control air quality will be implemented. No dust generating works will be conducted during high winds and stockpiles will be kept covered with material to prevent the generation of dust in addition to applying water dust suppression techniques during dust generating activities along access tracks.

9.3 Prescribed impacts

This section identifies the potential prescribed biodiversity impacts on threatened species associated with the project in accordance with Chapter 6 of the BAM. These are impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat.

9.3.1 Karst, caves, crevices, cliffs, rocks or other geological features of significance

Nature, extent duration, consequences

There are no occurrences of karst, caves, crevices and cliffs or other geological features of significance within the footprint of development site. The development site follows an existing engineered cutting in the plateau areas (containing the existing pipeline). This cutting was investigated thoroughly and does not contain suitable crevices or caves (it is a shaped wall of sandstone). The development site avoids the adjacent steep sandstone exposures and escarpments (above ground). It is noted that cliff lines occur within around 200 m of the project at the southern end of the pipeline, however these areas will not be directly impacted. As such, this prescribed impact has not been considered further.

9.3.2 Human-made structures and non-native vegetation

Nature, extent duration, consequences

There are no human-made structures of concern in terms of providing known or potential habitat for threatened species. Existing structures associated with the Fitzroy Canal and Bendeela pondage were inspected and considered of low habitat value and unlikely to provide habitat for threatened species. Similarly, infrastructure for the existing scheme is currently in use and does not provide known or potential habitat for threatened species.

There are no areas of non-native vegetation associated with this project that would potentially provide habitat for threatened species. All project infrastructure and construction areas occur in either existing cleared areas, regrowth, or remnant vegetation.

9.3.3 Habitat connectivity

Nature, extent duration, consequences

The vegetation on the plateau is largely contiguous as much of this is preserved within Morton National Park. The plan to position and design the surface penstock adjoining the existing scheme penstock in the plateau portion of the project is an important consideration, as the project will not create a new barrier for fauna movement or result in significant breaking up of a continuous vegetated landscape or creating new barriers to fauna movement. In the upper scheme, all infrastructure, including pipes and surge tank, construction

areas and access will be placed adjacent to existing infrastructure within cleared sections of forest. Similarly, the track upgrade required for access will occur on an existing track and will not widen the track significantly, such that the project will not create any new barriers to fauna movement and impacts to current movement opportunities would be considered low. In the valley portions of the project habitat connectivity has been historically reduced and fragmented by clearing for agriculture and infrastructure, including existing powerline easements. The project has been placed in previously disturbed areas or adjacent to existing infrastructure and therefore will not result in significant breaking up of a continuous vegetated landscape or creating new barriers to fauna movement.

9.3.4 Water bodies, water quality and hydrological processes

Nature, extent and duration of impact

Due to the nature of the project being associated with construction activities near Kangaroo River as well as numerous ephemeral creek lines, there is potential for mobilised sediments to enter the waterways, particularly during and after vegetation clearing and in the event of heavy rainfall occurring during construction. This indirect impact has potential to cause negative short-term impacts to aquatic habitat in these waterways, that is potentially used by fish, amphibians, birds and mammals (including threatened species). The extent of the impact is unknown but may occur over large distances downstream depending on the scale of the impact.

In addition to potential displacement of sediment, there is a risk of localised release of contaminants (i.e. hydraulic fluids, oils, drilling fluids, etc.) into the receiving waterways, in the event of an accidental spill or incident. The most likely result of contaminant discharge will be the localised contamination of soil, the waterway, and potential direct physical trauma to aquatic fauna that come into contact with contaminants. Accidental release of contaminants is considered low risk, and if it did occur would be limited to the construction phase and would likely to be localised and able to be contained. Over the long-term operational phase of the project, the recovery of ground layer vegetation at the site would be expected to prevent further movement of sediment and as construction ends there is low risk of further spill of contaminants.

Mitigation strategies

Control measures will be implemented and maintained during the duration of construction to ensure that accidental spills are immediately reported and remediated, any contaminated water (if generated) will be separated from stormwater and will be managed in a process water system and on-site signage will be provided to identify contaminated topsoils of relevance. A range of mitigation measures will occur to prevent sediment entering waterways, and these would be documented in the CEMP.

9.3.5 Vehicle strikes

Construction of the project will involve regular vehicle movements on existing roads, fire trails and tracks for routine access by workers, transportation of spoil from excavation tunnels and site works to stockpile sites, and transportation to and from laydown areas. Increased vehicle movements during construction of the project have the potential to result in fauna mortality directly from vehicle strikes with construction related vehicles and potentially local traffic adjusting to the new traffic situation.

The risk of fauna injury and mortality during the construction and operation of the project through vehicle strike is considered possible given the roads used traverse large areas of forest, including Morton National Park. Vehicle strikes are common in the area already for species such as the Common Wombat. Vehicle strike is an impact that can reduce local population numbers, although any impacts would be short-term and during construction only. Mammals, reptiles, amphibians, and birds are all at risk of vehicle strike, particularly those common species (birds and wombats) that are tolerant of disturbance and remain in the development site during construction. The risk of an increase in the frequency of vehicle strike due to the development is relatively moderate and would generally be limited to vehicle movements to and from the construction site and using haul routes. Construction activities will only occur during the day, therefore there is no risk of collision at night from construction vehicles.

Vehicle strike associated with the development may have a potential impact to animals that are part of a TEC, including threatened species. The Southern Highlands Shale Forest and Woodland which is located adjacent

to the Promised Lands track entry is known to be habitat for eastern Pygmy Possum, Greater Glider, and a diversity of common fauna species, including Common Wombats.

Fauna injury or death has the greatest potential to occur during the construction phase when excavation and vegetation clearing would take place. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (ground dwelling mammals, amphibians and reptiles), or those that are nocturnal and nest or roost in trees during the day (arboreal mammals and microbat species), may find it difficult to rapidly move away from the clearing activities when disturbed. In addition to this, entrapment of fauna in any excavated trenches or pits may potentially occur if the trenches or pits are deep and steep sided. Fauna may also become trapped in or may choose to shelter in construction vehicles, infrastructure, machinery and equipment and/or during relocation of stored construction materials that is stored in the development site overnight. Fauna that may take shelter inside construction vehicles, infrastructure, machinery, and equipment and/or during relocation of stored construction materials machinery, may result in injury or death if not thoroughly checked prior to construction activities and equipment use.

Table 9-5 Assessment of vehicle strikes on animals associated with a TEC

Threatened fauna or protected fauna that are part of a TEC that are at risk of vehicle strike	SAIL entity	Likelihood	Estimated vehicle strike rates	Consequences
Greater Glider	No	Low. This is an arboreal species that would very rarely come to ground	None	None
Eastern Pygmy Possum	No	Moderate. The species is both arboreal and terrestrial and capable of moving along the ground and cross roads to disperse and access habitat	Rare, potentially only one during entire construction phase, particularly as vehicles not using road at night	None
Common Wombat	No	Moderate. The species is both arboreal and terrestrial and capable of moving along the ground and cross roads to disperse and access habitat	Wombats are already struck by vehicles in the location, including KV. The rate may increase slightly during construction, however in relation to the TEC, given the small area of the TEC adjacent to the project, any vehicle strikes would be limited at this location (potentially one during construction), particularly as vehicles not using road at night	Temporary decrease in population levels
Swamp Wallaby	No	Moderate. The species is both arboreal and terrestrial and capable of moving along the ground and cross roads to disperse and access habitat	Rare associated with the TEC, potentially one during construction, particularly as vehicles not using roads at night	None
Red-necked wallaby	No	Moderate. The species is both arboreal and terrestrial and capable of moving along the ground and cross roads to disperse and access habitat	Rare associated with the TEC, potentially one during construction, particularly as vehicle not using roads at night	None

Avoidance and mitigation strategies

Increased vehicle movements during construction of the project have the potential to result in fauna mortality from vehicle strikes. These potential impacts can be avoided and managed and will be addressed in the CEMP, and include examples such as on-site education, identifying and reporting hazards as they occur during construction, and setting appropriate working hours and vehicle speed limits.

10. Mitigating residual impacts – management measures and implementation

While direct impacts are easily quantified and controlled by managing the extent of clearing within the development site, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during project design, whereas indirect impacts are mitigated through effective environmental management during construction and can also be associated with an adaptive management strategy where impacts are uncertain. The following section outlines measures to minimise, mitigate and monitor the predicted impacts to biodiversity that are described in Chapter 9 of the BDAR.

10.1 Mitigation measures

Proposed mitigation measures are documented in **Table 10.1** which includes details of the proposed action or technique, timing, frequency, and responsibility for implementing each measure. These mitigation measures would be applied to all vegetation zones where applicable.

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Table 10-1 Proposed biodiversity mitigation measures

Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
Removal of native vegetation and habitat including disturbance to bush rock (Section 9.2.1 and 9.2.2)	BIO1	A Biodiversity Management Plan (BMP) will be prepared and implemented. The BMP will be prepared by a qualified ecologist and include a plan for implementing, evaluating and reporting on the effectiveness of all mitigation measures outlined in this BDAR, but not be limited to these measures. The overarching framework of the BMP will be based on SMART principals (Specific, Measurable, Achievable, Realistic, Timebound) and will focus on monitoring the performance of measures and informing any adaptive management required based on performance triggers for remedial action or additional offsets where further impacts are identified. The BMP will detail required mitigation actions for the project for all biodiversity, including indirect, and prescribed impacts.	Avoid, minimise, and mitigate impacts to biodiversity through planning and active management	Pre-clearing, during and post construction	Known and proven effective measure
	BIO2	Mitigation measures for avoiding harm to animals and threatened hollow dependent fauna during pre-clearing survey and any translocation activities. include: <ul style="list-style-type: none"> Pre-clearing surveys to be conducted with a suitably qualified and licenced wildlife handler to rescue and re-locate fauna Protocol for the removal of hollow bearing trees - hollow inspection /lowering limbs to the ground Protocol to mitigate harm to hollow dependent threatened fauna known or with potential to be utilising breeding habitat in the Project area and disturbance footprint, e.g. Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>), Glossy Black-cockatoo (<i>Calyptorhynchus lathami</i>), Eastern Pygmy-possum (<i>Cercartetus nanus</i>), and Greater Glider (<i>Petauroides volans</i>).	Avoid, minimise, and mitigate impacts to biodiversity through planning and active management	Pre-clearing	Known and proven effective measure
	BIO3	Preclearing process: Pre-clearance surveys will be undertaken prior to tree felling works by suitably qualified and experienced persons/personnel and will include: <ul style="list-style-type: none"> Scheduling the clearing works for a time of year to avoid the breeding seasons of identified potential threatened species and other threatened fauna that may breed on site, where practicable. In the event that works cannot be scheduled outside of breeding times, additional controls will be implemented prior to clearing to further manage the risk. This could include, but is not limited to, additional pre-clearance surveillance of potential den tree (stagwatching or cameras) and sectional removal of suspected habitat trees Comparative habitat assessments conducted on clearing sites and proposed release sites to ensure that habitat features are available in the released sites Release sites identified and mapped prior to clearing and all appropriate approvals granted by the landholders The demarcation of areas approved for clearing to reduce risk of accidental clearing Habitat resources and habitat trees will be identified and marked. Other habitat features to be identified include fallen timber/hollow logs, burrows, and boulder piles 	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing	Known and proven effective measure

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Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
		<ul style="list-style-type: none"> The identification of potential presence of threatened flora and fauna species, endangered populations and TECs The identification of threatened species or habitat features that are suitable for translocation or salvage Disturbance activities will be targeted to specific times of the year to minimise impacts to threatened species' usage of habitat features for breeding and roosting, where practicable. 			
	BIO4	<p>Habitat clearing: Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential habitat features.</p> <p>The tree-felling process will include the following:</p> <p>Prior to Felling Habitat Trees:</p> <ul style="list-style-type: none"> Completion of actions recommended from the pre-clearing surveys, including (but not limited to) salvage of identified habitat features, additional surveys to determine threatened fauna usage of the area (if required), identification of active dens or burrows, any actions required to discourage fauna occupation and weed or feral fauna management requirements Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees. <p>On the Day of Felling Habitat Trees:</p> <ul style="list-style-type: none"> Tree clearing should not be conducted above 35°C for the interests of animal welfare Communication with rescue agencies and local veterinarians prior to the commencement of clearing to confirm the availability of resources for any captured/injured fauna that is unable to be released Clearing should be conducted sequentially and directionally towards areas of refuge to prevent the creation of vegetation islands All habitat trees will be subject to a visual inspection to survey for threatened species Trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, 	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing and clearing	Known and proven effective measure

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Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
		<p>soft felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitat</p> <ul style="list-style-type: none"> ▪ Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time ▪ Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment ▪ Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised ▪ All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape ▪ Ensure that trees felled are positioned so that hollows are facing upwards and out to allow fauna to escape overnight <p>Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.</p>			
	BI05	<p>The boundary of the clearing limits for each disturbance zone will be clearly marked on site by a surveyor before vegetation clearing commences:</p> <p>Exclusion zones, or 'No-Go' zones, will be clearly marked at the edge of the clearing zones to protect the vegetation to be retained outside the project from inadvertent direct impacts. These will be in place for pre-clearing, construction and remain in place until post-construction rehabilitation objectives have been met.</p>	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing, construction and early operation	Known and proven effective measure
	BI06	<p>Staged Habitat Removal: The staged habitat removal process will be required for removal of habitat (hollow-bearing trees, habitat trees, and bushrock) Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally. The process includes:</p> <ul style="list-style-type: none"> ▪ Avoiding clearing during times when hollow-dependent fauna is breeding ▪ Contact vets and wildlife carers before works commence ▪ Ensure that licensed wildlife carers and/or ecologists are on site during habitat removal ▪ Adopt two staged removal clearing non-habitat first (e.g. shrubs, regrowth, ground cover and non-habitat trees). Allow at least 24 hours for fauna to vacate habitat before removing habitat trees ▪ Ensure wildlife carers and/or ecologists are present during removal of habitat trees, and that habitat trees are felled carefully, using equipment that allows habitat trees to be lowered to the ground with minimal impact ▪ A procedure for the ethical handling of injured or displaced fauna ▪ Record the effort and outcomes of the habitat removal process ▪ Save and reuse cleared habitat material for rehab ▪ Preparation of an 'Unexpected threatened species finds procedure' to be implemented during construction and operation and documented in the BMP. Applies to all activities that have potential to impact upon threatened flora and fauna species which have not already been assessed and approved. Any threatened 	Avoid, minimise impacts to fauna during clearing and construction	Construction	Known and proven effective measure

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Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
		<p>entities found in a location previously unknown during construction or operation must be immediately notified to NPWS</p> <ul style="list-style-type: none"> Preparation of a Fauna handling and rescue procedure to be implemented during construction and operation. 			
Removal of habitat including for the Gang-gang and Glossy Black-cockatoos (Section 9.1)	BIO	<p>Gang-gang and Glossy Black-cockatoos: Specific measures to mitigate the impact to individual breeding pairs of Gang-gang cockatoo (<i>Callocephalon fimbriatum</i>) and Glossy Black-cockatoo (<i>Calyptorhynchus lathami</i>) (adults, chicks and eggs) will be confirmed. The pre-clearing protocol of breeding habitat for cockatoos needs to comprise:</p> <ul style="list-style-type: none"> Hollow-bearing potential nest tree(s) is to be clearly identified on construction planning maps Hollow bearing tree(s) are to be removed outside the breeding season where practicable (breeding season is October to January). A pre-clearing protocol will include inspection of the tree to determine if live cockatoos are present and potentially nesting. <p>If nesting cockatoos are present, additional mitigation is to be implemented and could include clearing of identified potential habitat trees outside the breeding season and installation of nest boxes by a suitably qualified and experienced ecologist.</p> <p>Where nesting is identified as occurring at the proposed time of clearing, the subject trees are to be clearly marked as no-go zones and removal delayed until the chicks have fledged. There is to be no disturbance within 100 m of the tree, and disturbance between 100 -200 m is to be minimised. The removal of the tree must allow time for fauna to vacate the immediate habitat.</p>	Avoid, minimise impacts to habitat for the Gang-gang and Glossy Black-cockatoos	Pre-clearing	Known and proven effective measure
Impacts on water quality and hydrological processes and that sustain threatened species (Section 9.3.4)	BIO8	<p>Erosion and sedimentation will be managed through implementation of effective sediment control management plans to ensure that sediment does not enter the waterways and result in changes to the habitat structure of riparian areas or areas downstream of the assessment area. Effective control measures will include:</p> <ul style="list-style-type: none"> Erosion and sediment control plans for all stages of construction The implementation of sediment control measures across the assessment area - sediment control ponds and sediment basins, coir logs and sediment fencing to control sediment run-off, catch drains and perimeter bunds and diversion drains where required Runoff from spoil piles will be managed through the above listed control measures to ensure that there is no contamination or sediment entering waterways or adjacent areas Accidental spills will be reported to the contractor's environmental representative as soon as the incident is observed so that the site can be remediated rapidly Sediment traps or filters (targeting removal of coarse sediment) will be maintained at all discharge locations and will be monitored and maintained as per the scheduled requirements Disturbed are will be stabilised and rehabilitated to reduce erosion potential (i.e. exposure period of bare earth). This will be particularly important for revegetation of slopes as soon as possible, in accordance with 	Avoid, minimise impacts to aquatic habitat and particularly known habitat for the Booroolong Frog	Pre-construction and construction Operation (for removal of hazard trees upstream or within Booroolong Frog habitat)	Known effectiveness

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Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
		the rehabilitation plan. Landscaping of pervious surfaces using only native indigenous species only. Soil loss will be minimised by immediate stabilisation of exposed surfaces (e.g. use of Jute mesh and/or soil binder)			
Increase in weeds and disease pathogens in adjacent vegetation (Section 9.2.3)	BIO9	Weed management: A Weed monitoring and control program (s) will include the following. <ul style="list-style-type: none"> Identify, map, and remove all weeds before clearing for construction, and record location of weed and sprayed area for use in ongoing weed monitoring and management programs. Prepare a vehicle and machinery hygiene strategy and implement during construction. The strategy will include specific locations, timing and methods for removing soil and plant matter from vehicles and machinery. Ensure vehicle and machinery hygiene measures in the strategy are applied during construction. During the clearing works, weeds will be disposed and managed appropriately to stop the spread of weed species Wash down stations will be constructed at suitable locations to wash down vehicles and employee shoes to stop the spread of weeds, pathogens (including amphibian chytrid fungus, <i>Phytophthora cinnamomi</i> and exotic rust fungi) and the introduction of new species 	Control spread of weed from the project	Pre-construction, and construction	Known effectiveness
Increase in predatory and pest species (Section 9.2.4)	BIO10	Personal waste / refuse generated during construction will be stored appropriately in accessible bins and disposed at appropriate waste disposal facilities off-site. Any personal waste generated during operation will be removed from the site (including power station) and disposed in an appropriate waste facility.	Control attraction of introduced predators and pests to the construction area	During construction	Known effectiveness
	BIO11	A feral animal monitoring program will be developed and implemented as described in Section 11.2 based on performance triggers for adaptive management. Data will be shared with NPWS. Increased predator activity will trigger the need for predator control based on performance measures. Control will be implemented in consultation with NPWS.			
Light and noise and vibration impacts during night works (Section 10.2.7)	BIO12	Directional lighting will be used for any permanent lighting required as part of the permanent infrastructure to minimise light spill as much as possible.	Avoid, minimise, and mitigate impacts to biodiversity	During construction and Operation	Known and proven effective
	BIO13	Artificial lighting required during construction in the early morning and late afternoon in winter or night periods will be minimised consistent with the requirements of Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting.			
	BIO14	Minimise noise from equipment through measures such as: <ul style="list-style-type: none"> Selecting equipment with the lowest noise rating that meets task requirements and minimise operating loud machinery simultaneously in close proximity. For example, operating a jackhammer and concrete saw Keeping both stationary and mobile plant and equipment in good working condition (including mufflers, enclosures etc.) Avoid leaving engines running on standby when machinery is not being used. 			
Dust pollution	BIO15	Dust management and monitoring programs using industry best practices and standards to control air quality will be implemented. <ul style="list-style-type: none"> No dust generating works will be conducted during high winds 	Avoid, minimise, and mitigate	During construction	Known and proven effective measure

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Direct and Indirect Impact (refer Section 9)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Effectiveness of action
(Section 10.2.8)		<ul style="list-style-type: none"> Keep stockpiles covered with material to prevent the generation of dust Apply water dust suppression techniques during dust generating activities. 	impacts from dust pollution		
Contaminant pollution (Section 9.3.4)	BIO16	Provide sediment and erosion controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways, vegetation, and fauna habitat. Control measures will include: <ul style="list-style-type: none"> Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles Source controls, such as mulching, matting and sediment fences will only be used where approved in the CEMP Sediment traps or filters (targeting removal of sediment) will be maintained at all discharge locations and will be regularly monitored and maintained Disturbed areas will be stabilised and rehabilitated as soon as the event has been reported to reduce erosion potential (i.e., exposure period of bare earth) Accidental spills will be immediately reported and remediated Contaminated water will be separated from stormwater and will be managed in a process water system Provide on-site signage to identify contaminated topsoils. 	Avoid, minimise, and mitigate impacts from contaminant pollution	During construction	Known and proven effective measure
Wildlife impacts from vehicle strike (Section 9.3.5)	BIO17	Vehicle movements on internal access tracks will be limited to 20km/h speed limit implemented to reduce the risk of vehicle strike to fauna.	Minimise fauna strike during construction and operation	Construction and Operation	Known and proven effective measure

10.2 Implementation of mitigation measures management

As the upper scheme portion of the project is located adjacent to Morton National Park, and the lower scheme areas occur upslope for the Kangaroo River, the effectiveness of measures designed to prevent negative impacts on vegetation and aquatic habitats will require monitoring of performance and applying adaptive or corrective actions where performance is not met. Examples of monitoring and performance criteria are outlined below, and the BMP and CEMP will provide further details of the proposed timing, frequency and location of monitoring activities for management measures that include performance based monitoring.

Table 10-2 Proposed biodiversity mitigation implementation

Measure/action	Monitoring and evaluation criteria	Performance criteria	Adaptive management threshold	Adaptive management response
Sediment control during construction	Monitoring of sediment controls will follow a Trigger Action Response Plan	Water quality and suspended solids collected from below any discharge points, including sediment basins Monitoring of sediment fence locations Monitoring after rainfall events >50mm	Remediation of sediment breaches and repair of control measures	Sediment load has increased from baseline Sediment controls have failed due to high rainfall event
Weed and pathogen control during construction	Monitoring weed species and abundance adjacent to the project and compare with baseline data collected before construction commences. Report outcomes	Cover of weeds collected from strategic locations and recorded from floristic plots or linear strip transects adjacent to the project	Targeted control of selective weeds and locations	Cover of weeds has increased >10% from baseline cover scores

11. Serious and irreversible impacts

11.1 Assessment for serious and irreversible impacts on biodiversity values

The concept of serious and irreversible impacts (SAIL) is fundamentally about protecting threatened entities that are most at risk of extinction from potential development. The BOS recognises that there are some types of serious and irreversible impacts that the community expects would not occur except where the consent authority considers that this type of impact is outweighed by the social and economic benefits that a development will deliver to the State.

The BC Act permits the Minister for Planning to give consent to or approve State Significant Infrastructure which is likely to have serious or irreversible impacts. The Minister must take those impacts into consideration and determine whether there are any additional and appropriate measures that will minimise those impacts if consent or approval is to be granted. Entities at risk of an SAIL relevant to the Project and as identified by the BAM-C include:

- Southern Highlands Shale Woodland in the Sydney Basin Bioregion (TEC)
- Scrub Turpentine (*Rhodamnia rubescens*)
- Bauer's Midge Orchid (*Genoplesium baueri*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*).

11.2 Additional impact assessment provisions for TECs at risk of an SAIL

11.2.1 Southern Highlands Shale Woodlands in the Sydney Basin Bioregion

Details on the current NSW status of the endangered ecological community are outlined in **Table 11-1** and is taken from the NSW Scientific Committee final determination (OEH 2001). Information relevant to assessing the impact of the project on this TEC is provided in **Table 11-2**.

- **Table 11-1 Current status of the Southern Highlands Shale Woodlands in the Sydney Basin Bioregion (Endangered Ecological Community)**

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Current total geographic extent (ha) of the TEC in NSW	<ul style="list-style-type: none"> • Population reduction of $\geq 80\%$ in 10 years or three generations • Southern Highlands Shale Woodlands is found on clay soils derived from Wianamatta Shale on the Southern Highlands, south of Colo Vale, extending from west of Mittagong, eastwards to the Illawarra Escarpment, south to Bundanoon and south-west to Canyonleigh. Elevation ranges from about 600 m to about 800 m. Rainfall ranges from 1400 mm in the east to 900 mm per annum in the west. 	TBDC NSW Scientific Committee – final determination (OEH 2001)	N/A
Estimated reduction in geographic extent of the TEC since 1970	Southern Highlands Shale Woodlands has been extensively cleared for agriculture and rural development. Remnants are mostly small, isolated pockets. About 2000 ha, or less than 5% of the original extent now remains	Benson & Howell (1994)	N/A

Extent of reduction in ecological function, describing the degree of environmental degradation or disruption to biotic processes (Principle 2) indicated by factors listed in BAM Subsection 9.1.1(2.b.)

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Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of restricted geographic distribution (Principle 3) based on the TEC's geographic range in NSW			
Extent of occurrence (ha)	About 2000 ha, or less than 5% of the original extent now remains	Benson and Howell (1994)	N/A
Area of occupancy (ha)	About 2000 ha, or less than 5% of the original extent now remains	Benson and Howell (1994)	N/A
Number of threat-defined locations	Much of the remaining area of Southern Highlands Shale Woodlands is highly fragmented with much of it occurring on private land. Many remnants are in poor condition, including in some reserves, with aging trees, lack of regeneration and weed invasion. Ongoing threats include clearing for agriculture, hobby farming and replacement with European landscape e.g. pines, grazing that kills saplings and understorey species, ringbarking by stock, firewood cutting and invasion by exotic species.	OEH (2001)	No threat defined locations are identified in the TBDC

Table 11-2 Impact assessment of Southern Highlands Shale Woodlands in the Sydney Basin Bioregion

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Impact on the geographic extent of the TEC (Principles 1 and 3)			
Area of TEC to be impacted by the Project (ha)	0.23 hectares, occurs at the entrance to the project on the plateau on land owned by Water NSW	N/A	N/A
Area of TEC to be impacted by the Project as a % of the current geographic extent in NSW (%)	based on the information that there is 2000 ha remaining, the project will impact on around 0.01% of the current extent of the TEC	N/A	N/A
Direct/indirect impacts likely as a result of the Project to contribute to loss of flora/fauna species characteristic of the TEC (BAM Subsection 9.1.1(4.a.ii.))	the project has been designed to minimise impacts to this TEC during the planning phase. There is an existing access track running adjacent to the community which will be used for access to the site. The intersection associated with this access track will require upgrade to allow turning of construction vehicles and avoid accidents with local traffic. The direct impact will occur on an existing cleared edge by widening. And no impact on undisturbed vegetation will occur. No hollow-bearing trees were mapped within the edge areas to be disturbed	N/A	N/A
Impacts likely to contribute to further environmental degradation or disruption of biotic processes (Principle 2)			
Remaining extent of isolated areas of TEC (ha)	there is around 2000 ha remaining and project will impact on 0.01% of this	TBDC and OEH (2001)	Data deficient

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
	extent. The TEC is not isolated to the edge of the project and extends to the south and east outside of the project		
Average distance between remaining remnants – remnant is retained (m)	the vegetation to be impacted in not isolated and the impact will occur along the edge of an existing track and public road, so will not increase fragmentation of remaining vegetation	Site survey and regional vegetation mapping	Has relied on regional vegetation mapping and aerial photograph interpretation. Survey was restricted to the landscape buffer
Average distance between remaining remnants – remnant is removed (m)	the vegetation to be impacted in not isolated and the impact will occur along the edge of an existing track and public road, so will not increase fragmentation of remaining vegetation	Site survey and regional vegetation mapping	Has relied on regional vegetation mapping and aerial photograph interpretation. Survey was restricted to the landscape buffer
Estimated maximum dispersal distance of species associated with the TEC (km)	unknown. importantly the project will not increase fragmentation of remaining vegetation		
Area to perimeter ratio of remaining remnants (ratio)	aera to perimeter ration will not increase, as the impact is associated with removal of a small area along the edge of an existing track and public road	Site survey and regional vegetation mapping	
Vegetation integrity analysis			
Vegetation Zone MV1 (Composition score)	98.8	N/A	N/A
Vegetation Zone MV1 (Structure score)	67.2	N/A	N/A
Vegetation Zone MV1 (Function score)	53.1	N/A	N/A

11.3 Additional impact assessment provisions for threatened species at risk of an SAIL

11.3.1 Rhodamnia rubescens

Details on the current NSW status of threatened species are outlined in **Table 11-3** and information relevant to assessing the impact of the project on this species is provided in **Table 11-4**.

Table 11-3 Current status of the Scrub Turpentine (*Rhodamnia rubescens*)

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Population reduction of $\geq 80\%$ in 10 years or three generations (estimate)	TBDC	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	No formal estimates of total abundance of <i>Rhodamnia rubescens</i> across the range of the species, or of extinction-risk status prior to 2010, have been located (Australian Network for Plant Conservation, in litt. April 2016). It is reasonably suspected that given the large geographic range size of <i>R. rubescens</i> and its characterisation as a 'common' species (Benson and McDougall 1998; Floyd 2008) that the number of mature individuals may be large (i.e., not $< 10,000$, the IUCN threshold for Vulnerable).	NSW Threatened Species Scientific Committee (2018)	yes, data deficient
Decline in species' population size in 3 years or one generation	Large reductions in population size across the range of <i>R. rubescens</i> since infection with <i>A. psidii</i> have been documented over a short period of time (10% mortality over a period of 3-3.5 years (2011 -2014)) relative to the generation length of the species.	NSW Threatened Species Scientific Committee (2018)	yes, data deficient
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	Population size ranges considerably, the species will likely continue to undergo fluctuations due to infection from Myrtle Rust	NSW Threatened Species Scientific Committee (2018)	data deficient
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	The extent of occurrence (EOO) was estimated to be 147,340 km ² . The EOO is estimated based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017).	NSW Threatened Species Scientific Committee (2018)	N/A
Area of occupancy (ha)	The area of occupancy (AOO) was estimated to be 3,360 km ² . This calculation was based on the species occupying 840 (2 km x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2017).	NSW Threatened Species Scientific Committee (2018)	N/A
Number of threat-defined locations	the species is threatened with mortality caused by infection by <i>Austropuccinia psidii</i> .	NSW Threatened	data deficient

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Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
	This disease is widespread across entire range	Species Scientific Committee (2018)	
Whether the species' population is likely to undergo extreme fluctuations	Population size ranges considerably, the species will likely continue to undergo fluctuations due to infection from Myrtle Rust	NSW Threatened Species Scientific Committee (2018)	N/A

Table 11-4 Impact assessment for *Rhodamnia rubescens* associated with the project

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present in the subpopulation on the subject land	Two plants were recorded within the development site and are likely to be impacted. An additional four plants were recorded in areas of PCT 1245 outside the development site and will not be impacted. The total known subpopulation is 6	Targeted survey conducted across the development assessment area	Surveys were limited to the assessment area and immediately adjoining buffer areas, the extent of the local population is unknown
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	the total population size in NSW is unknown however the area of occupancy is estimated at 3,360km ² . Considering a buffer area of 30 metres around each of the 6 plants, the project will impact <0.02% of the total project	survey and NSW Threatened Species Scientific Committee (2018)	data deficient
Number of individuals (mature and immature) to be impacted by the Project	2 mature plants, both infected with Myrtle Rust	survey	N/A
Individuals (mature and immature) to be impacted by the Project as a percentage of total NSW population (%)	the total population size in NSW is unknown however the area of occupancy is estimated at 3,360km ² . Considering a buffer area of 30 metres around each of the 2 plants, the project will impact <0.01% of the total project	survey and NSW Threatened Species Scientific Committee (2018)	data deficient
Area of habitat to be impacted (ha) (for species measured by area only)	60m ² based on a 30 m radius buffer around each plant	survey	N/A
Area of the species' geographic range to be	The plants found be survey all occur in Illawarra Escarpment Blue Gum wet forest (PCT 1245). Nearby areas of Turpentine - Red Bloodwood - Sydney Peppermint	survey and PCT mapping	N/a

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
impacted by the Project (ha)	shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283) are also suitable habitat for this species (according to the TBDC). The project impact on this potential habitat will be 4.0 ha The species range in NSW is apparently 147,340 km ²	NSW Threatened Species Scientific Committee (2018)	
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The project impact on this potential habitat will be 4.0 ha The species EOO in NSW is estimated at 3,360 km ²	survey	N/A
Individuals impacted	Some individuals of subpopulation and habitat will be impacted	survey	N/A
Viability of a fragmented population	the population at the site will not become fragmented	survey	N/A

11.3.2 Genoplesium baueri

Details on the current NSW status of threatened species are outlined in **Table 11-5** and information relevant to assessing the impact of the project on this species is provided in **Table 11-6**.

Table 11-5 Current status of Genoplesium baueri in NSW

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	No population viability analysis undertaken.	NSW Scientific Committee (2014)	data deficient
Evidence of small population size (Principle 2)			
Current population size in NSW	Total number of mature individuals is thought to be less than 250	NSW Scientific Committee (2014)	N/A
Decline in species' population size in 3 years or one generation	No population viability analysis undertaken.	NSW Scientific Committee (2014)	data deficient

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Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	not known	NSW Scientific Committee (2014)	data deficient
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	The extent of occurrence for <i>G. baueri</i> was estimated to be approximately 11 500 km ²	NSW Threatened Species Scientific Committee (2021)	N/A
Area of occupancy (ha)	The area of occupancy was estimated to be 168 km ²	NSW Threatened Species Scientific Committee (2021)	N/A
Number of threat-defined locations	not known	NSW Threatened Species Scientific Committee (2021)	Data deficient
Whether the species' population is likely to undergo extreme fluctuations	not known	NSW Threatened Species Scientific Committee (2021)	Data deficient

Table 11-6 Impact assessment for *Genoplesium baueri*

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present in the subpopulation on the subject land	the species was not identified from survey and so was assumed present for an area of 9.4 ha of possible habitat, however if present a population would occupy only very small area of this habitat	assumed based on associated PCTs in TBDC	no survey was able to be conducted
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	not known (see above)	assumed based on associated PCTs in TBDC	no survey was able to be conducted
Number of individuals (mature and immature) to be impacted by the Project	the species was not identified from survey and so was assumed present for an area of 9.4 ha of possible habitat, however if present a population would occupy only very small area of this habitat	assumed based on associated PCTs in TBDC	no survey was able to be conducted
Individuals (mature and immature) to be impacted by the	the species was not identified from survey and so was assumed present	assumed based on	no survey was able to be conducted

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Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Project as a percentage of total NSW population (%)	for an area of 9.4 ha of possible habitat, however if present a population would occupy only very small area of this habitat	associated PCTs in TBDC	
Area of habitat to be impacted (ha) (for species measured by area only)	potentially up to 9.4 ha of preferred habitat would be impacted based on associated PCTs	assumed based on associated PCTs in TBDC	no survey was able to be conducted
Area of the species' geographic range to be impacted by the Project (ha)	The brittle midge orchid is endemic to New South Wales. The species generally occurs within coastal areas from Ulladulla on the south coast to Port Stephens on the mid-north coast, although it has been recorded from as far west as Woodford in the Blue Mountains and Penrose State Forest in the southern highlands. The potential impact would be minor percentage of the species geographic range	NSW Threatened Species Scientific Committee (2021)	N/A
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The area of occupancy was estimated to be 168 km ² the species was not identified from survey and so was assumed present for an area of 9.4 ha of possible habitat, however if present a population would occupy only very small area of this habitat	NSW Threatened Species Scientific Committee (2021)	Data deficient
Individuals impacted	No individuals will be directly impacted, some habitat will be impacted	NSW Threatened Species Scientific Committee (2021)	Data deficient
Viability of a fragmented population	not expected	NSW Threatened Species Scientific Committee (2021)	Data deficient

11.3.3 Large-eared Pied Bat

Details on the current NSW status of the threatened species are outlined in **Table 11-7** and information relevant to assessing the impact of the project on this species is provided in **Table 11-8**.

Table 11-7 Current status of the Large-eared Pied Bat in NSW

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	no population viability analysis available	N/A	Data deficient
Evidence of small population size (Principle 2)			
Current population size in NSW	The species' total population size is estimated to be less than 20 000 individuals	DAWE (2021)	N/A
Decline in species' population size in 3 years or one generation	no population viability analysis available	N/A	Data deficient
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	There are some accounts of subpopulation size for a number of individual locations, with the largest known maternity colonies containing 20-40 females	DAWE (2021)	data deficient
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	EOO is estimated to be 280 000 km	DAWE (2021)	N/A
Area of occupancy (ha)	The species' AOO is estimated to be 1500 km ²	DAWE (2021)	N/A
Number of threat-defined locations	not known		N/a
Whether the species' population is likely to undergo extreme fluctuations	not known		N/a

Table 11-8 Impact assessment for Large-eared Pied Bat associated with the project

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present in the subpopulation on the subject land	Impacts were calculated based on the loss of native vegetation within a 100 m distance from the mapped cliff lines. The cliff habitat is outside of the direct impact area; however a small area does intersect within the 100 m buffer. The cliff lines were not	survey and GIS	N/A

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Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g. TBDC indicates data is unknown or deficient)
	searched, however are assumed to containing potential breeding habitat (shallow caves, overhangs and crevasses). The impact on potential habitat = 0.8 ha		
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	population size is not known. Calls of only one bat were recorded, and areas of potential breeding habitat is small = 0.8 ha	survey and GIS	N/A
Number of individuals (mature and immature) to be impacted by the Project	population size is not known. Calls of only one bat were recorded, and areas of potential breeding habitat is small = 0.8 ha	survey and GIS	N/A
Individuals (mature and immature) to be impacted by the Project as a percentage of total NSW population (%)	potentially < 0.05%	DAWE (2021)	N/A
Area of habitat to be impacted (ha) (for species measured by area only)	area of potential breeding habitat is = 0.8 ha	survey and GIS	N/A
Area of the species' geographic range to be impacted by the Project (ha)	geographic range is estimated at over 280 000 km. the project will only impact a total of 29.5 ha that could potentially be used by the species	DAWE (2021)	N/A
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The species' AOO is estimated to be 1500 km. the project will only impact a total of 29.5 ha that could potentially be used by the species (<0.001%)	DAWE (2021)	N/A
Individuals impacted	No individuals will be directly impacted, some habitat will be impacted	DAWE (2021)	N/A
Viability of a fragmented population	not expected	DAWE (2021)	N/A

12. Impact summary

This chapter of the BDAR identifies the impact thresholds that the assessor must apply, including impacts:

- For which the assessor is required to determine an offset requirement
- That do not require further assessment by the assessor.

12.1 Impacts that are required to be offset

The determination of impacts on the development site which require an offset was undertaken in accordance with Section 10.1 of the BAM. Impacts were then provided separately for each of the three BAM C case development per subregion.

12.1.1 Impacts on native vegetation and TECs (ecosystem credits)

An offset is required for the impacts to all of the native vegetation in the development site as outlined in **Table 12-1**. The vegetation integrity for all vegetation in the assessment area was above the VI threshold and thus all vegetation impacts are required to be offset. Complete removal of the vegetation within the development site is assumed, and as such the future VI score is assessed as zero. The location of the vegetation zones that will be impacted and hence an offset is required are shown in **Figure 12-1**, which also includes areas not requiring offset, and areas not requiring assessment (i.e. cleared tracks, and cleared land),

Table 12-1 impacts that require an offset – ecosystem credits

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	TEC	VI Score (= loss)	Biodiversity risk weighting	No. of ecosystem credits required
MV-1	1254	0.23	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Yes	69.7	2	8
MV-2	1156	1.31	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	No	68.3	1.5	34
MV-3		2.20			56.1	1.5	46
MV-4		1.06			40	1.5	16
MV-5	1082	2.26	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	No	65.2	1.5	55
MV-6		4.29			57.9	1.5	93
ILL-1	1156	0.57	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion	No	68.3	1.5	15
ILL-2		0.32			56.1	1.5	7
ILL-3		0.09			40	1.5	1
ILL-4	1082	0.004	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion	No	57.9	1.5	1
ILL-5	1283	0.34	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	No	45.7	1.5	6
ILL-6		0.08			40	1.5	1
ILL-7		0.03			60.5	1.5	1
ILL-8	1245	1.41	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion		46.3	1.5	24
ETT-1	1283	2.19	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion	No	45.7	1.5	38
ETT-2		0.02			40	1.5	1
ETT-3	1083	2.98	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion	No	75.2	1.5	84
ETT-4		3.59			46.7	1.5	63
ETT-5		2.82			38.2	1.5	40
ETT-6	1108	1.14	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal	No	74.3	1.75	37
ETT-7		2.54			22.2	1.75	25

Vegetation zone	PCT ID	Direct impact area (ha)	Plant Community Type name	TEC	VI Score (= loss)	Biodiversity risk weighting	No. of ecosystem credits required
			lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion				
Total credits							596

12.1.2 Impacts on threatened species and their habitat (species credits)

An offset is required for direct impacts to the threatened species identified below. Details of the direct impacts and calculation of impact area used in the BAM-C is described in the following.

12.1.2.1 Scrub Turpentine (*Rhodamnia rubescens*)

Direct impact to two plants from an area of PCT 1245 to the west of Kangaroo Valley Power Station. The location of the plants is shown in **Figure 12-2**.

12.1.2.2 *Hibbertia puberula*

Impacts include removal of three plants from an area of PCT 1083 to the east of Bendeela pondage, the impact includes a 30m buffer to generate a species polygon for each plant. The location of the habitat to be impacted (species polygon) is shown in **Figure 12-2**.

12.1.2.3 Bauer's Midge Orchid (*Genoplesium baueri*)

The species was assumed present, and the impact calculated on removal of native vegetation considered to be suitable habitat for this species. This includes all vegetation zones of PCT 1083 within the valley portions of development site. The location of the habitat to be impacted (species polygon) is shown in **Figure 12-2**.

12.1.2.4 Gang-gang Cockatoo (Breeding) (*Callocephalon fimbriatum*)

A dedicated survey was conducted to identify and map all hollow-bearing trees within the development site and a 200 m buffer. Following this, all recorded hollow-bearing trees were surveyed in October 2022 for breeding activity (total of 344 trees surveyed). One adult female and juvenile male were recorded perched and foraging near three suitable hollow-bearing trees at the southern end of the existing pipeline (on the plateau). Whilst not observed entering/exiting the hollows, it was assumed that one of these trees is a potential nest (as a precautionary approach all three trees at this location were deemed actual nest trees). The impact on breeding habitat thus included placing a 200 m buffer around each of those trees and calculating the loss of vegetation within each vegetation zone where this intersected the 200 m buffer. Whilst these trees are located outside the development site boundary, applying the 200m buffer species polygon does intersect a small portion of the development site (along with 1.01 hectares of native vegetation). This vegetation is characterized by PCT 1156 and PCT 1082. Despite thorough surveys, no other hollow-bearing trees showed evidence of breeding of this species. . The location of the habitat to be impacted (species polygon) is shown in **Figure 12-3**.

12.1.2.5 Greater Glider (*Petauroides volans*)

The Greater Glider was recorded on the plateau portion of the development site, adjoining Morton National Park, on a number of occasions, however, was not identified from habitat in the lower Kangaroo Valley portion of the project. The absence from the valley and floodplain habitat is likely attributed to past clearing and fragmentation of habitat for agriculture and rural development. The impact to this species was calculated on the loss of vegetation containing mature or semi-mature Eucalypt trees (used for foraging and home-range dispersal). This vegetation includes all PCTs on the plateau portion of the project associated with the Moss Vale subregion and a small area of the Illawarra subregion, but not the Ettrema subregion. The location of the habitat to be impacted (species polygon) is shown in **Figure 12-4**.

12.1.2.6 Eastern Pygmy Possum (*Cercartetus nanus*)

The Eastern Pygmy Possum was confirmed from survey. The impact to the species was calculated based on associated PCTs and where preferred habitat and known habitat resources were confirmed. The impact was calculated based on the loss of vegetation containing potential foraging and nesting habitat and includes all PCT associations for this species, and condition classes in development site, except for PCT 1108 (vegetation zone associated with low derived grassland) as this zone lacks suitable habitat for this species (canopy and mid-stratum vegetation is absent). The species polygon for this species is shown in **Figure 12-4**.

12.1.2.7 Southern Myotis (*Myotis macropus*)

Impacts on the Southern Myotis were calculated based on the loss of all vegetation from the project that occurs within 200 m of a water body with pools that stretch 3 metres or wider, including rivers creeks and dams. This is considered to represent potential foraging habitat for the species. The location of this habitat (species polygon) is shown in **Figure 12-5**.

12.1.2.8 Large-eared Pied Bat (*Chalinolobus dwyeri*)

Impacts were calculated based on the loss of native vegetation within a 100 m distance from the mapped cliff lines. The cliff habitat is outside of the direct impact area; however a small area does intersect within the 100 m buffer. The cliff lines were not searched, however are assumed to containing potential breeding habitat (shallow caves, overhangs and crevasses). The location of this habitat and species polygon is shown on **Figure 12-5**.

12.1.2.9 Giant Burrowing Frog (*Heleioporus australiacus*)

The species was assumed present, and the impact was calculated on the loss of native vegetation within 300 m from suitable watercourses (i.e. Kings Creek, Trimbles Creek and numerous streams containing permanent pools). The 300 m buffer was applied to all nearby 1st order streams on the plateau and the valley. Some 1st order streams within the assessment area were visited during surveys and found to be small drainage ditches with no water, which makes them unsuitable habitat for this species which requires ephemeral flowing streams with permanent pools according to the TBDC (and for this reason some drainage lines in the assessment area were not mapped all the way to their start point). Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks). Given there are many mapped 1st order streams within 300 m of development site, and not all could be visited, many are assumed (and mapped) as suitable habitat (even if their headwaters are unlikely to contain permanent water). Applying the 300 m buffer to the 1st order streams means the species polygon encompasses a large area of vegetation and development site. As a result, vegetation impacted includes associated PCTs; PCT 1254, PCT 1156, PCT 1082, PCT 1083, PCT 1283 and PCT 1245. These PCTs are all located within a 300 m buffer of potentially suitable creek lines. The location of this habitat and species polygon is shown in **Figure 12-6**. The size of the species polygon for Giant Burrowing Frog is precautionary, and it is unlikely that all mapped streams are suitable habitat. Nonetheless, the direct impacts are outlined below in **Table 12-2**.

12.1.2.10 Littlejohn's Tree Frog (*Litoria littlejohni*),

The species was assumed present, and the impact calculated on the loss of native vegetation within 300 m from suitable watercourses that provide potential habitat (i.e. Kings Creek, Trimbles Creek and 1st order streams and swamps on the plateau or in the valley). Where headwaters of these 1st order streams mapped within development site and assessment area were found to be dry drainage lines (upon inspection) and may only contain water during high rainfall events, these were deemed not suitable breeding habitat for this species and excluded from the calculation. Some mapped drainage lines to the east of Bendeela pondage (in the valley) are no longer existing and were likely removed during construction of the power station dam (and nearby earthworks). Given there are many mapped 1st order streams within 300 m of development site, and not all could be visited, many are assumed (and mapped) as suitable habitat (even if their headwaters are unlikely to contain permanent water). Applying the 300 m buffer to the 1st order streams resulted in a 12.10 ha impact (species polygon) encompasses a large area of vegetation and development site. The location of this habitat and species polygon is shown in **Figure 12-7**. The size of the species polygon for Littlejohn's Tree Frog is precautionary, and based on assumed presence, and it is unlikely that all mapped streams are suitable habitat. Nonetheless, the direct impacts are outlined below in **Table 12.2**.

12.1.2.11 Summary of impacts on threatened species

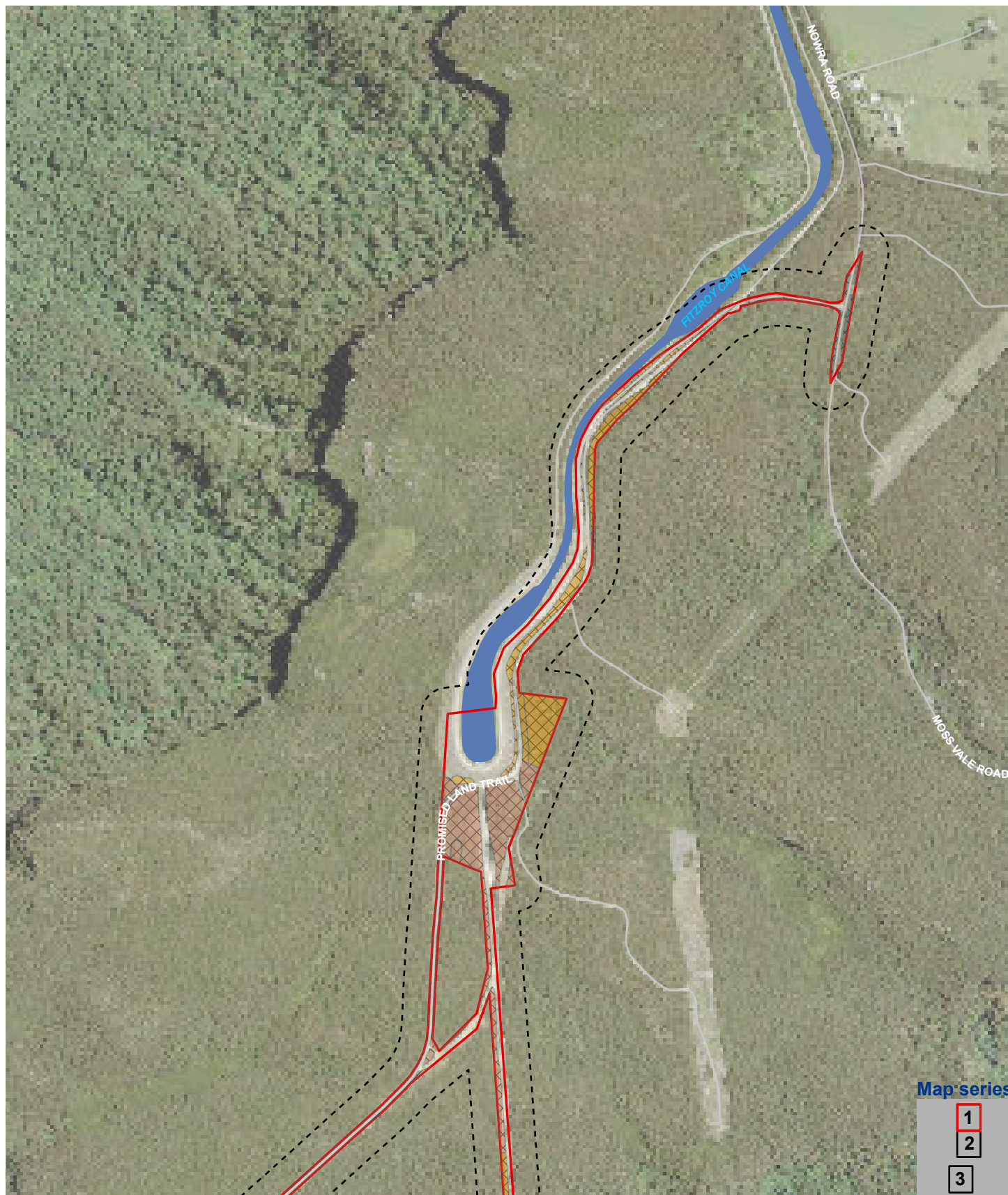
- Table 12-2 impacts that require an offset – species credits

Common name	Scientific name	BC Act status	EPBC Act status	Loss of habitat (ha) or individuals	Biodiversity risk weighting	Number of species credits required
Eastern Pygmy Possum	<i>Cercartetus nanus</i>	V	-	25.79 ha	2	709
Gang-Gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	E	24.63 ha	2	34
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V	V	25.79 ha	1.5	531
Bauer's Midge Orchid	<i>Genoplesium baueri</i>	E	E	9.39 ha	3	375
Greater Glider	<i>Petauroides volans</i>	-	V	12.33 ha	2	364
Littlejohn's Tree Frog	<i>Litoria littlejohni</i>	V	V	12.10 ha	2	356
Southern Myotis	<i>Myotis macropus</i>	V	-	9.69 ha	2	233
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	0.87 ha	3	35
Hibbertia puberula	<i>Hibbertia puberula</i>	E	-	0.55 ha	2	21
Scrub Turpentine	<i>Rhodamnia rubescens</i>	CE	CE	2 individuals	3	6
Total credits						2,664

12.2 Impacts that do not require further assessment

In accordance with Section 10.4 of the BAM, an assessor is not required to assess areas of land on the development site for ecosystem-credits where native vegetation (defined under Chapter 3 or Chapter 4 of the BAM) is absent, in this case refers to cleared land along the existing Promised Land track and within the cleared footprint of the existing penstock corridor. These areas are shown on **Figure 12-8**.

The areas of cleared land within the development site were assessed for suitable threatened species habitat (as defined in Chapter 5 of the BAM). However, these cleared areas (such as existing tracks) were found to lack habitat suitable for species-credit threatened species. Furthermore, patches of cleared land within the development site would not be subject to new prescribed impacts (as listed in Chapter 6 of the BAM). The only prescribed impact relevant to cleared land would be 'vehicle strikes' resulting from increased vehicle use on existing cleared tracks (access tracks).



Legend

- | | |
|---|--|
| PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion | PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion |
| PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion | Vegetation clearing impacts requiring an offset |
| | Development site |
| | Project area |
| | Waterbody |

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources¹

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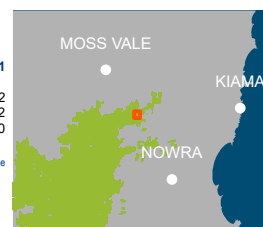
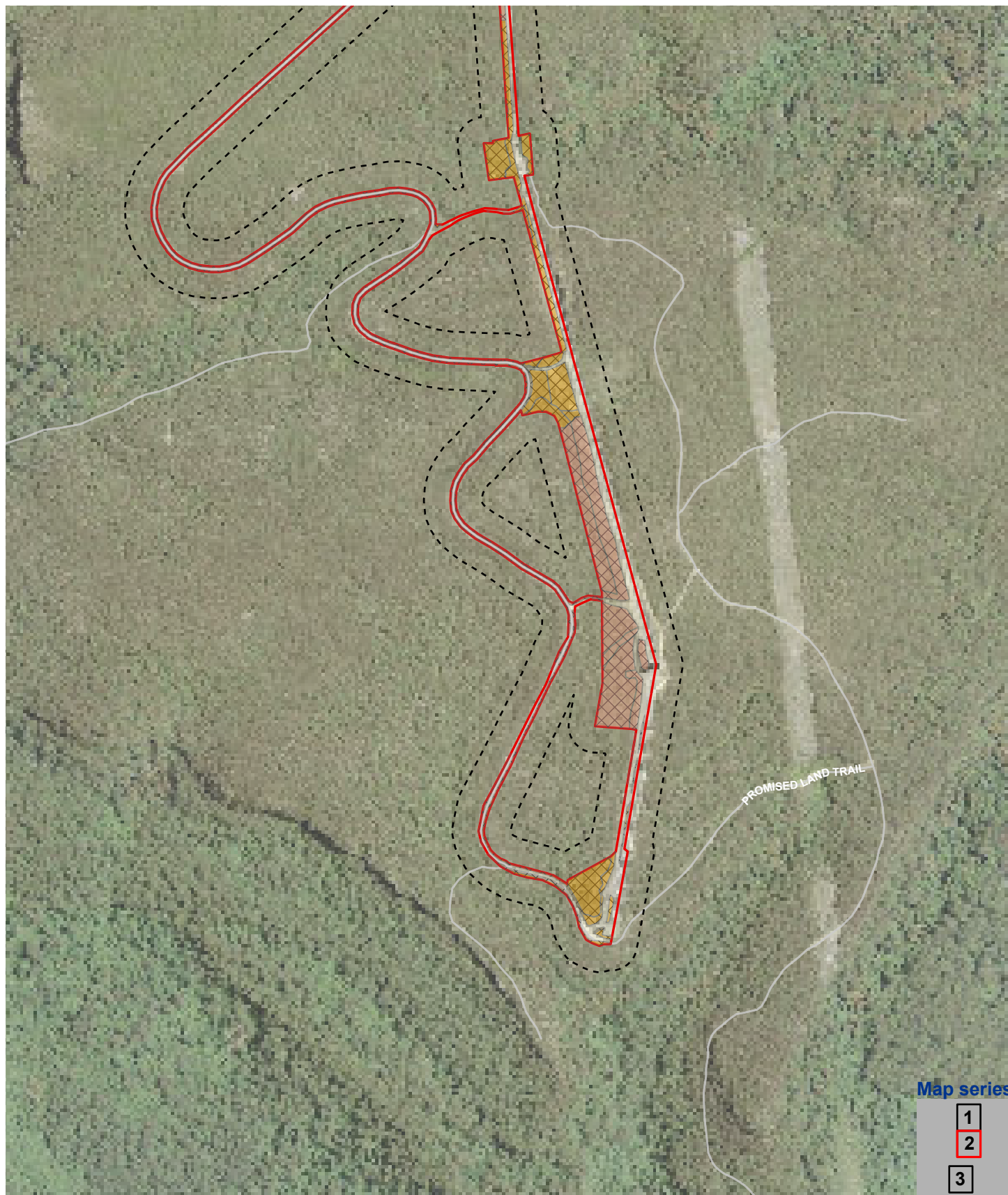


Figure 12-1 Direct impacts to PCTs which require an offset



Legend

- | | |
|--|---|
| <p>PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> | <p> Vegetation clearing impacts requiring an offset</p> <p> Development site</p> <p> Project area</p> |
|--|---|

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources2

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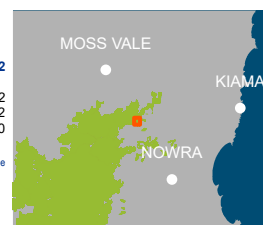
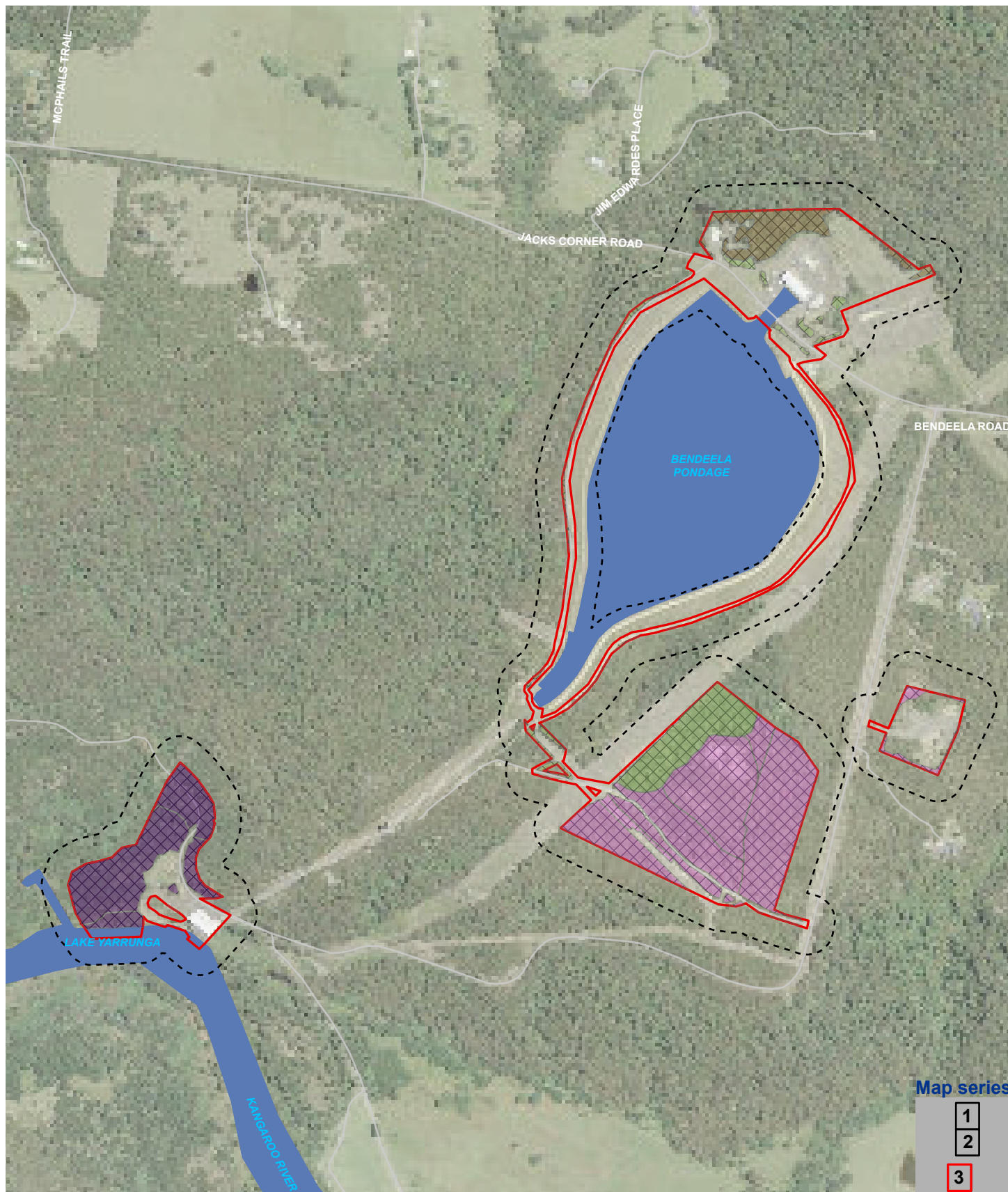


Figure 12-1 Direct impacts to PCTs which require an offset



Legend

- | | |
|--|---|
| <p>PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion</p> <p>PCT 1108 - River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> | <p>PCT 1283 - Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Vegetation clearing impacts requiring an offset</p> <p>Development site</p> <p>Project area</p> <p>Waterbody</p> |
|--|---|

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



Data sources3

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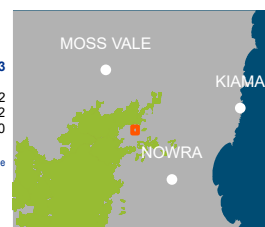
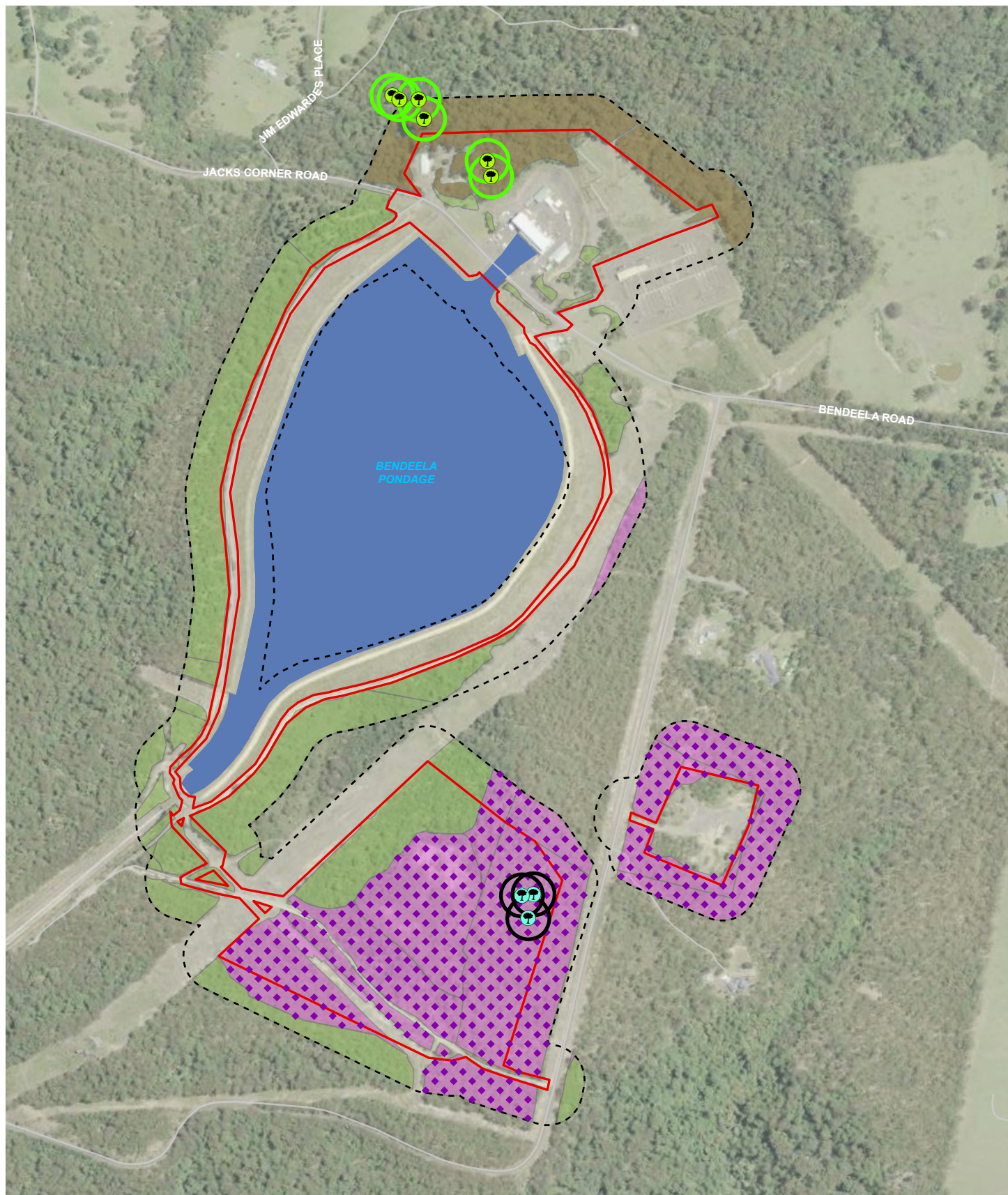


Figure 12-1 Direct impacts to PCTs which require an offset



Legend

- | | | | |
|--|--|--|---|
| | PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion | | Hibbertia puberula - Species polygon |
| | PCT 1245 - Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion | | Scrub Turpentine (<i>Rhodamnia rubescens</i>) - Species polygon |
| | PCT 1283 - Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion | | Bauer's Midge Orchid (<i>Genoplesium baueri</i>), (assumed present) - Species polygon |
| | Hibbertia puberula | | Development site |
| | | | Assessment area |
| | | | Waterbody |

0 100 200 300 metres

1:7,500 at A4

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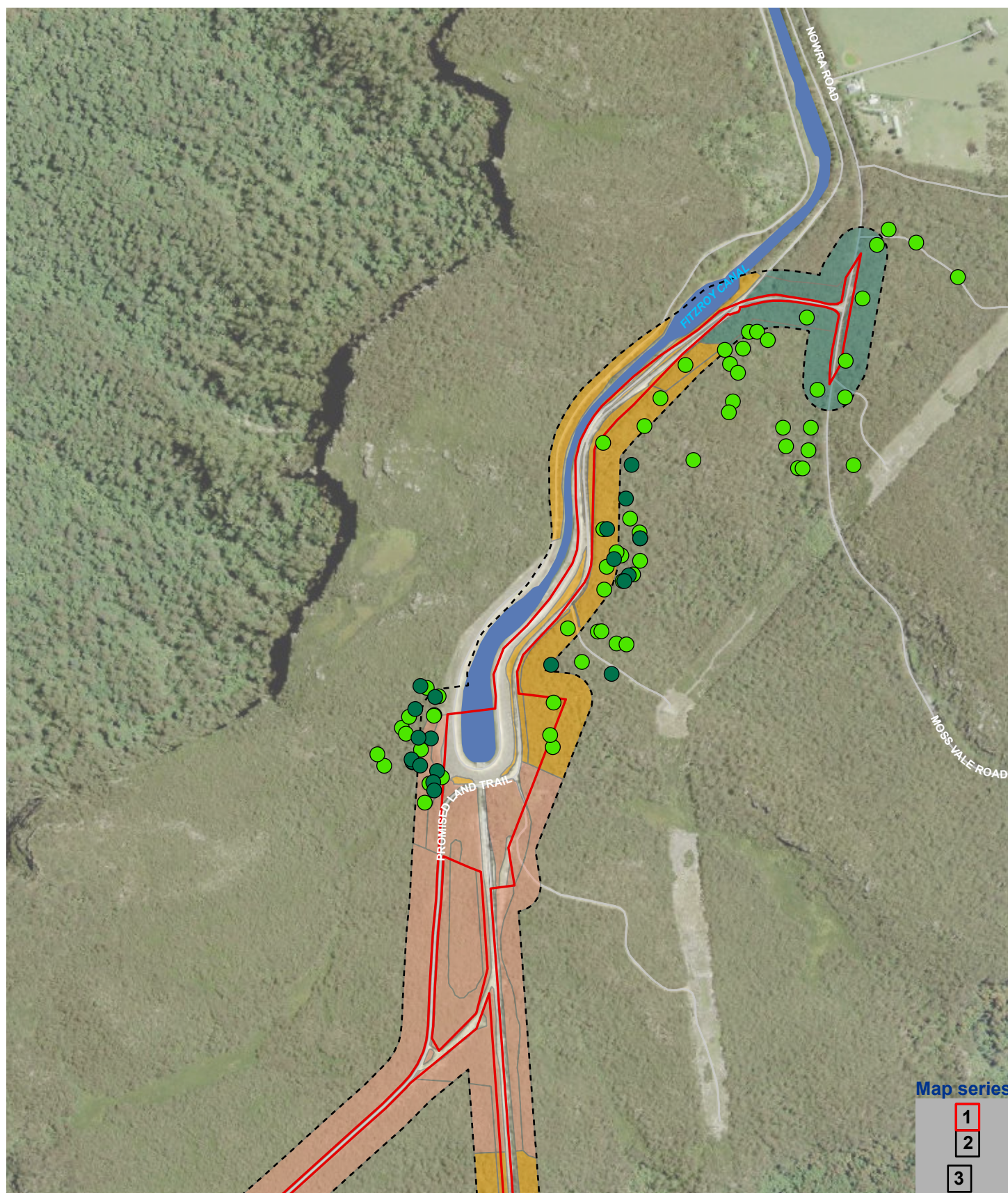
Data sources

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Figure 12-2 Direct impacts to threatened plants which require an offset



- Hollow-bearing tree - medium
- Hollow-bearing tree - large
- Development site
- Project area
- Waterbody
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

0 200 400 metres
1:10,000 at A4
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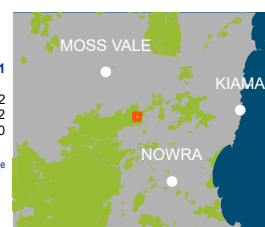
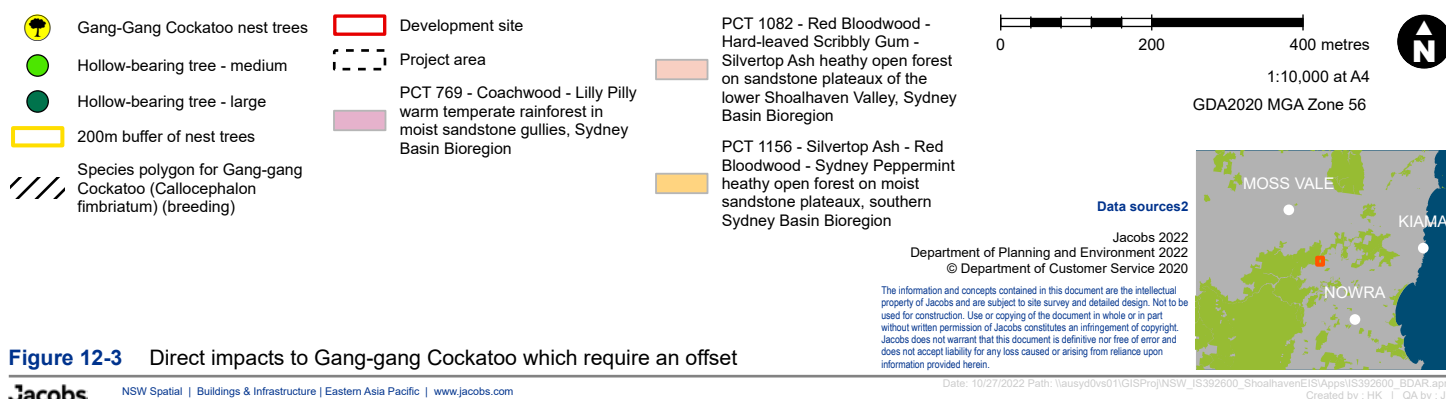
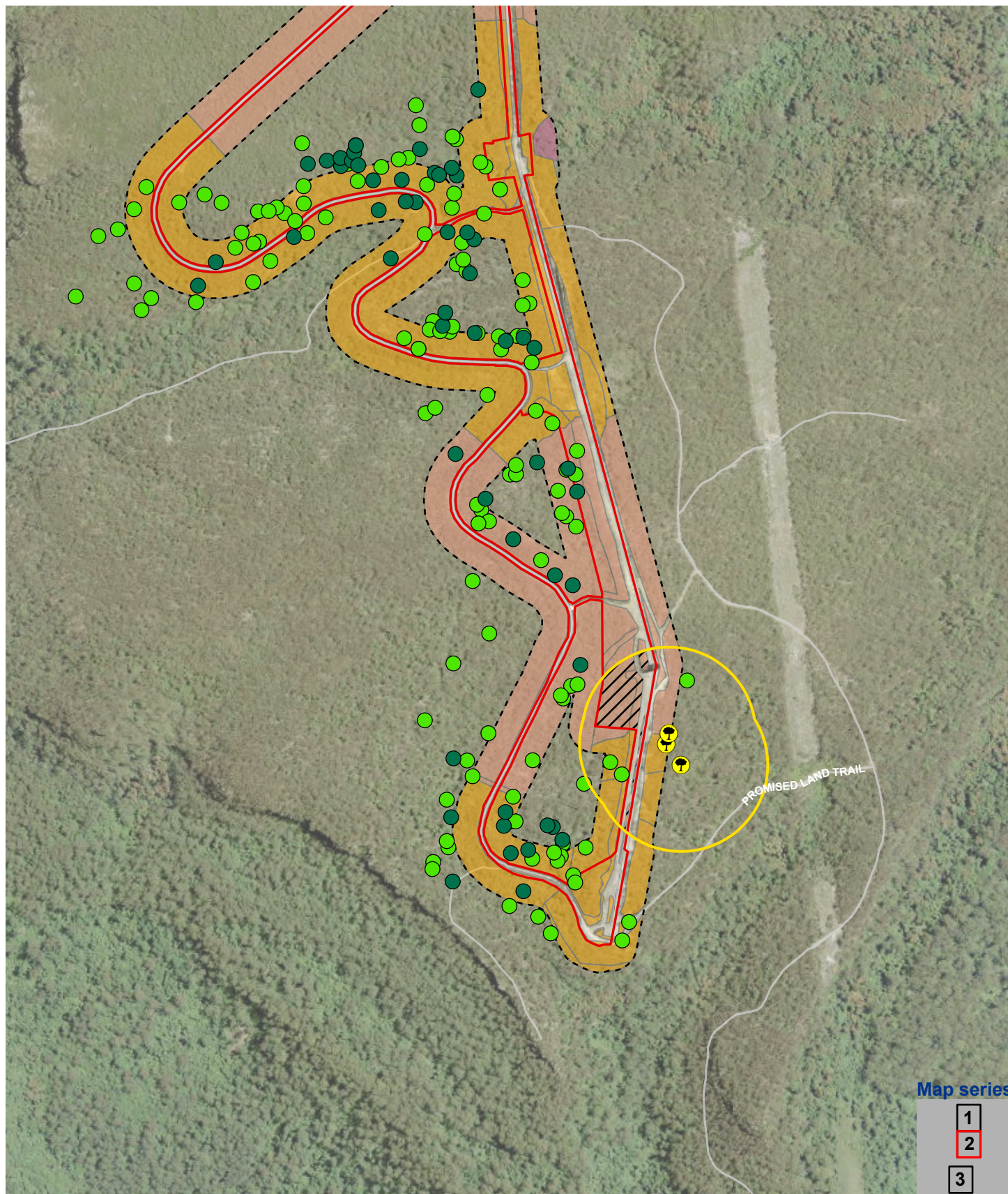
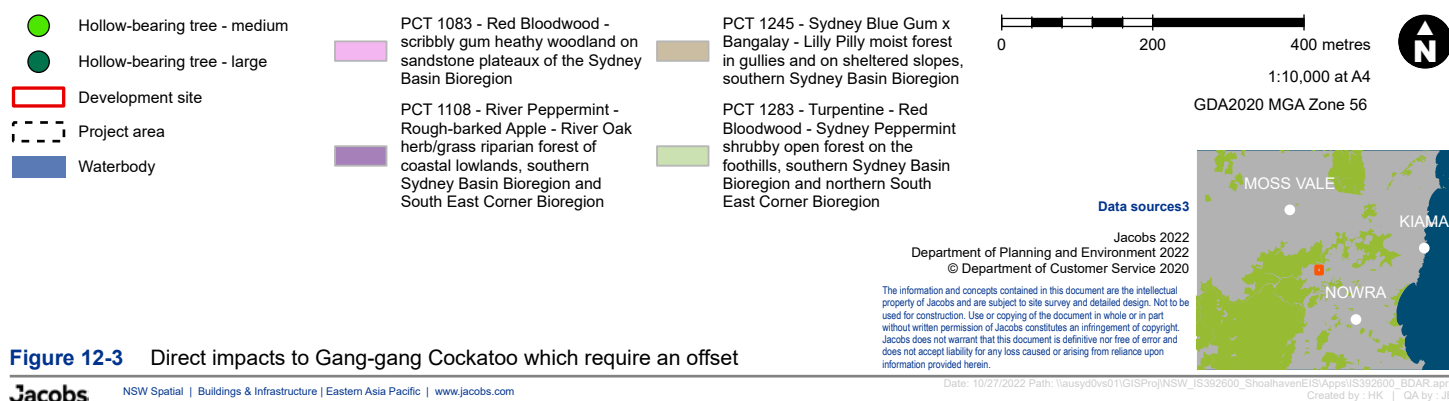
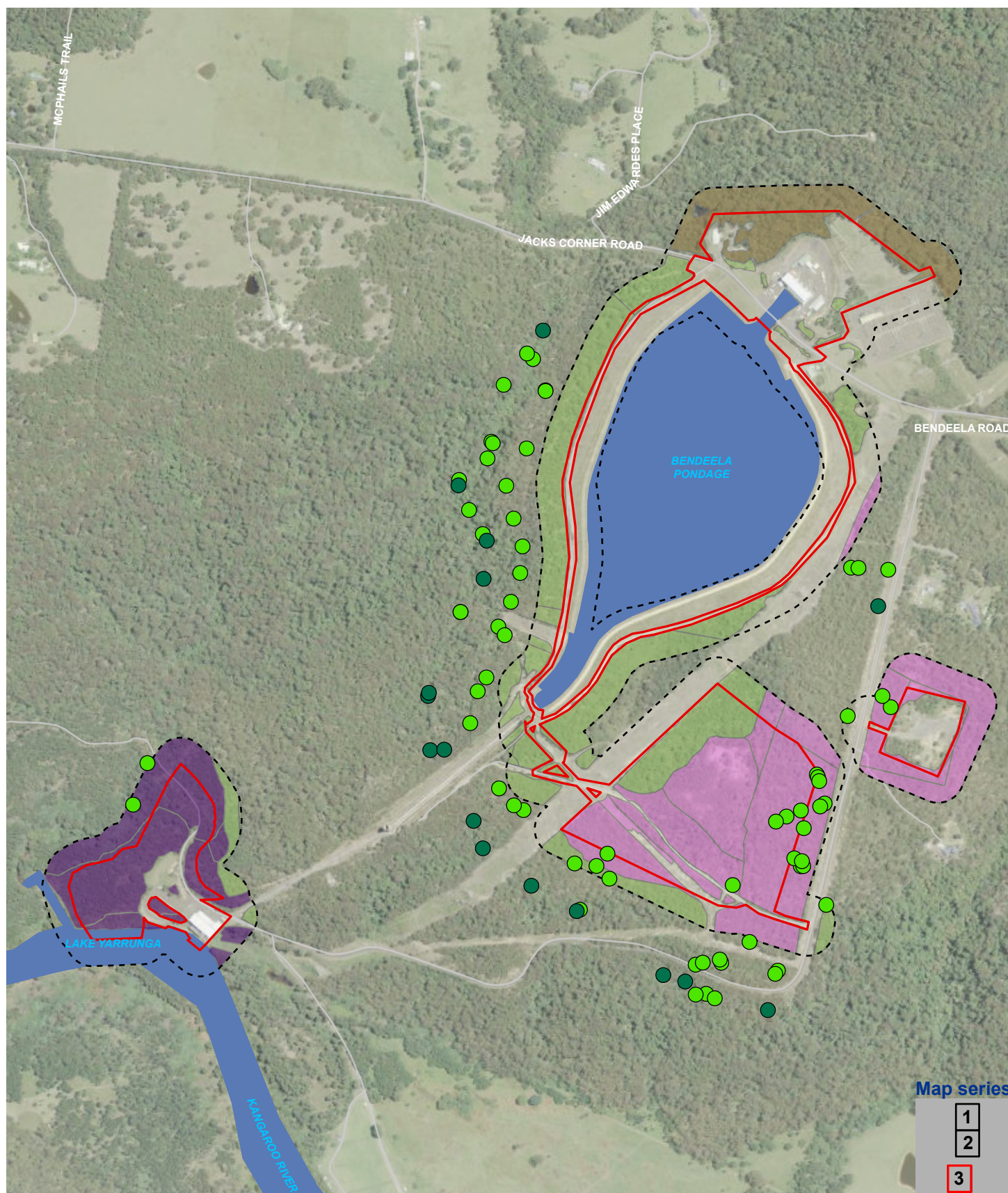
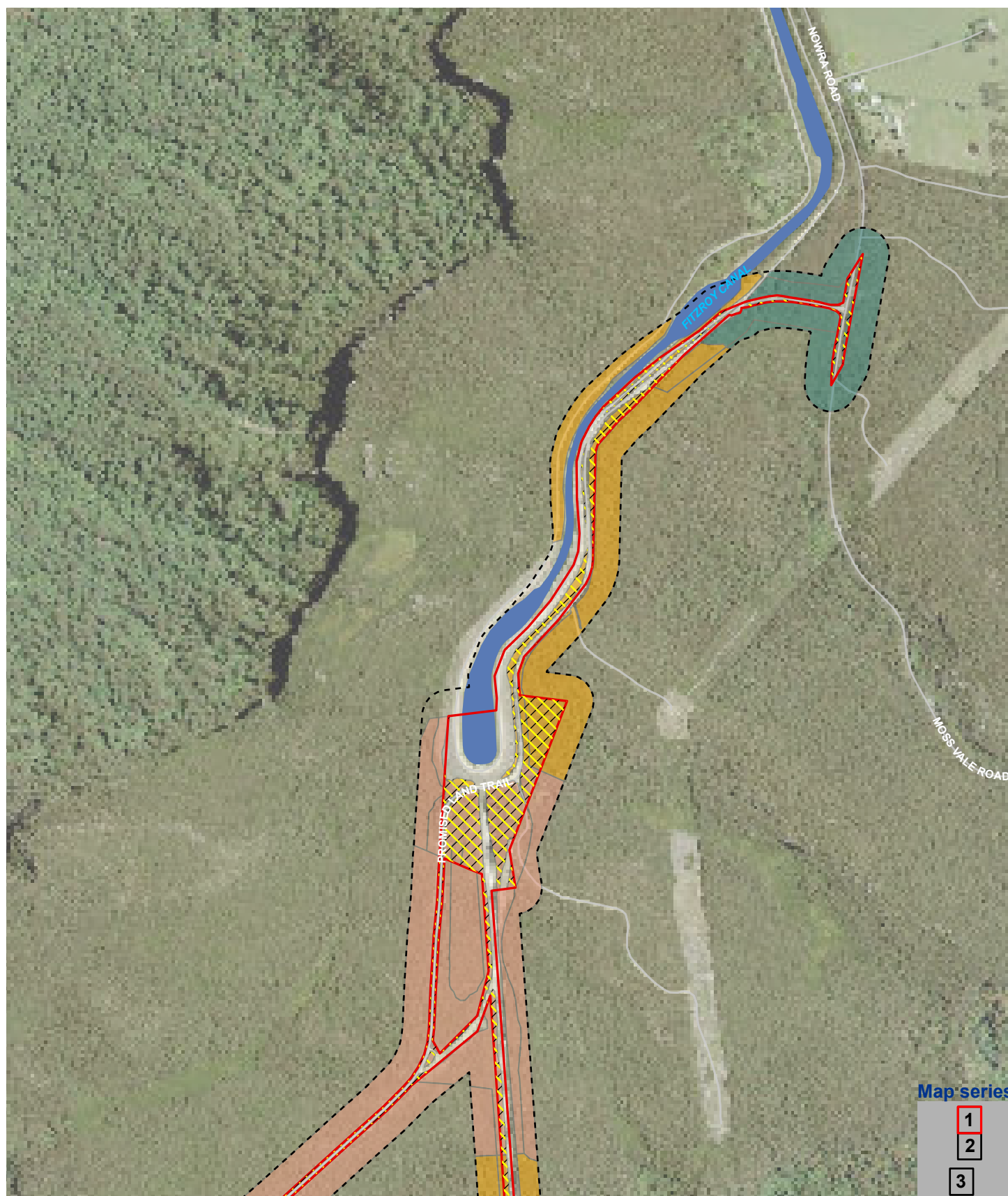


Figure 12-3 Direct impacts to Gang-gang Cockatoo which require an offset







Map series

1
2
3

PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

Greater Glider (*Petauroides volans*) - Species polygon

Eastern Pygmy Possum *Cercartetus nanus*- Species polygon

Development site

Project area

Waterbody

0 200 400 metres

1:10,000 at A4

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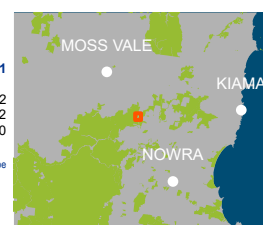


Figure 12-4 Direct impacts to Greater Glider and Eastern Pygmy Possum which require an offset



Figure 12-4 Direct impacts to Greater Glider and Eastern Pygmy Possum which require an offset

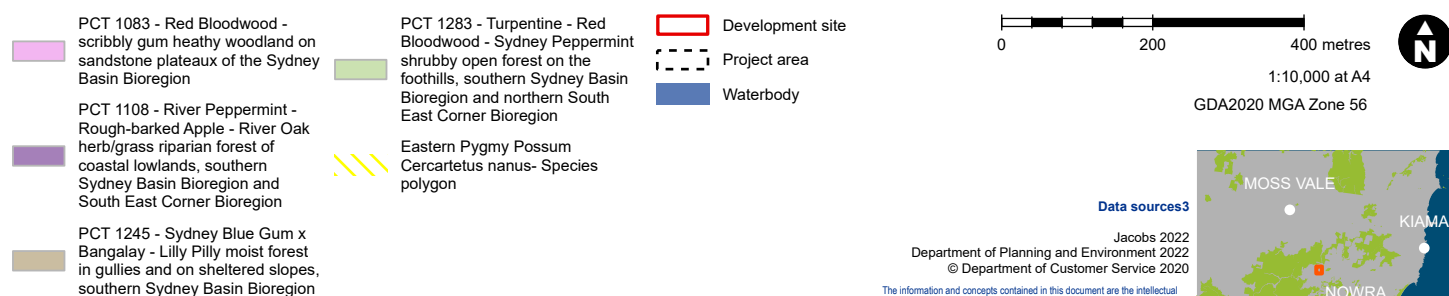
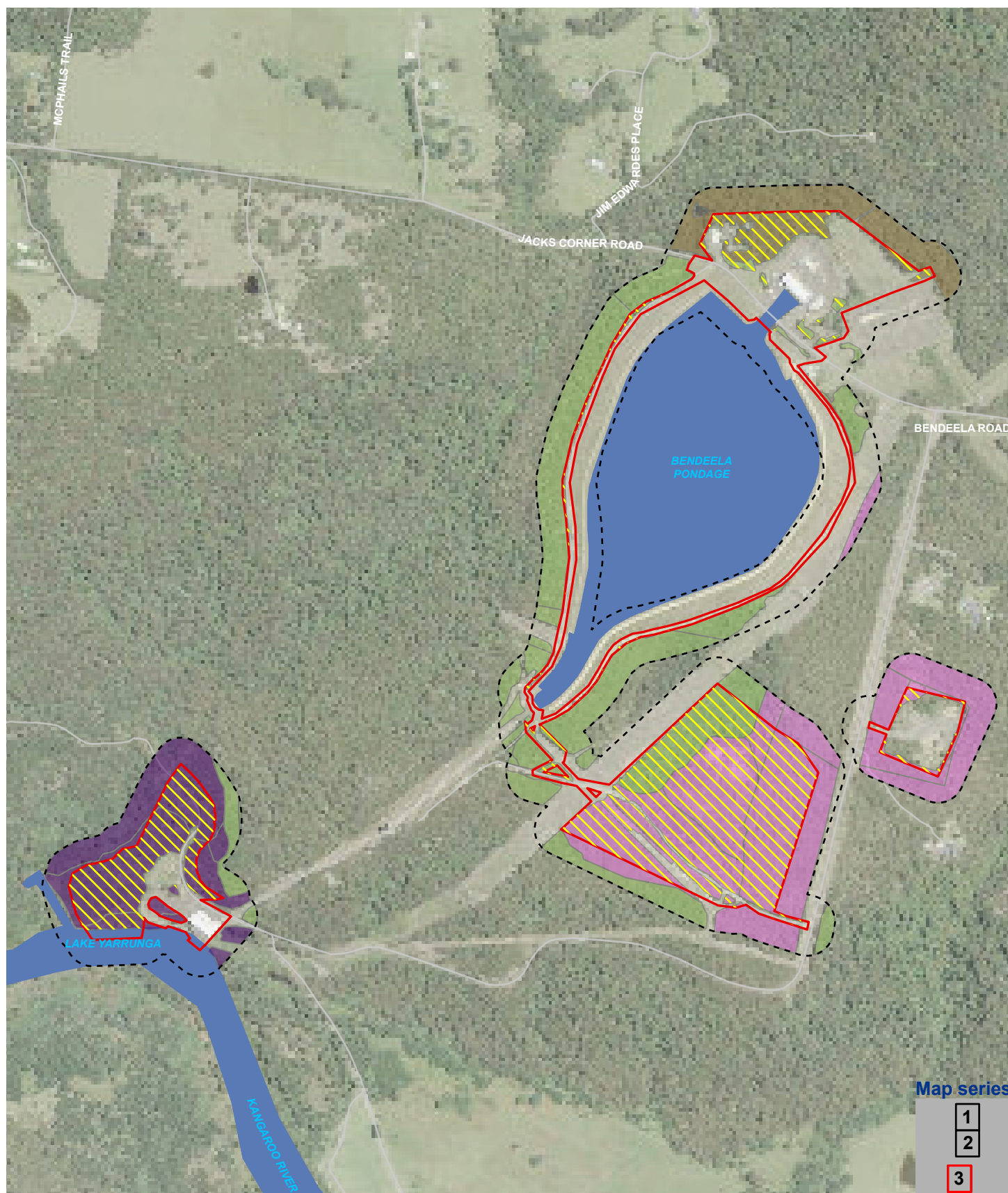


Figure 12-4 Direct impacts to Greater Glider and Eastern Pygmy Possum which require an offset

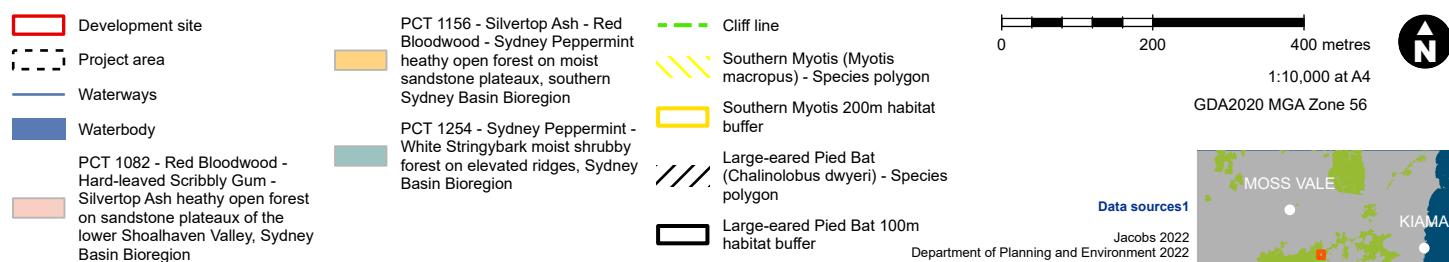
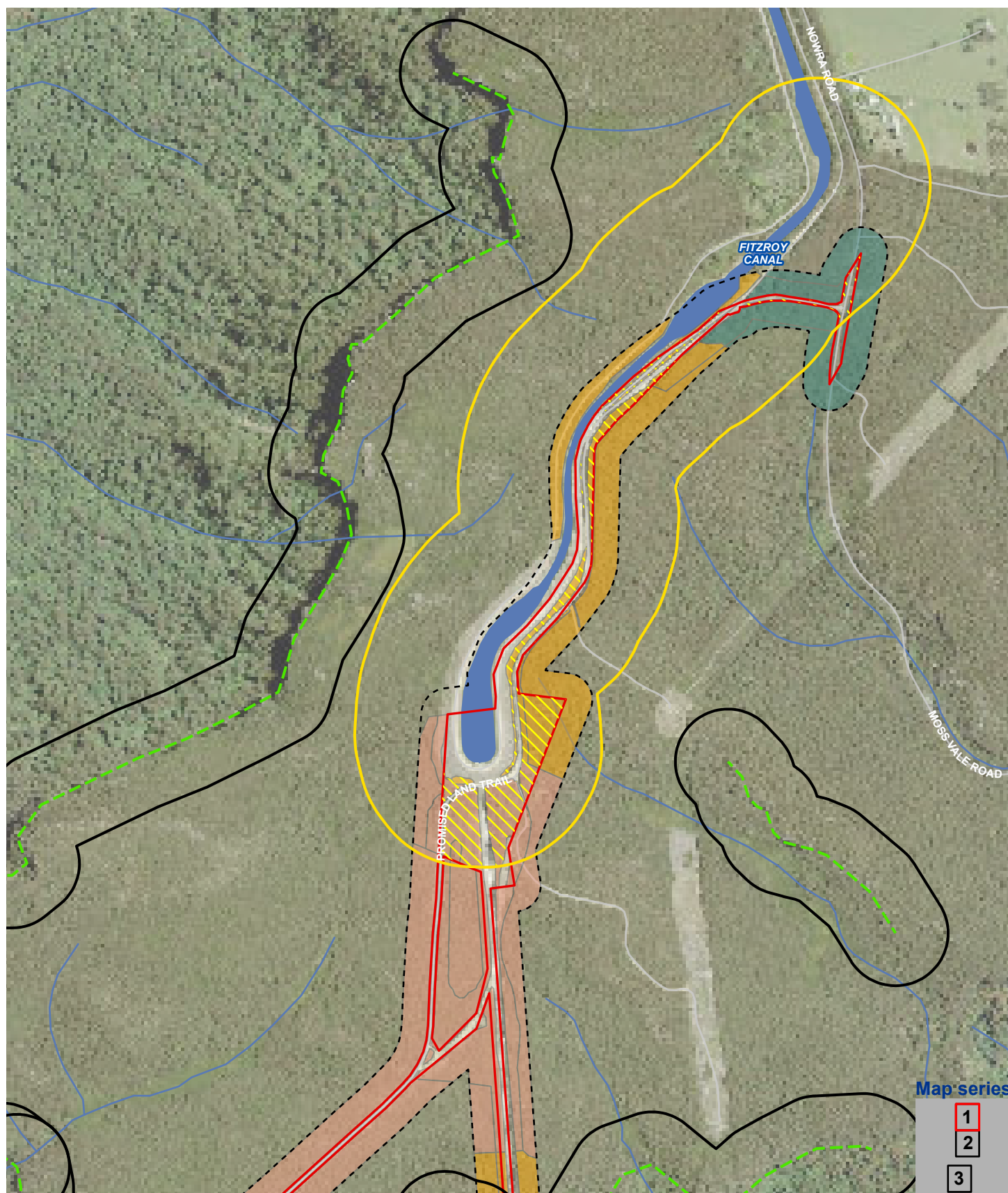


Figure 12-5 Direct impacts to threatened bats which require an offset

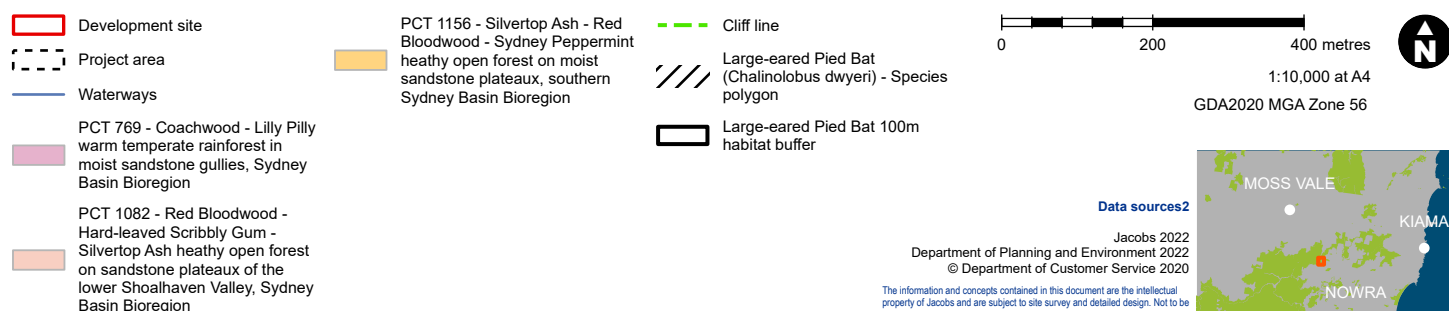
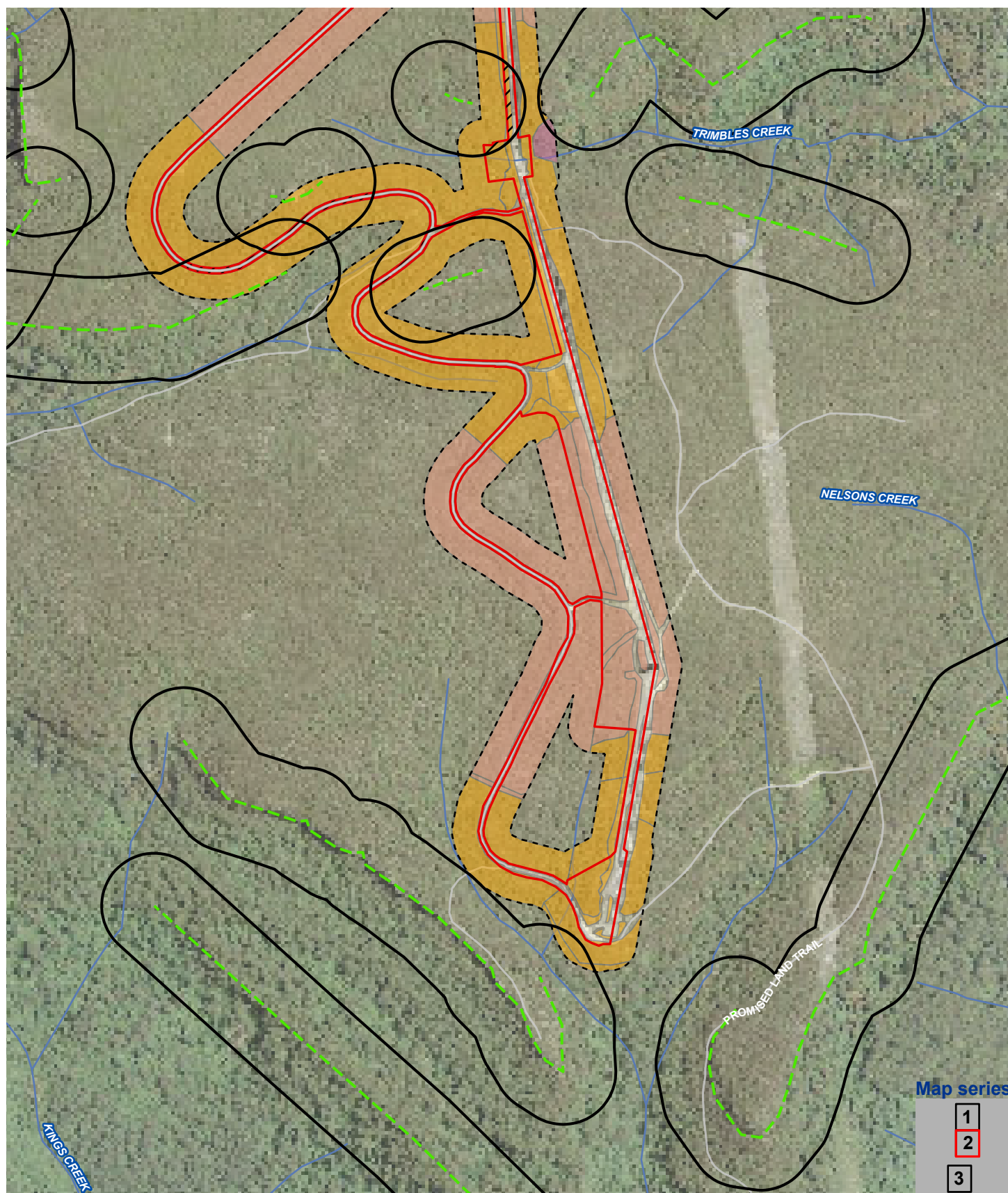


Figure 12-5 Direct impacts to threatened bats which require an offset

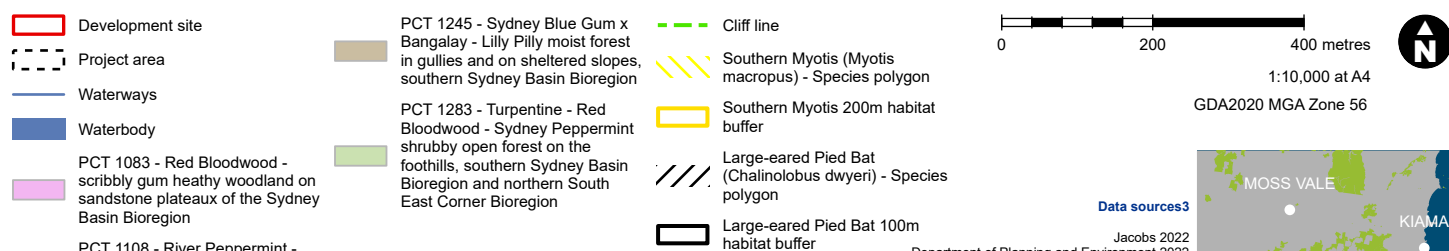
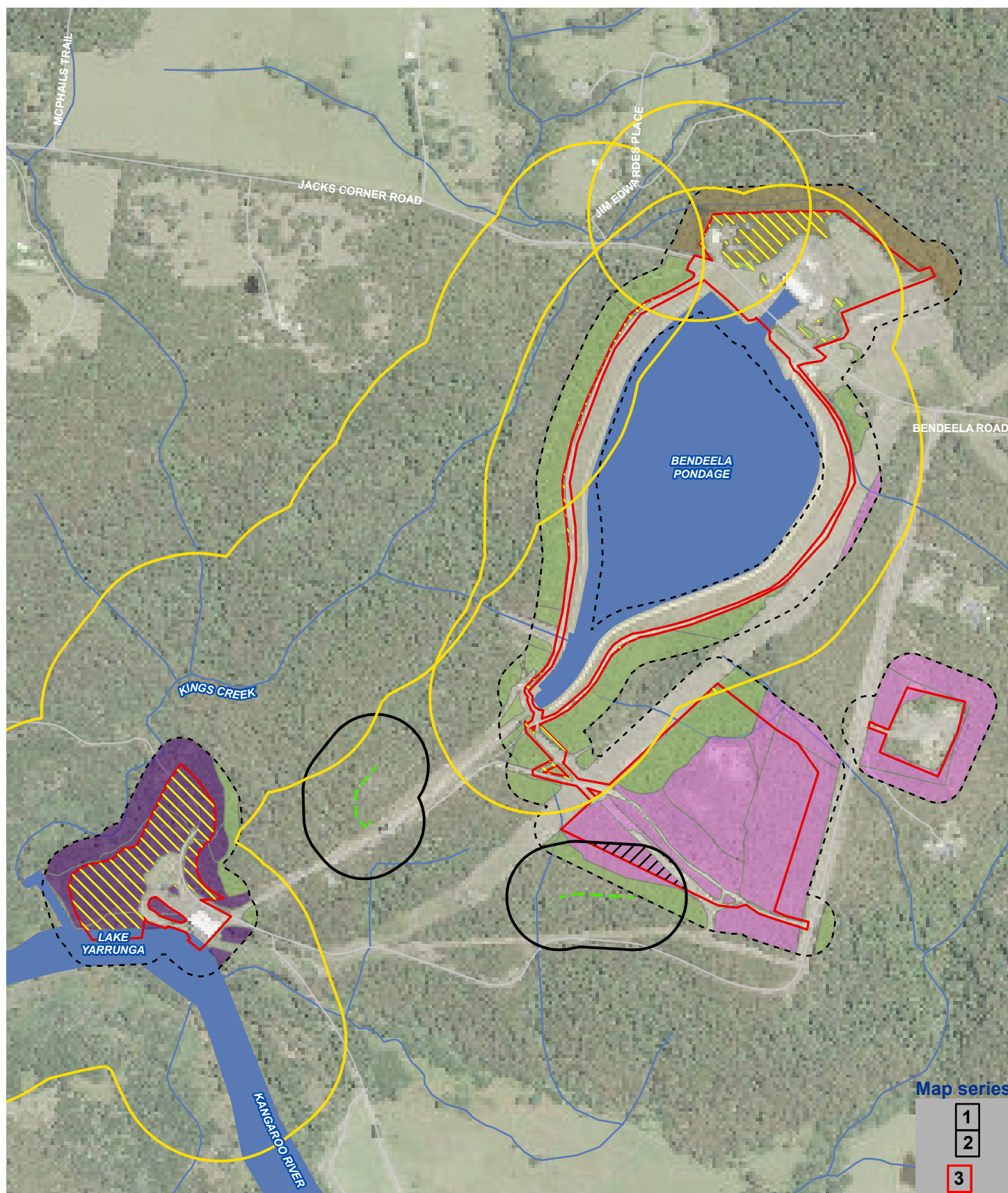
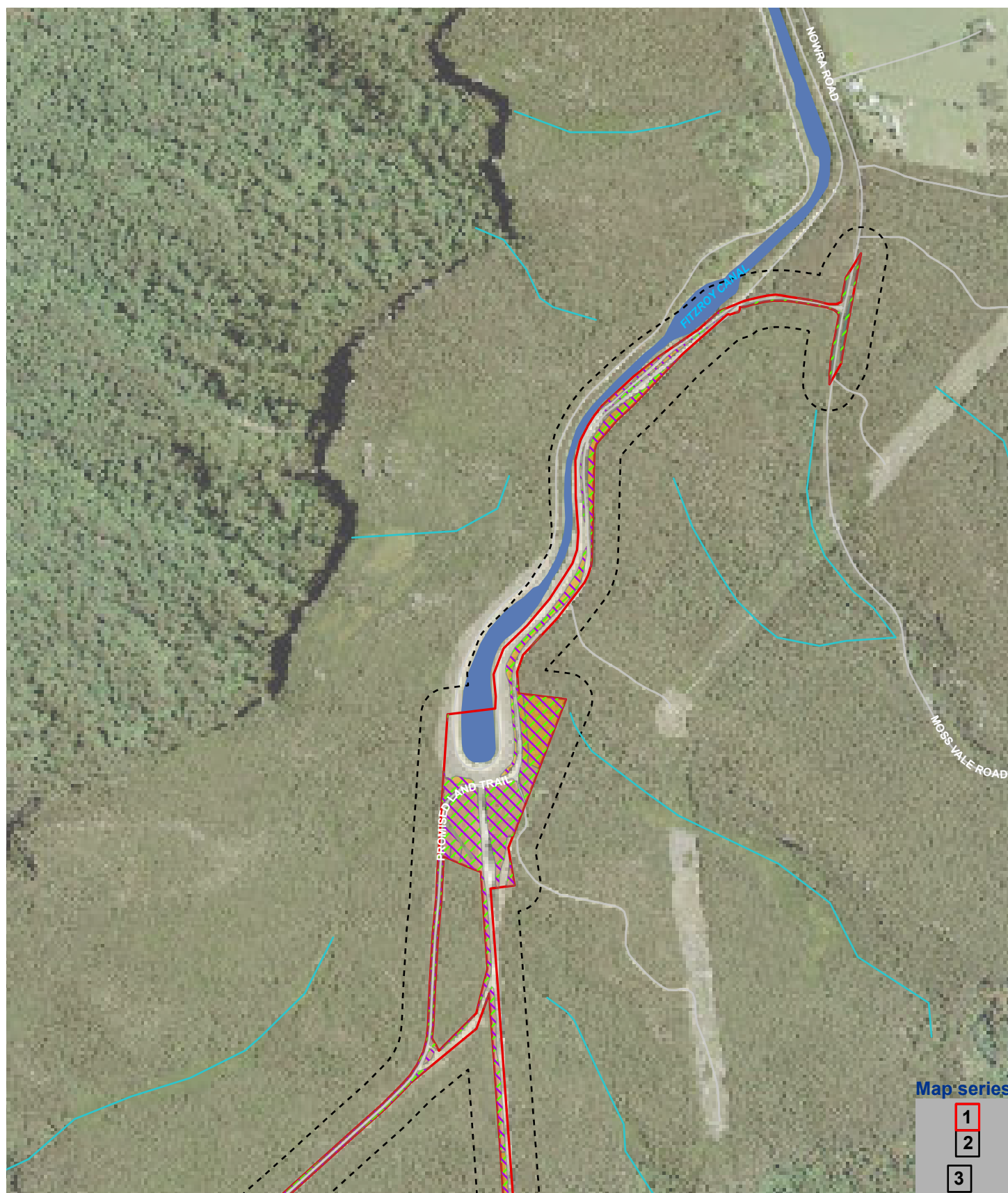


Figure 12-5 Direct impacts to threatened bats which require an offset



Map series

1
2
3

0 200 400 metres

1:10,000 at A4

GDA2020 MGA Zone 56



- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
- Littlejohn's Tree Frog (*Litoria littlejohni*) (assumed present) - Species polygon
- Giant Burrowing Frog (*Heleioporus australiacus*) (assumed present) - Species polygon
- Creeks and ephemeral drainage lines
- Development site
- Study area
- Waterbody

Data sources¹

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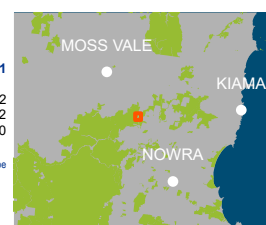
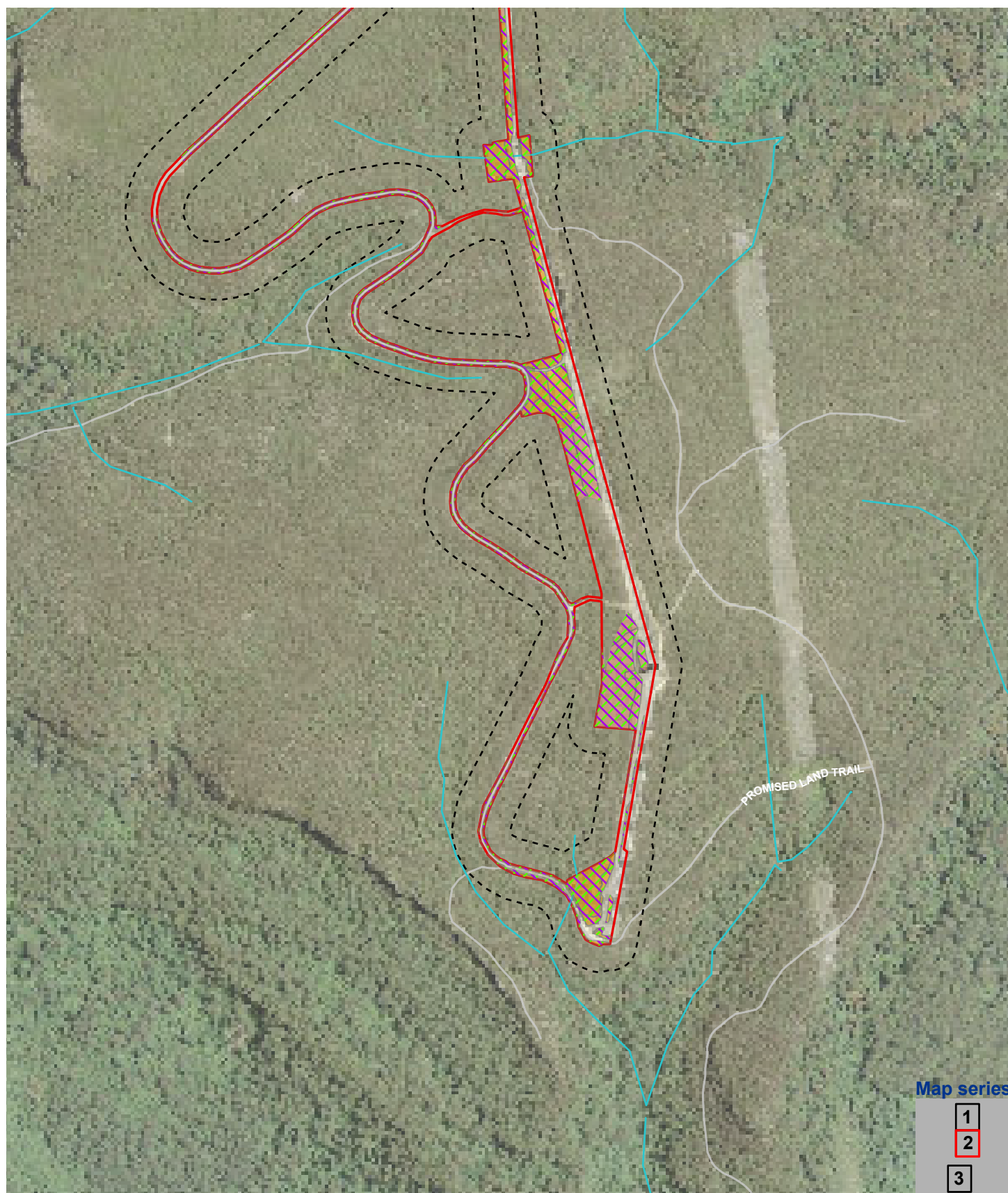


Figure 12-6 Direct impacts to threatened amphibians which require offset



Map series

1
2
3

PCT 1082 - Red Bloodwood -
Hard-leaved Scribbly Gum -
Silvertop Ash heathy open forest
on sandstone plateaux of the
lower Shoalhaven Valley, Sydney
Basin Bioregion

PCT 1156 - Silvertop Ash - Red
Bloodwood - Sydney Peppermint
heathy open forest on moist
sandstone plateaux, southern
Sydney Basin Bioregion

Littlejohn's Tree Frog (*Litoria
littlejohni*) (assumed present)
-Species polygon

Giant Burrowing Frog
(*Heleioporus australiacus*
(assumed present) - Species
polygon

Creeks and ephemeral drainage
lines

Development site

Study area

0 200 400 metres

1:10,000 at A4

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Data sources2

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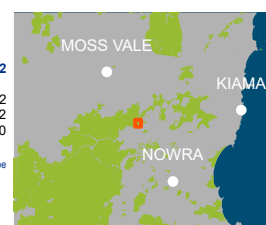


Figure 12-6 Direct impacts to threatened amphibians which require offset

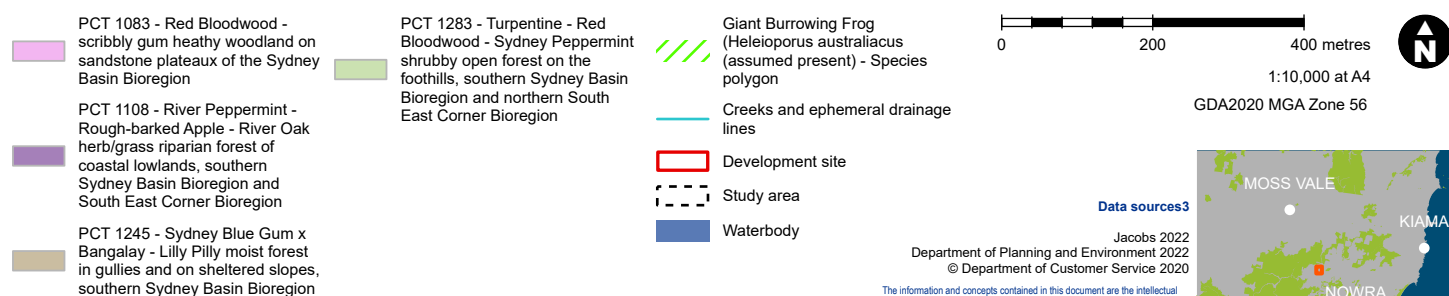
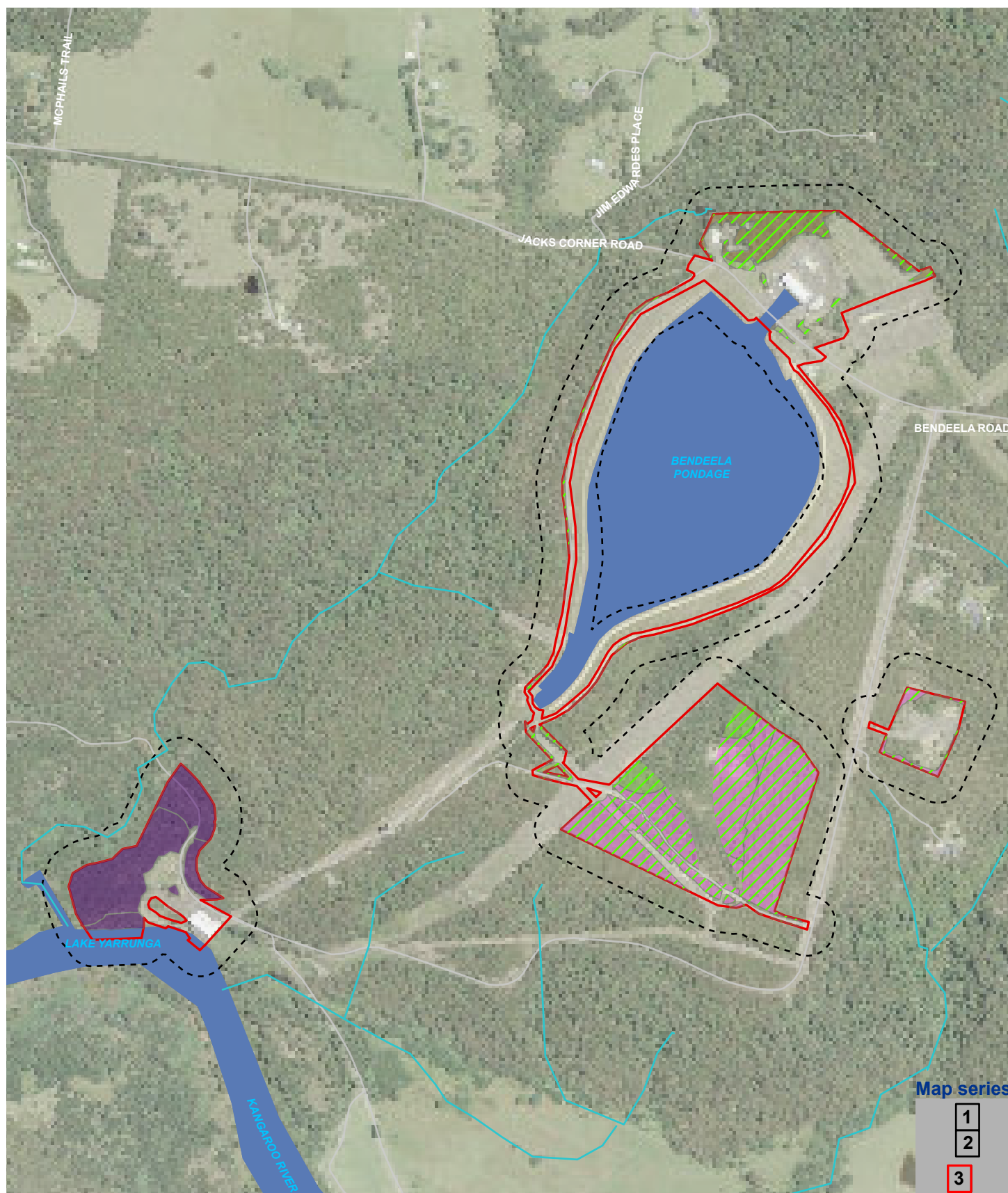
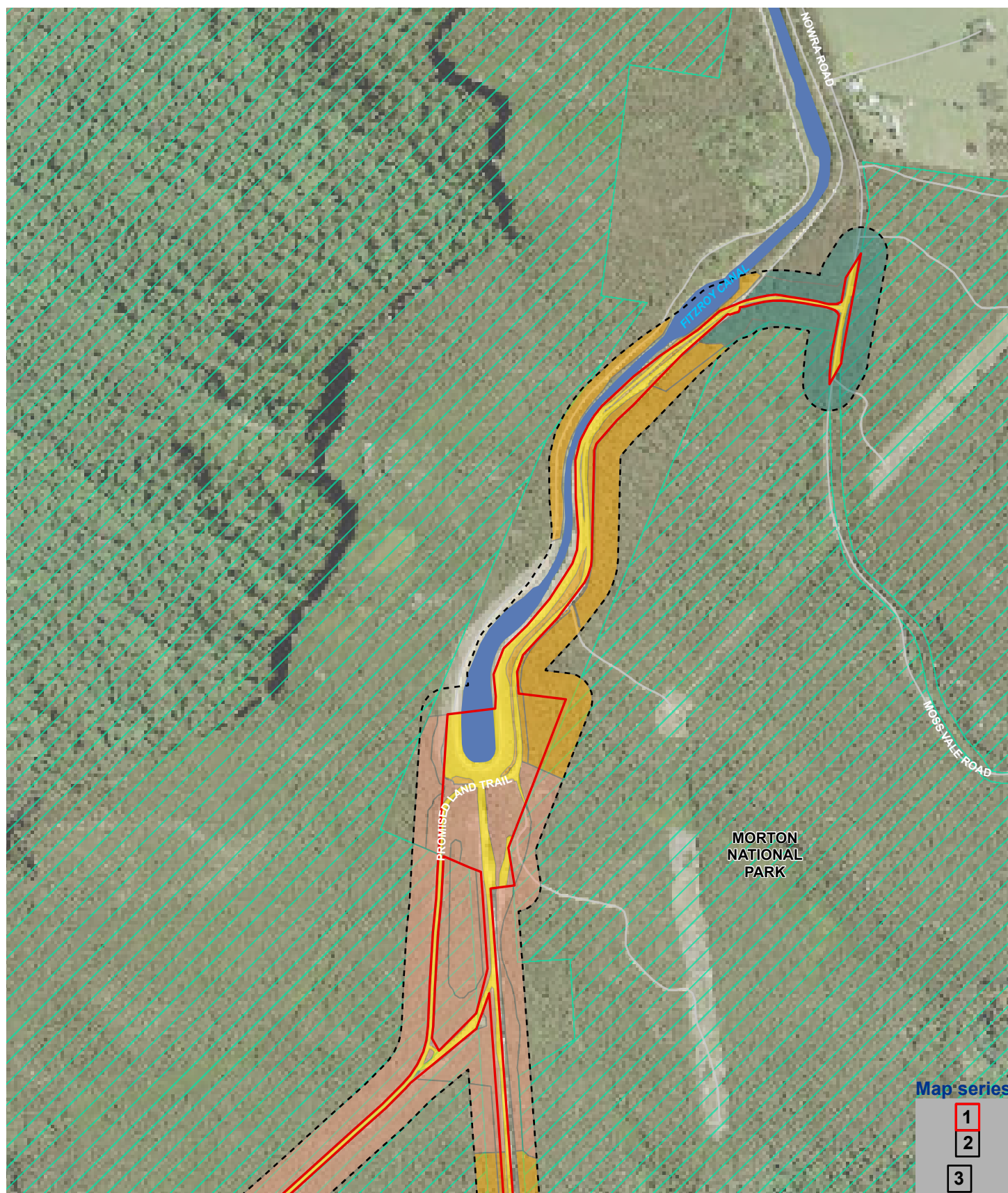


Figure 12-6 Direct impacts to threatened amphibians which require offset



- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- PCT 1254 - Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
- Development site
- Project area
- No native vegetation / cleared land
- Road
- Waterbody
- NPWS Reserve

0 200 400 metres

1:10,000 at A4

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Data sources¹

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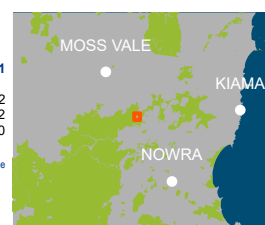
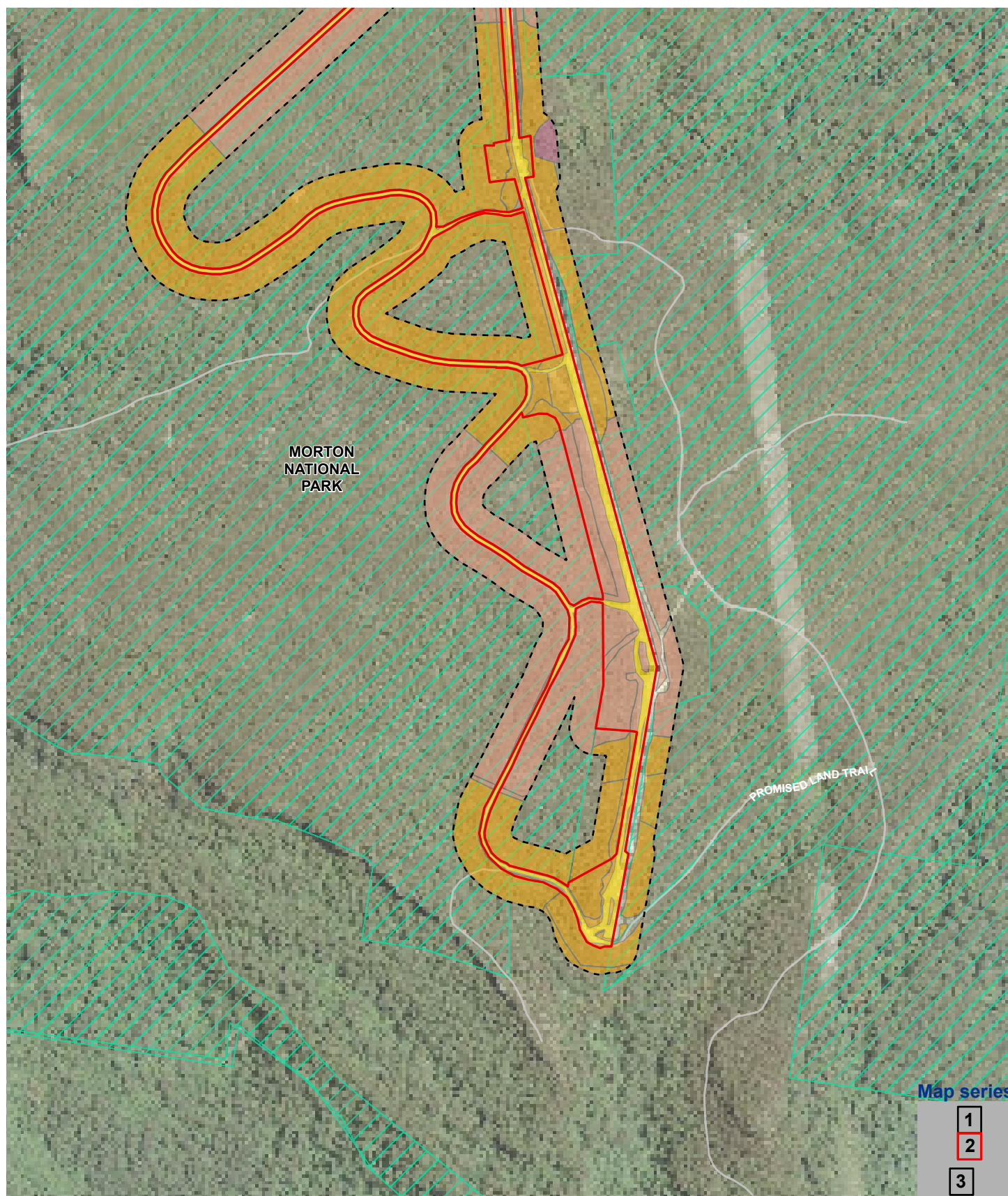


Figure 12-7 No native vegetation / cleared land



- PCT 769 - Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
- PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- PCT 1156 - Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
- Development site
- Project area
- No native vegetation / cleared land
- Road
- NPWS Reserve

0 200 400 metres

1:10,000 at A4

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Figure 12-7 No native vegetation / cleared land

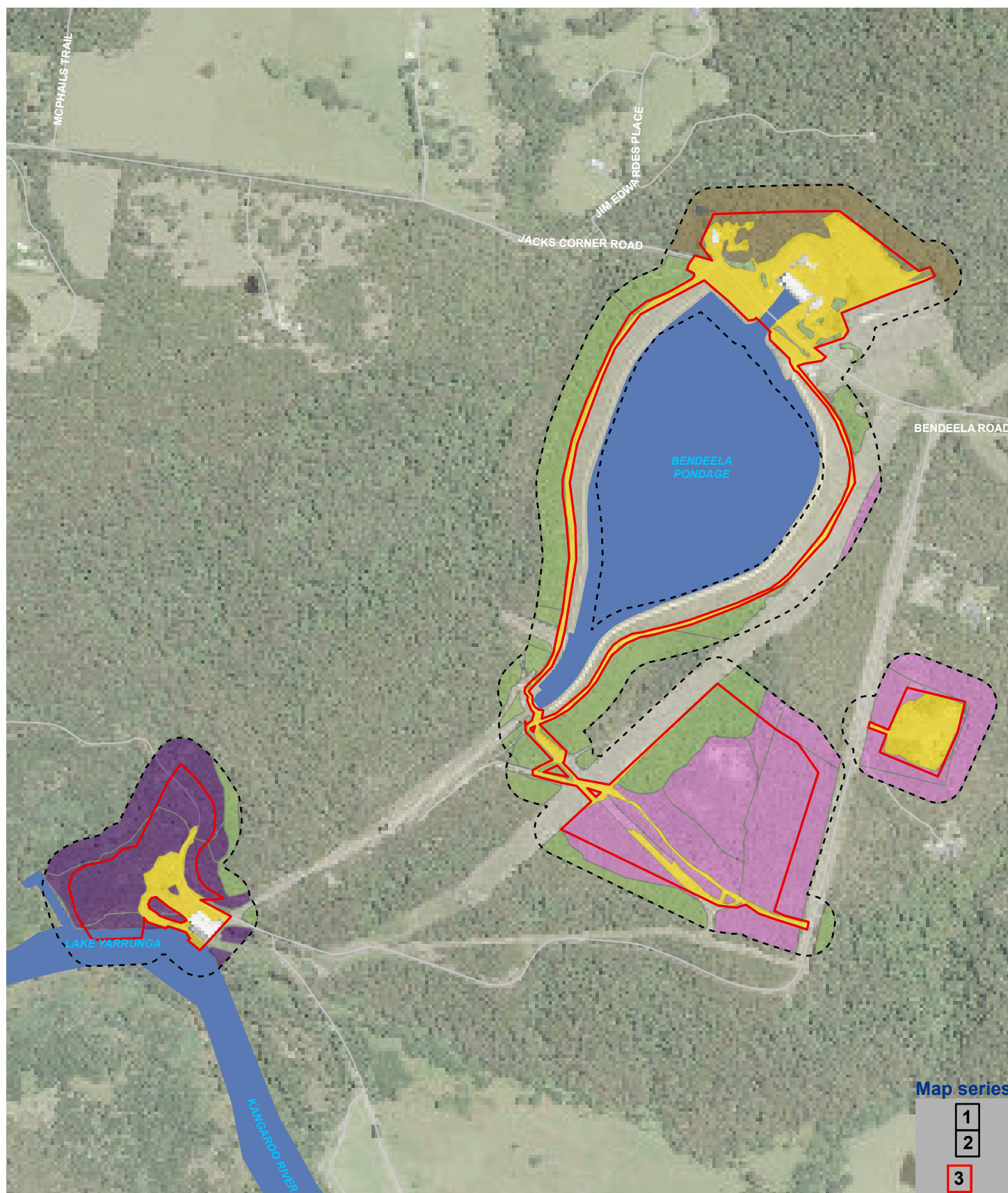


Figure 12-7 No native vegetation / cleared land

13. Biodiversity credit report

13.1 Ecosystem credits

A summary of the biodiversity credit requirements for the development are provided below in **Table 13-1** for ecosystem credits and **Table 13-2** for species credits. The credit report is provided in **Appendix E**.

Table 13-1 Ecosystem credit class and matching credit profile

Ecosystem credit	Attributes shared with matching credits PCT name	PCT vegetation class	PCT vegetation formation	Associated TEC or EC	Offset trading group (BAM Section 10.2, Tables 4 & 5)	Hollow bearing trees present?	IBRA subregion (in which Project is located)
8	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254)	Southern Escarpment Wet Sclerophyll Forests	Wet Sclerophyll Forests (Shrubby sub-formation)	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Yes	Moss Vale
102	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateau, southern Sydney Basin Bioregion (PCT 1156)	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not a TEC	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher threat status).	Yes	Moss Vale, Illawarra
17						No	
149	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateau of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT1082)	Southeast Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not a TEC	Southeast Dry Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher threat status).	Yes	Moss Vale, Illawarra
47	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern Southeast Corner Bioregion (PCT1283)	Southern Lowland Wet Sclerophyll Forest	Wet Sclerophyll Forests (Grassy sub-formation)	Not a TEC	Southern Lowland Wet Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher threat status).	No	Illawarra, Ettrema
24	Illawarra Escarpment Blue Gum Wet Forest (PCT 1245)	North Coast Wet Sclerophyll Forests	Wet Sclerophyll Forests (Shrubby sub-formation)	Not a TEC	North Coast Wet Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher threat status).	No	Illawarra
147	Red Bloodwood - scribbly gum heathy woodland on sandstone plateau of the Sydney Basin Bioregion (PCT 1083)	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not a TEC	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher threat status).	Yes	Ettrema
40						No	
37	River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and Southeast Corner Bioregion (PCT1108)	Eastern Riverine Forests	Forested Wetlands	Not a TEC	Eastern Riverine Forests - ≥ 50% - < 70% cleared group (including Tier 3 or higher threat status).	Yes	Ettrema
25						No	

13.2 Species credits

- Table 13-2 Species credit class and matching credit profile

Species credit	Attributes shared with matching credits				
	Name of threatened species	Kingdom	BC Act status	EPBC Act status	IBRA region
6	<i>Rhodamnia rubescens</i>	Plantae	CE	CE	Sydney Basin
21	<i>Hibbertia puberula</i>	Plantae	E	-	Sydney Basin
375	<i>Genoplesium baueri</i>	Plantae	E	E	Sydney Basin
364	Greater Glider	Animalia	-	V	Sydney Basin
709	Eastern Pygmy Possum	Animalia	V	-	Sydney Basin
661	Gang-gang Cockatoo	Animalia	V	E	Sydney Basin
531	Giant Burrowing Frog	Animalia	V	V	Sydney Basin
356	Littlejohn's Tree Frog	Animalia	V	V	Sydney Basin
233	Southern Myotis	Animalia	V	-	Sydney Basin
35	Large-eared Pied Bat	Animalia	V	V	Sydney Basin

13.3 Offset obligation and strategy

The Biodiversity Offsets Scheme applies to SSI projects unless the Secretary of DPE and the Executive of EESG determine that the Project is not likely to have a significant impact.

Offsets would be required for the residual impacts to native vegetation and species-credit species present within the Project area. The Project impacts and offset obligations have been calculated using the BAM-C based on the concept design, as is normal for a major project at this stage of the process. The Project impacts and offset obligations would be revised in response to submissions and detailed design and would include consideration of areas where total clearing and permanent infrastructure may be avoided.

The credit requirement for the Project that has generated by the BAM-C for the three subregions assessed, includes 596 ecosystem credits and 2,664 species credits. The Biodiversity Credit Report is included in Appendix D.

Fulfilling offset requirements under the BC Act can be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site and the retirement of credits
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

As Origin does not own land in the vicinity of the Project area where all required credits are likely to be available, the establishment of a Stewardship site has not been investigated to date. As such, Origin currently proposes to secure credits through the open market where available or otherwise make payment through the Biodiversity Conservation Fund. Should an opportunity arise to establish a suitable Stewardship site in time, Origin would consider this further in negotiation with relevant landowners. Otherwise, Origin intends to commence consultation with the Biodiversity Conservation Trust including initiating an expression of interest for identified credit requirements.

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Appendix A. Habitat Assessment

State and nationally listed threatened species identified from the literature review, database searches and the BAM-C, were considered in terms of their likelihood to occur in the habitats present within the survey area based on identified habitat requirements.

- Table A-1 Likelihood of occurrence criteria

Likelihood of Occurrence	Criteria
Unlikely	<ul style="list-style-type: none"> Species highly restricted to certain geographical areas not within the assessment area Species has specific habitat requirements that are not present in the study area
Low	<ul style="list-style-type: none"> Species that fit into one or more of the following criteria: Have not been recorded previously in the study area/surrounds, and for which the study area is beyond the current distribution range Use specific habitats or resources not present in the study area. Are non-cryptic perennial flora species that were targeted by surveys and were not recorded.
Moderate	<ul style="list-style-type: none"> Species that fit into one or more of the following criteria: Have infrequently been recorded previously in the study area/surrounds Use specific habitats or resources present in the study area but in poor or modified condition Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration Are cryptic flowering species what were not seasonally targeted by surveys and have not been recorded.
High	<ul style="list-style-type: none"> Species that fit into one or more of the following criteria: Have frequently been recorded previously in the study area/surrounds Use habitat types or resources that are present in the study area in abundance and/or in good condition Are known or likely to maintain resident populations surrounding the study area Are known or likely to visit the site during regular seasonal movements or migration

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Table A-2 Assessment for threatened ecological communities

Ecological community	BC Act	EPBC Act	Distribution and Habitat	Habitat suitability within the study area	Likelihood of Occurrence within the study area
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community (Commonwealth) Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (NSW)	E	E	Known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which <i>Casuarina glauca</i> (swamp oak) is the dominant species northwards from Bermagui. Other trees including <i>Acmena smithii</i> (Lilly Pilly), <i>Glochidion</i> spp. (cheese trees) and <i>Melaleuca</i> spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude. On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, <i>Alexfloydia repens</i> , as well as <i>Baumea juncea</i> , <i>Juncus kraussii</i> , <i>Phragmites australis</i> , <i>Selliera radicans</i> and other saltmarsh species.	None	Unlikely – floodplain habitats in study area are not suitable.
Illawarra and south coast lowland forest and woodland ecological community (Commonwealth) Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (NSW)	E	CE	Recorded from the local government areas (LGAs) of Wollongong, Shellharbour and Kiama, and Shoalhaven. Vegetation types that occupy the Illawarra coastal plain and escarpment foothills. Characteristic tree species include Forest Red Gum <i>Eucalyptus tereticornis</i> , Thin-leaved Stringybark <i>Eucalyptus eugenioides</i> , Wollybutt <i>Eucalyptus longifolia</i> , Coast Grey Box <i>Eucalyptus bosistoana</i> and White Feather Honey-myrtle <i>Melaleuca decora</i> . The understorey is not necessarily grassy as moist forest vegetation types are also included within this broad community. Common shrub species include <i>Acacia mearnsii</i> and <i>Dodonaea viscosa</i> subsp. <i>angustifolia</i> . Floodplain vegetation dominated by <i>Casuarina</i> species or rainforests on latite soils are not part of this community.	This community was identified within the broader study area in disturbed grassy patches with scattered trees in Kangaroo Valley	Low – extensive plot-based vegetation surveys did not detect this community in the study area.
Natural Temperate Grassland of the South Eastern Highlands	-	CE	Natural Temperate Grassland is confined to the Southern Tablelands, a region bounded by the ACT, Yass, Boorowa, the Abercrombie River, Goulburn, the Great Eastern Escarpment, the Victorian border and the eastern boundary of Kosciusko National Park. The community is often treeless, though trees of a range of species may occur in low densities, either as isolated individuals or in clumps. Seasonally wet areas within a site may also contain a range of wetland flora species, including rushes, sedges and a variety of wetland specialist forbs.	Potential habitat in association with nearby floodplain forest along Kangaroo River	Low
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion (Commonwealth) Southern Highlands Shale Woodlands in the Sydney Basin Bioregion (NSW)	CE	CE	Southern Highlands Shale Woodland is confined to a small area in the Southern Highlands. It occurs roughly within an area bounded by the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. Occurs in the Wingecarribee local government area, but may occur elsewhere in the Sydney Basin Bioregion. Southern Highlands Shale Woodland is a variable community in terms of both structure and composition. The community may exist as tall open forest, grassy woodland or scrub; though it originally existed as woodland. The dominant canopy species vary across the distribution of the community. Common species throughout much of the community's range are Mountain Grey Gum <i>Eucalyptus cytellocarpa</i> , Sydney Peppermint <i>E. piperita</i> , Swamp Gum <i>E. ovata</i> , Narrow-leaved Peppermint <i>E. radiata</i> and White Stringybark <i>E. globoidea</i> . Brittle Gum <i>E. mannifera</i> , Snow Gum <i>E. pauciflora</i> , Cabbage Gum <i>E. amplifolia</i> and Rough-barked Apple <i>Angophora</i>	Confirmed in the study area associated with Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254)	Present – found in the northern extent of the study area on shale soils (0.23ha within development site)

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Ecological community	BC Act	EPBC Act	Distribution and Habitat	Habitat suitability within the study area	Likelihood of Occurrence within the study area
			floribunda are less common. Camden Wollybutt <i>E. macarthurii</i> occurs throughout, but appears to be most common in the south-west of the distribution of the community, around Bundanoon. The shrub layer is usually open, though there may be denser patches of shrubs in some areas. As with the canopy layer, the shrub layer of this community varies (e.g. typical species in the north-eastern parts of the distribution of the community include <i>Oxylobium ilicifolium</i> , <i>Melaleuca thymifolia</i> and <i>Olearia microphylla</i> , while in south-western areas these species are rare or absent and <i>Daviesia ulicifolia</i> may be locally common). The groundlayer is usually diverse and dominated by native grasses such as <i>Themeda australis</i> , <i>Austrostipa rudis</i> , <i>Microlaena stipoides</i> and <i>Austrodanthonia</i> species. Common herb species include <i>Gonocarpus tetragynus</i> , <i>Veronica plebeia</i> , <i>Hypericum gramineum</i> , <i>Poranthera microphylla</i> and <i>Viola hederacea</i> .		
Temperate Highland Peat Swamps on Sandstone (Commonwealth) Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions (NSW)	E	E	The Montane Peatlands and Swamps EEC is currently known from parts of the Local Government Areas of Armidale Dumaresq, Bega Valley, Bellingen, Blue Mountains, Bombala, Cooma-Monaro, Eurobodalla, Gloucester, Greater Argyle, Guyra, Hawkesbury, Lithgow, Oberon, Palerang, Severn, Shoalhaven, Snowy River, Tenterfield, Tumbarumba, Tumut, Upper Lachlan and Wingecarribee but may occur elsewhere in these bioregions. The community typically has an open to very sparse layer of shrubs, 1-5 m tall, (e.g. <i>Baeckea gunniana</i> , <i>B. utilis</i> , <i>Callistemon pityoides</i> , <i>Leptospermum juniperinum</i> , <i>L. lanigerum</i> , <i>L. myrtifolium</i> , <i>L. obovatum</i> , <i>L. polygalifolium</i>). Species of <i>Epacris</i> (e.g. <i>E. breviflora</i> , <i>E. microphylla</i> , <i>E. paludosa</i>) and <i>Hakea microcarpa</i> are also common shrubs. In some peatlands and swamps, particularly those with a history of disturbance to vegetation, soils or hydrology, the shrub layer comprises dense thickets of <i>Leptospermum</i> species.	None	Unlikely
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion (Commonwealth) Robertson Basalt Tall Open-forest in the Sydney Basin and South Eastern Highlands Bioregions (NSW) Mount Gibraltar Forest in the Sydney Basin Bioregion (NSW)	CE	E	Robertson Basalt Tall Open Forest is restricted chiefly to occurrences of Robertson Basalt on the Southern Highlands of NSW but also found on the Cambewarra Range to the south. It is found in the Wingecarribee and Shoalhaven local government areas, but may occur elsewhere in the Sydney Basin Bioregion. Robertson Basalt Tall Open Forest is an open forest or woodland reaching to 30 m tall with a sparse to moderately dense shrub layer and a dense herbaceous ground layer. Dominant tree species include Brown Barrel <i>Eucalyptus fastigata</i> , Manna Gum <i>E. viminalis</i> , Narrow-leafed Peppermint <i>E. radiata</i> and Mountain Grey Gum <i>E. cypellocarpa</i> . Blackwood <i>Acacia melanoxylon</i> is a common small tree species in this community. Common shrubs include <i>Coprosma quadrifida</i> and <i>Senecio linearifolius</i> . The composition of the community varies across its distribution, largely reflecting a rainfall gradient from east (near the Illawarra Escarpment) to west (near Bundanoon). Mount Gibraltar Forest in the Sydney Basin Bioregion occurs in the local government areas of Shellharbour and Kiama, where remnants have been recorded at Dunmore, Jambaroo Valley, and in small patches in and around Killalea State Park. May occur elsewhere within the Sydney Basin Bioregion. A dense, dry shrubland to about five metres tall, which is dominated by the large Paperbark shrub, <i>Melaleuca armillaris</i> (Bracelet Honey Myrtle). Characteristic tree and shrub species include <i>Acacia mearnsii</i> (Black Wattle), <i>Alphitonia excelsa</i> (Red Ash), <i>Commersonia fraseri</i> (Brown Kurrajong), <i>Dodonaea viscosa</i> subsp. <i>viscosa</i> , <i>Hibiscus heterophyllus</i> (Native Rosella) and <i>Prostanthera linearis</i> . Characteristic groundcovers include <i>Bracteantha bracteata</i> (Golden Everlasting), <i>Calandrinia pickeringii</i> (Pink Purslane), <i>Cheilanthes distans</i> (Bristly Cloak Fern), <i>C. sieberi</i> (Mulga Fern), <i>Commelina cyanea</i> (Scurvy Weed), <i>Crassula sieberana</i> (Austral Stonecrop) and <i>Plectranthus graveolens</i> . The community also provides habitat for large populations of the endangered shrub <i>Zieria granulata</i> (Illawarra Zieria). Dense stands of <i>M. armillaris</i> on coastal headlands are not included within this ecological community.	No suitable basalt derived soils identified in study area	Low

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Ecological community	BC Act	EPBC Act	Distribution and Habitat	Habitat suitability within the study area	Likelihood of Occurrence within the study area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Commonwealth) White Box Yellow Box Blakely's Red Gum Woodland	E	CE	Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW. White Box Eucalyptus albens, Yellow Box E. melliodora and Blakely's Red Gum E. blakelyi. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare.	None	Unlikely
Coastal Upland Swamp in the Sydney Basin Bioregion (Commonwealth)	E	E	Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The Coastal Upland Swamp is endemic to NSW and confined to the Sydney Basin Bioregion. It occurs in the eastern Sydney Basin from the Somersby district in the north to the Robertson district in the south.	Potential habitat outside study area in association with heathland along drainage lines on the sandstone plateau.	Low
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion (Commonwealth) Illawarra Subtropical Rainforest in the Sydney Basin Bioregion (NSW)	E	CE	Recorded from the local government areas of Wollongong, Shellharbour, Shoalhaven and Kiama, but may occur elsewhere in the Sydney Basin Bioregion. The main occurrences of ISR are located between Albion Park and Gerringong (referred to as the Illawarra Brush in Mills & Jakeman 1995) and on the Berkeley Hills north of Lake Illawarra (referred to as the Berkeley Brush in Mills & Jakeman 1995). Outlying occurrences extend south to the Shoalhaven River and west into the Kangaroo Valley. Illawarra Subtropical Rainforest (ISR) is a rainforest community that occupies high nutrient soils in the Illawarra region, south of Sydney. Characteristic tree species include Baloghia inophylla (Brush Bloodwood), Brachychiton acerifolius (Flame Tree), Dendrocnide excelsa (Giant Stinging Tree), Diploglottis australis (Native Tamarind), Ficus spp., Pennantia cunninghamii (Brown Beech), and Toona ciliata (Red Cedar). Species of Eucalyptus, Syncarpia and Acacia may also be present as emergents or incorporated into the dense canopy. While rainforest canopies are generally closed, in highly disturbed stands the canopy of ISR may be irregular and open.	Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (769) adjacent to the study area is inconsistent with this TEC.	Low
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	E	CE	Known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Eucalyptus tereticornis (forest red gum), E. amplifolia (cabbage gum), Angophora floribunda (rough-barked apple) and A. subvelutina (broad-leaved apple). Eucalyptus baueriana (blue box), E. botryoides (bangalay) and E. elata (river peppermint) may be common south from Sydney, E. ovata (swamp gum) occurs on the far south coast, E. saligna (Sydney blue gum) and E. grandis (flooded gum) may occur north of Sydney, while E. benthamii is restricted to the Hawkesbury floodplain.	Associated with the areas of River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (1108). However the development site is the wrong landform for this community.	Unlikely – found in nearby areas along Kangaroo River. the southern extent of the study area is on a disturbed and elevated site (not floodplain or river terrace). Flooding and water accumulation does not occur within the development site and therefore this community does not occur

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Ecological community	BC Act	EPBC Act	Distribution and Habitat	Habitat suitability within the study area	Likelihood of Occurrence within the study area
			<p>A layer of small trees may be present, including <i>Melaleuca decora</i>, <i>M. styphelioides</i> (prickly-leaved teatree), <i>Backhousia myrtifolia</i> (grey myrtle), <i>Melia azaderach</i> (white cedar), <i>Casuarina cunninghamiana</i> (river oak) and <i>C. glauca</i> (swamp oak).</p> <p>Scattered shrubs include <i>Bursaria spinosa</i>, <i>Solanum prinophyllum</i>, <i>Rubus parvifolius</i>, <i>Breynia oblongifolia</i>, <i>Ozothamnus diosmifolius</i>, <i>Hymenanthera dentata</i>, <i>Acacia floribunda</i> and <i>Phyllanthus gunnii</i>.</p> <p>The groundcover is composed of abundant forbs, scramblers and grasses including <i>Microlaena stipoides</i>, <i>Dichondra repens</i>, <i>Glycine clandestina</i>, <i>Oplismenus aemulus</i>, <i>Desmodium gunnii</i>, <i>Pratia purpurascens</i>, <i>Entolasia marginata</i>, <i>Oxalis perennans</i> and <i>Veronica plebeian</i>. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.</p>		
Robertson Rainforest in the Sydney Basin Bioregion	E	CE	<p>Robertson Rainforest has a restricted distribution in the eastern parts of the Southern Highlands of NSW. There are two main occurrences of the community within this distribution; the principal occurrence is on the Robertson Plateau around the town of Robertson on the Southern Highlands; the second is on the higher parts of the Cambewarra Range further to the south where it is less widespread. It occurs in the Wingecarribee and Shoalhaven local government areas, but may occur elsewhere in the Sydney Basin Bioregion.</p> <p>Robertson Rainforest is a warm or cool temperate rainforest with a generally dense structure. It is dominated by Possumwood <i>Quintinia sieberi</i>, Featherwood <i>Polyosma cunninghamii</i>, Sassafras <i>Doryphora sassafras</i> and Blackwood <i>Acacia melanoxylon</i>. Common shrub species include Tree Violet <i>Hymenanthera dentata</i>, Prickly Coprosma <i>Coprosma quadrifida</i> and Brush Pepperbush <i>Tasmannia insipida</i>.</p>	Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (769) adjacent to the study area is inconsistent with this TEC.	Low
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (Commonwealth) Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (NSW)	E	E	<p>The most widespread and abundant dominant trees include <i>Eucalyptus robusta</i> (swamp mahogany), <i>Melaleuca quinquenervia</i> (paperbark) and, south from Sydney, <i>Eucalyptus botryoides</i> (bangalay) and <i>Eucalyptus longifolia</i> (woollybutt).</p> <p>This community is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.</p>	Potential habitat in association with floodplain forest	Low

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Table A.3 Habitat suitability assessment for threatened plant species (PMST: Means the species was listed in the EPBC Act Protected Matters Search Tool, BAM C: Means the species was listed in the BAM Candidate Species Report based on PCTs, # records: number of records from OEH BioNet Species Sightings Search)

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
Acacia bynoeana Bynoe's Wattle	E	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (<i>Corymbia gummifera</i>), Scribbly Gum (<i>Eucalyptus haemastoma</i>), Drooping Red Gum (<i>E. parramattensis</i>), Old Man Banksia (<i>Banksia serrata</i>) and Small-leaved Apple (<i>Angophora bakeri</i>).	PSMT BAM-C	Low – Lack of records in study locality and not detected during targeted surveys. <i>Acacia bynoeana</i> is not known within the study area locality with the nearest records at Bundanoon and south of Nowra in Colymea State Conservation Area. Known vegetation associations include Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Boronia deanei - Deane's Boronia	V	V	There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau), mainly in conservation reserves. Wildfires have depleted some populations.	PMST BAM-C	Low – non-cryptic perennial flora species that were targeted by surveys and were not recorded. Specific habitats for this species not present in development site. <i>Boronia deanei</i> is known around Nowra Road at Fitzroy Falls near the Visitors Centre. No wet heath or other suitable habitat was identified in development site during targeted surveys. Known vegetation associations include Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Caladenia tessellata Thick-lipped Spider-orchid	E	V	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	PMST BAM-C	Low – Lack of records in study locality and not detected during targeted surveys. Known vegetation associations include Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Calochilus pulchellus - Pretty Beard Orchid	E	-	<i>Calochilus pulchellus</i> is endemic to New South Wales. It is known from the Sydney Basin Bioregion, where a total of less than 30 adult plants have been recorded in three sites over a range of 40 km on the South Coast of NSW, at altitudes from 20-560 m above sea level. All currently known sites are within the Shoalhaven Local Government Area. Occurrence in small, widely separated colonies is not unusual in the genus. The cryptic nature of the species, with a single leaf above ground for only a few months and a flowering stem lasting a few days or a week, makes detection difficult for most of the year. It is likely that additional scattered individuals and small colonies exist within the area of occurrence.	BAM C	Moderate – although not detected during targeted surveys. In Morton National Park on the Little Forest Plateau it occurs in low heath among scattered clumps of emergent eucalypts and Banksia in shallow coarse white sand over sandstone, in a near-escarpment area subject to strong orographic precipitation.
Commersonia prostrata Dwarf Kerrawang	E	V	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (<i>Eucalyptus pauciflora</i>) Woodland and Ephemeral Wetland floor at Rows Lagoon; Blue leaved Stringybark (<i>E. agglomerata</i>) Open Forest at Tallong; and in Brittle Gum (<i>E. mannifera</i>) Low Open Woodland at	PMST BAM-C	Low – species unlikely to occur in Study area or locality. Study area is likely outside species range This species is not associated with any of the PCTs found within the study area (NSW BioNet TBDC).

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			Penrose; Scribbly Gum (<i>E. haemostoma</i>)/ Swamp Mahogany (<i>E. robusta</i>) Ecotonal Forest at Tomago. Dwarf Kerrawang occurs on the Southern Highlands and Southern Tablelands (one plant at Penrose State Forest, one plant at Tallong, a small population near the Corang and about 2000 plants at Rowes Lagoon), a larger population in the Thirlmere Lakes area (particularly among the dying reeds at the edge of the water), and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It is also found in Victoria.		
Cryptostylis hunteriana Leafless Tongue Orchid	V	V	Larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>Cryptostylis subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	PMST BioNet Atlas 1 record BAM C	Low – targeted surveys found no specimens. Two records of this species occur north (north of Fitzroy Falls) and south (Red Rocks plateau – Cambewarra Range Nature Reserve) of the study area. Dry Sclerophyll Forest is broadly considered suitable habitat and Large Tongue Orchid (<i>Cryptostylis subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>) were common in this habitat.
Cynanchum elegans White-flowered Wax Plant	E	E	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest, Coastal Tea-tree (<i>Leptospermum laevigatum</i>) – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honey myrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.	PMST	Low - Use specific habitats or resources not present in the study area. Have not been recorded previously in the study area/surrounds. The nearest records are east towards the coast in Albion Park and Kiama. There is modelled habitat within Kangaroo Valley, however there is no suitable habitat in study area.
Daphnandra johnsonii Illawarra Socketwood	E	E	Restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest.	BAM C	Low – Targeted surveys found no specimens The nearest records are east towards Berry and to the north in Buderoo NP. There is modelled habitat within Kangaroo Valley. Known vegetation associations on site include Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
Eucalyptus aggregata Black Gum	V	V	Black Gum is found in the NSW Central and Southern Tablelands, with small, isolated populations in Victoria and the ACT. In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (<i>Eucalyptus pauciflora</i>), Manna or Ribbon Gum (<i>E. viminalis</i>), Candlebark (<i>E. rubida</i>), Black Sallee (<i>E. stellulata</i>) and Swamp Gum (<i>E. ovata</i>). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (<i>Poa labillardierei</i>) or Kangaroo Grass (<i>Themeda australis</i>), but with few shrubs.	PMST	Unlikely - Species has specific habitat requirements that are not present in the study area. There is modelled habitat within parts of Kangaroo Valley. However, <i>Eucalyptus aggregata</i> is not known from the study area and this species is not associated with any of the PCTs present in, or adjacent to, development site.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
<i>Eucalyptus langleyi</i> Albatross Mallee	V, EP	-	The main occurrence of the Albatross Mallee is to the south-west of Nowra as far as Yarramunmun Creek. A very small population is found to the north of the Shoalhaven River in the Bomaderry Creek Regional Park.	BAM C	Unlikely - Have not been recorded previously in the study area/surrounds, and for which the study area is beyond the current distribution range. Records of <i>Eucalyptus langleyi</i> occur south from Bomaderry. There is modelled habitat in Kangaroo Valley, but it is not associated with any of the PCTs present in, or adjacent to, development site.
<i>Eucalyptus macarthurii</i> Camden Woollybutt	V	E	Has a moderately restricted distribution. It is currently recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges, of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park	PMST BAM-C	Low - Have not been recorded previously in the study area/surrounds, and the study area is beyond the current known distribution. The nearest records are north of Fitzroy Falls and modelled habitat within the plateau of the study area. Known vegetation associations include: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion and Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion. Targeted surveys in habitats with fertile soils did not detect any trees and its considered unlikely to occur.
<i>Eucalyptus sturgissiana</i> - Ettrema Mallee	V	-	The Ettrema Mallee is mostly restricted to the Northern Budawang Range in Morton National Park, with a few occurrences on the nearby coastal plain. Usually grows as an emergent in low shrub heath	BAM C	Low - outside the known range of the population and habitat not preferred
<i>Genoplesium baueri</i> Bauers Midge Orchid	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	PSMT BAM C	Moderate - Have not been recorded previously in the study area/surrounds. No records of this species close to the study area. The nearest record is east near Meroo Meadow. Known vegetation associations on site include: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion. This species will be assumed present in BDAR due to BAM compliant survey occurring outside 2022 flowering season. Plateau areas (PCT 1082) are outside the BAM-C geographical constraint '20km from Nowra'.
<i>Gentiana wingecarrii</i> (Wingecarribee Gentian)	E		Wingecarribee Gentian is known only from Hanging Rock Swamp and Wingecarribee Swamp on the Southern Highlands.	PMST	Low - species unlikely to occur in Study area or locality. Study area is likely outside species range. This species is not associated with any of the PCTs found within the study area (NSW BioNet TBDC). No suitable habitat available in study area. No nearby records.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
<i>Grevillea molyneuxii</i> Wingello Grevillea	V	E	The Wingello Grevillea is restricted to a small area south of Penrose, above Tallowa Gully and Bundanoon Creek, in Morton National Park and on Crown Land.	PMST	Low – species unlikely to occur in Study area or locality. Study area is likely outside species range This species is not associated with any of the PCTs found within the study area (NSW BioNet TBDC). No suitable habitat available in study area. No nearby records.
<i>Grevillea rivularis</i> Carrington Falls Grevillea	CE	E	The Carrington Falls Grevillea is confined to the Carrington Falls area on the upper Kangaroo River west of Kiama, within Budderoo National Park. It had been regarded as restricted to the water's edge but the recent discovery of a small population of mature individuals in woodland at least 500m from the water's edge raises doubt about this assumption. The woodland population may represent a rare establishment event although it is more likely that the species was once more widespread in the landscape and has been pushed to the waterside habitat by increased fire in the landscape.	BAM C	Unlikely – Have not been recorded previously in the study area. No records of this species close to the study area. Known modelled habitat in Fitzroy Falls. Known vegetation: Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion
<i>Grevillea raybrownii</i>	V	-	Generally occurs on ridgetops and, less often, slopes and benches of Hawkesbury Sandstone and Mittagong Formation. It occurs in Eucalyptus open forest and woodland with a shrubby understorey on sandy, gravelly loam soils derived from sandstone that are low in nutrients.	BAM C	Low – species unlikely to occur in Study area or locality. Study area is likely outside species range This species is not associated with any of the PCTs found within the study area (NSW BioNet TBDC). No suitable habitat available in study area. No nearby records.
<i>Haloragis exalata</i> subsp. <i>exalata</i> Square Raspswort / Wingless Raspswort	V	V	Four scattered localities in eastern NSW. Requires protected and shaded damp situations in riparian habitats.	PMST	Low – Have not been recorded previously in the study area/surrounds, and the study area is beyond the current distribution range. No records of this species near the study area. The nearest record is south west past Moollattoo. The species is known from the Illawarra region, but the species is not associated with any of the PCTs present in, or adjacent to, development site.
<i>Helichrysum calvertianum</i>	V	-	<i>Helichrysum calvertianum</i> is endemic to New South Wales where it is currently only known from the Wingecarribee Shire. There are seven known populations. Only one population occurs within the reserve estate, in the northern part of Morton National Park.	PMST BAM C	Low – species unlikely to occur in Study area or locality. Study area is likely outside species range This species is not associated with any of the PCTs found within the study area (NSW BioNet TBDC). No suitable habitat available in study area. No nearby records.
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	E	-	Known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. The species usually grows in 'gravelly loam or clay soil in heath under open woodland'. Habitat of the South Coast population is poorly recorded, but	BAM C	Low – Have not been recorded previously in the study area/surrounds, and the study area is beyond the current distribution range. Surveyed during the time of flowering for this species, but no specimens found. No records of this species near the study area. The nearest records are south east near Bomaderry. There is modelled habitat in Kangaroo Valley. Known vegetation associations on site include: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone.		sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
<i>Hibbertia puberula</i>	E	-	It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath	BAM C	Recorded from targeted survey
<i>Irenepharsus trypherus</i> Illawarra Irene	E	E	Prefers to grow on steep rocky slopes near cliff lines and ridge tops that extend south and east of the Illawarra escarpment. Has also been recorded in deep sandstone gorges along the Shoalhaven River.	PMST BioNet Atlas 15 records BAM C	Low - Surveyed during the time of flowering for this species, Dec-Mar. No specimens found in relevant habitat. Nearest record is near the study area in Kangaroo River Nature Reserve. Suitable habitat modelled in Kangaroo Valley. Known vegetation associations on site include: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Uses specific habitats or resources not present in the study area. No records of this species close to the study area. Nearest records south near Jervis Bay. No suitable habitat modelled in Kangaroo Valley. No known vegetation associations on site.
<i>Melaleuca deanei</i> Deane's Melaleuca	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species grows in heath on sandstone	PMST BAM-C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Associated with PCT 1083. Was targeted by surveys and was not recorded. Nearest records west near Moolattoo.
<i>Persicaria elatior</i> Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	PMST	Low - no suitable habitat in study area. This species is not associated with any of the PCTs found within the study area. No suitable habitat available in study area. No nearby records.
<i>Persoonia glaucescens</i> Mittagong Geebung	E	V	The Mittagong Geebung's historical distribution places the northern and eastern limit at Couridjah (Thirlmere Lakes), the southern limit at Fitzroy Falls and the western limit at High Range. However, recent surveys have indicated that the species no longer extends to Fitzroy Falls or Kangaloon	BAM C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			and that the present southern limit is near Berrima. The Mittagong Geebung grows in woodland to dry sclerophyll forest on clayey and gravely laterite. The preferred topography is ridge-tops, plateaux and upper slopes.		distribution range. Nearest records north near Meryla State Forest. No suitable habitat modelled in Kangaroo Valley.
Persoonia acerosa Needle Geebung	V	V	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba/ Wentworth Falls/ Springwood area.	PMST	Low – species unlikely to occur in Study area or locality. Study area is outside species range. PCT 1083 is associated habitat for Needle Geebung however the development site is not within the species known distribution.
Phyllota humifusa Dwarf Phyllota	V	V	Dwarf Phyllota is known from the southern Blue Mountains (Bimlow Tableland), the Joadja area west of Mittagong and Penrose area near Paddys River. e species occurs in dry sclerophyll forest, sometimes near swamps, in deep sandy soils or gravely loams over a sandstone substrate. Accompanying trees are often Brittle Gum Eucalyptus mannifera, Narrow-leaved Peppermint E. radiata or Sydney Peppermint E. piperita.	BAM-C	Low - Has not been recorded previously in the study area. No records of this species close to the study area. Suitable predicted habitat modelled in Fitzroy Falls. Known vegetation: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Pimelea spicata Spiked Rice-flower	E	E	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open woodland with a more well developed shrub and grass understorey.	PMST BAM C	Low - Have not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. No records of this species close to the study area. Nearest record east near Gerringong. Suitable habitat modelled in Kangaroo Valley. No known vegetation associations on site.
Pomaderris brunnea Brown Pomaderris	E	V	According to the NSW BioNet TBDC profile for this species; Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria. Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. The species has been found in association with Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa and Kunzea ambigua.	PMST BioNet Atlas 1 record	Low - Has not been recorded previously in the study area. PCTs are not associated habitat. Not associated with any PCTs in the study area (NSW BioNet TBDC). Scarce records in locality. No records in Kangaroo Valley or Fitzroy areas. Closest records are south of berry (1), west of Bundanoon (1) and Mittagong (3). Kangaroo Valley is likely beyond the southern extent of this species range.
Pomaderris cotoneaster Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd National Park, the Canyonleigh area and Ettrema Gorge in Morton National Park. The species has also been recorded along the Genoa River in Victoria	PMST BioNet Atlas 2 records	Low – Despite records nearby, species uses specific habitats or resources not present in the study area. Multiple recent records (2016) of this species within 10km of the study area near Cambewarra Range Nature Reserve. Suitable habitat modelled within Kangaroo Valley. No known vegetation associations on site.
Pomaderris sericea Silky Pomaderris	E	V	In NSW, Silky Pomaderris is known only from Berrima and from Wollemi National Park. Silky Pomaderris has also been recorded in north-eastern Victoria. There are only two Silky Pomaderris records in NSW that give	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. One PCT association in study area – PCT 1083

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			details of habitat so it is difficult to generalise about the habitat preferences of the species. Both of these records, however, are from open forest on sandstone. The Bundanoon collection was made at the foot of a cliff.		Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion.
Prasophyllum affine Jervis Bay Leek Orchid	E	E	Grows on poorly drained grey clay soils that support low heathland and sedgeland communities. Jervis Bay Leek Orchid is currently known from three areas south-east of Nowra on South Coast. These are Kinghorne Point, Wowly Gully near the town of Callala Bay, and near the township of Vincentia.	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Not associated with any PCTs in the study area (NSW BioNet TBDC). Closest records are south of Nowra. Kangaroo Valley is likely out of known range.
Prasophyllum fuscum Slaty Leek-orchid	CE	V	Grows in moist heath, often along seepage lines. The known population grows in moist sandy soil over sandstone amongst sedges and grasses in an area that appears to be regularly slashed by the local council.	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range.
Prostanthera densa Villous Mintbush	V	V	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park (Marley), Cronulla, Helensburgh and Port Stephens (Nelson Bay). The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. Prostanthera densa generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	PMST	Low - Targeted surveys in PCT 1083. not recorded. the study area is beyond the known current distribution range. One PCT association in study area - PCT 1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion.
Pterostylis gibbosa Illawarra Greenhood	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>).	PMST BAM C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Uses specific habitats or resources not present in the study area. No records of this species close to the study area. Nearest records east near Broughton Vale. Suitable habitat modelled in Kangaroo Valley. No known vegetation associations on site.
Pterostylis pulchella Waterfall greenhood	V	V	The Waterfall Greenhood is found only at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek (Meryla) and Minnamurra Falls. Found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water.	PMST BAM-C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Uses specific habitats or resources not present in the study area. A few records on the edges of Kangaroo valley, not near the study area. Suitable habitat modelled within Kangaroo Valley. No known vegetation
Pterostylis ventricosa	CE	-	<i>Pterostylis ventricosa</i> is known from populations at St Georges Basin, Sussex Inlet and west of Nowra in the Shoalhaven and also near Tallong and Mittagong in the Southern Highlands. Surveys carried out at various times between 2007 to 2010 estimate a total population of about 1,200	BAM C	Low - not recorded from targeted survey and has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			plants. The two largest populations, one at St Georges Basin and one at Sussex Inlet, are located on estates of private land. Two smaller populations, comprising a total of less than 10% of the known plants, are within Conjola National Park.		
<i>Pterostylis vernalis</i>	CE	CE	<i>Pterostylis vernalis</i> is only known from the Nowra area on the NSW south coast. There are five known populations located to the west and south-west of Nowra. Four are within a few kilometres of each other, and one is located approximately 18 km to the south-west. The total population is approximately 450-500 known individuals. The four northern populations may have once been considered as one population covering an area of approximately 3 km ² . Most known <i>Pterostylis vernalis</i> plants are located on land not reserved for conservation purposes. The exceptions are the southern-most population which is located in Jerrawangala National Park, and a part of one of the northern populations, which is located in Triplarina Nature Reserve.	BAM C	Low – not recorded from targeted survey and has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range.
<i>Rhizanthella slateri</i> Eastern underground orchid	V	E	Very little is known about the ecology of this elusive underground orchid. Flowers are visible on the forest floor in late winter to early spring but further research is needed to determine other factors of its natural history. Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	PMST BAM-C	Low – October surveys in PCT 1082 did not record flowering. the study area is beyond the known current distribution range. Nearest records are south of Nowra. One PCT association in study area – PCT 1082 - Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion. Nearest records are south of Nowra
<i>Rhodamnia rubescens</i> Scrub Turpentine	CE	CE	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	PMST BAM C	Recorded from targeted surveys
<i>Rhodomyrtus psidioides</i> Native Guava	V	CE	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts. Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.	PMST	Low – species unlikely to occur in Study area. Study area is likely outside species range. Not recorded during multiple surveys. A single record near Berry in 2011 is the only record south of Sydney. Associated with one PCT on site: 1245 Illawarra Escarpment Blue Gum wet forest
<i>Solanum celatum</i>	E	-	This shrub is restricted to an area from Wollongong to south of Nowra and west to Bungonia. Its habitat includes rainforest clearings or wet sclerophyll forest and is generally found in disturbed margins and clearings.	BioNet Atlas 10 records BAM C	Low – Targeted surveys in PCT 1245. not recorded.

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					Multiple records close to the study area. Nearest records in Kangaroo River Nature Reserve. Known vegetation associations on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	PMST BAM C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Associated with PCT 1245. No records of this species close to the study area. Nearest records north east near Buderoo. Suitable habitat modelled in Kangaroo Valley.
<i>Thelymitra kangaloonica</i> Kangaloon Sun Orchid	CE	CE	Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgeland over grey silty grey loam soils	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Uses specific habitats or resources not present in the study area. Nearest recent records north near Robertson. No suitable habitat modelled within Kangaroo Valley. No known vegetation associations on site.
<i>Thesium australe</i> Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	PMST	Low - Only one old record from 1911 for this species in the study area/surrounds, and the study area is outside the modelled habitat for this species. Uses specific habitats or resources not present in the study area.
<i>Triplarina nowraensis</i> Nowra Heath-myrtle	E	E	There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon.	PMST BAM C	Low - Has not been recorded previously in the study area/surrounds. Species was targeted by surveys and was not recorded. Nearest records south near Illaroo. Suitable habitat modelled within Kangaroo Valley. Known vegetation associations on site: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
<i>Xerochrysum palustre</i> Swamp Everlasting	V	V	Found in Kosciuszko National Park and the eastern escarpment south of Badja. Also found in eastern Victoria. Grows in swamps and bogs which are often dominated by heaths. Also grows at the edges of bog margins on peaty soils with a cover of shrubs or grasses.	PMST	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. Uses specific habitats or resources not present in the study area. No records of this species close to the study area. Nearest records north near Robertson. No suitable habitat modelled within Kangaroo Valley. No known vegetation associations on site.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
Zieria granulata Illawarra Zieria	E	E	Illawarra Zieria is a bushy shrubs restricted to the Illawarra region primarily in coastal lowlands. It typically occupies dry ridges and rocky outcrops on shallow volcanic soils and less frequently found on moist slopes of the Illawarra escarpment. It grows in association with vegetation comprising Melaleuca armillaris scrub and Eucalyptus tereticornis woodland and rainforest margins.	BAM C	Low - Has not been recorded previously in the study area/surrounds, and the study area is beyond the known current distribution range. No records of this species close to the study area. Nearest records east near Broughton Vale. Suitable habitat modelled in Kangaroo Valley. Known vegetation associations on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion
Zieria murphyi - Velvet Zieria	V	V	Velvet Zieria is found in the Blue Mountains at Mt Tomah and in the southern highlands where it has been recorded in Morton National Park in the Bundanoon area, and at Penrose. Several populations of fewer than 1000 plants are known to occur in both the Blue Mountains and Morton National Parks. The few populations in the Penrose area are believed to be within Morton NP and the largest is between 250 and 500 plants, but the others are much smaller. The Velvet Zieria is found in sheltered positions in moist gullies in moist eucalypt forest with sandy soil	PMST BAM C	Moderate – although not recorded from targeted surveys

Table A.4 Habitat suitability assessment for threatened fauna species *BAM C: Means the species was listed in the BAM Candidate Species Report based on PCTs *PMST: Means the species was listed in the EPBC Act Protected Matters Search Tool*# records: number of records from OEH BioNet Species Sightings Search

Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	Dry open forest in temperate woodlands, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Nest in horizontal branches or forks in tall mature eucalypts and Sheoaks.	PMST BAM C	Low – A few records in the vicinity of Kangaroo Valley, but all spatially suspect. old (1980), or undated. This species is associated with the following identified plant communities on site. River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion
<i>Artamus cyanopterus</i> Dusky Woodswallow	V	-	Dusky woodswallows are widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range.	BAM C BioNet Atlas 4 records	Moderate – not recorded. Many records in the locality. Several recent and reliable records. Associated with all plant communities on site. Not recorded during site surveys.
<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	PMST	Low – Has not been recorded previously in the study area/surrounds. Nearest record is north near Fitzroy Falls. Not associated with any of the vegetation types on site. This species relies on specific habitats not present in the study area.
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of	BioNet Atlas 8 Records BAM C	Present – observed foraging in PCT 1082 group of three. No Breeding activity recorded at large hollow-bearing trees

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			Sheoaks, including Drooping Sheoak, Allocasuarina diminuta, and A. gymnanthera. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata).		
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V	E	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger in eucalypts.	PMST BAM C	Present – Observations were usually of a single bird flying over the assessment area, except for one observation of up to 5 birds foraging in the eucalypt canopy near the southern end of Fitzroy Canal. One adult female and a juvenile male were recorded perched and foraging near three hollow-bearing trees (suitable for breeding) at the southern end of the existing pipeline (on the plateau). Whilst not observed entering/exiting the hollows, it was assumed that one of these trees is a potential nest (as a precautionary approach all three trees were deemed actual nest trees). ^w
<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE	The breeding range of the Curlew Sandpiper is mainly restricted to the Arctic of northern Siberia, including Yamal Peninsula east to Kolyuchiskaya Gulf, Chokotka Peninsula, and also New Siberian Island. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in salt works and sewage farms.	PMST	Low - Has not been recorded previously in the study area/surrounds. Nearest record south east at Shoalhaven Heads. This species relies on specific habitats not present in the study area
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats. Cave roosting bat which favours sandstone escarpment habitats for roosting, in shallow overhands, crevices, and caves.	PMST BAM C	High – No spatially reliable records in the locality. 'Probable' AnaBat recording near Bendeela pondage. Breeding habitat absent from development site Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
					Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Modelled distribution overlaps study area. Not recorded during site surveys.
<i>Charadrius leschenaulti</i> Greater Sand Plover	-	V, M	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	PMST	Unlikely – no suitable habitat present
<i>Dasyornis brachypterus</i> Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. The estimated population size is less than 2000 individuals occupying a total area of about 120 sq km. There are now only four populations in the southern Queensland/northern NSW area with a total of 35 birds, compared to 15 years ago when 14 populations and 154 birds were recorded. This population once extended as far south as at least Dorrigo and has recently been identified as a separate ultrataxon (monoides) but further research is being undertaken to determine the validity of this. The remaining populations are the nominate ultrataxon (brachypterus) and once extended at least to what is now the Sydney urban area. The central population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. The southern	PMST BioNet Atlas 2 records	Low – reliable records from 2003 and 2005 in the locality. Associated with the following plant communities on site: Not recorded during site surveys.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			population in Nadgee Nature Reserve and Howe's Flat is around 200 birds. Further surveys are required in parts of Ben Boyd National Park and Sydney Catchment Authority lands to determine whether further populations of the Eastern Bristlebird occur in these areas.		
<i>Dasyurus maculatus</i> Spotted-tail Quoll	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	PMST BioNet Atlas 6 records BAM C	Moderate – Not recorded during surveys. No records in locality. Nearest records east near Gerringong. Not recorded during camera surveys and spotlighting. However species has large home ranges. Associated with the following plant communities on site: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Euastacus dharawalus</i> Fitzroy Falls Spiny Crayfish	CE (FM Act)	CE	<i>Euastacus dharawalus</i> has only been recorded above (Shull et al. 2005) and below the Fitzroy Falls Reservoir (DPI 2011). The species is restricted to 12km of waterway of Wildes Meadow Creek NSW and less than 1km of this stretch is of good water quality (DPI n.d.). <i>Euastacus dharawalus</i> is found mostly borrowing in soft stream bed habitat under the waterline, however they have been seen foraging on substratum (DPI 2012; DPI 2011). They have adapted to flowing streams hence their disappearance in Fitzroy Falls Reservoir when its habitat became static water (DPI 2012).	PMST	Low – The study area is beyond the current distribution range of this species. Uses specific habitats or resources not present in the study area. Not recorded during site targeted surveys.
<i>Falco hypoleucos</i> Grey falcon	E	V	The Grey Falcon of inland Australia is widely but sparsely distributed in woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses, of mainland Australia. In NSW it occurs on the plains of the Murray-Darling Basin, and particularly west of the Darling	PMST	Low – species unlikely to occur in Study area or locality. This species is not associated with any of the PCTs found within the study area or locality. The study area is outside the species distribution.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			River. Falcons (including the Grey) are highly mobile, commonly travelling over hundreds of kilometres (Marchant & Higgins 1993)		
<i>Grantiella picta</i> <i>Painted Honeyeater</i>	V	V	Nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	PMST	Low - Has not been recorded previously in the study area/surrounds. Records of this species are very scarce in the locality with one in Wollongong and 4 in the Warragamba Dam catchment west of Sydney. No records near Kangaroo Valley, Fitzroy Falls, or Nowra PCT 1083 is associated habitat for the Painted Honeyeater. No mistletoe plants were recorded in the areas of this PCT.
<i>Heleioporus australiacus</i> <i>Giant Burrowing Frog</i>	V	V	Northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	PMST BAM C	Moderate – Three records in the locality. One reliable from 2010 near Red Rocks. Not recorded during surveys however surveys do not meet guidelines for this species. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Hirundapus caudacutus</i> – <i>White-throated Needletail</i>	-	V	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	PMST BAM C	Moderate – the species could occur, and would be expected to fly over the study area on occasion
<i>Hoplocephalus bungaroides</i> <i>Broad-headed Snake</i>	V	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Shelters	PMST BioNet Atlas 2 records	low –

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			in hollows of large trees within 200m of escarpments in summer	BAM C	<p>records in the locality, most recently from 1999. One record close to development site in Morton National park. Not recorded during surveys and habitat assessment reveals low-quality rocky outcrops.</p> <p>Associated with the following plant communities on site:</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion</p> <p>Not recorded during site surveys.</p>
<i>Isoodon obesulus obesulus</i> Southern Brown Bandicoot (eastern)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burned from time to time. A mosaic of post fire vegetation is important for this species.	PMST BAM C	<p>Low – Not recorded. No records in the locality. Nearest record south near Tapitallee. Not recorded during camera surveys and spotlighting.</p> <p>Associated with the following plant communities on site:</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Modelled distribution overlaps study area.</p> <p>Not recorded during site surveys.</p>
<i>Lathamus discolor</i> Swift Parrot	E	CE	Where eucalypts are flowering profusely or where there is abundant lerp infestations. Favour Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>).	PMST	Low - Has not been recorded previously in the study area/surrounds. Is likely to forage on occasion during migration.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	50 recorded locations in NSW, mostly coastal or near coastal. Large populations are located around metropolitan Sydney, Shoalhaven, and mid north coast.	PMST BAM C	Low – Two records with high spatial uncertainty in the locality, most recently in 1947. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Modelled distribution overlaps study area. Not recorded during site surveys.
<i>Mixophyes balbus</i> Stuttering Frog	V	V	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST BAM C	Low – Two records within the locality, most recently in 1994. The other record is spatially uncertain. Not recorded during call playback and spotlighting surveys. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Not recorded during site surveys.
<i>Litoria littlejohni</i> Littlejohn's Tree Frog	V	E	Distribution includes the plateaus and eastern slopes of the Great Dividing Range. Breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation.	PMST BAM C	Moderate – there are some records north and east of study area within Budderoo National Park. There is suitable habitat modelled around Fitzroy Falls and predicted habitat in Kangaroo Valley. Surveys were undertaken outside the recommended survey window. Associated with the following plant communities on site: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion
<i>Petauroides volans</i> Greater Glider	-	V	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. This population of Greater Gliders on the south coast of NSW is bounded by the Moruya River to the north, Coila Lake to the south and the Princes Highway and cleared land exceeding 700 m in width to the west. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use	PMST BioNet Atlas 2 records	High - recorded – Four separate sightings within and adjacent to the study area. Den trees also identified nearby.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha.		
<i>Tyto novaehollandiae</i> Masked Owl	V	-	Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	BAM C	High – Multiple recent records (2015) for this species in the locality.
<i>Tyto tenebricosa</i> Sooty Owl	V	-	Occupies the coast, coastal escarpment and eastern tablelands. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as most eucalypt forests. Nests in very large tree hollows.	BAM C	High – Many records in the vicinity and a few close to the study area, most recently in 2015.
<i>Ninox connivens</i> Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.	BAM C	Low – may be expected in the broader locality although very few records from the south coast. Not identified from nocturnal surveys conducted during the breeding season
<i>Ninox strenua</i> Powerful Owl	V	-	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species.	BAM C	Moderate – may be expected in the locality. Not identified from nocturnal surveys conducted during the breeding season.
<i>Petroica phoenicea</i> Flame Robin	V	-	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense.	BAM C	Low – Nine records within the locality, most recently in 2015. Most records prior to 1999. Associated with the following plant communities on site: Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion. Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Not recorded during site surveys.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes.		
<i>Petroica boodang</i> Scarlet Robin	V	-	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.	BioNet Atlas 4 records BAM C	Moderate – Not recorded. Eight records in the locality. A number of recent and reliable records. Most recently in 2015. Associated with the following plant communities on site: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Not recorded during site surveys.
<i>Pycnoptilus floccosus</i> Pilotbird	-	V	Pilotbirds are endemic to south-east Australia. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the Australian Capital Territory, and in the Snowy Mountains in New South Wales and north - east Victoria (Higgins & Peter 2002; Loyn et al. 2021). Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne (Higgins & Peter 2002; Loyn et al. 2021). Breeding takes places between August and January. Adults build a domed nest on or near the ground. The 2019/2020 bushfires in NSW severely impacted the habitat of this species. The species extent of occurrence (EOO) is estimated to be 212,200 km ² (stable trend), however the area of occupancy (AOO) is estimated to have contracted to 26,600 km ² (Loyn et al. 2021).	PMST 20+ close records on Atlas of Living Australia	Moderate – Not recorded. Numerous records in the locality. Cluster of historical records near Fitzroy Falls. A number of nearby records to development site (Bendeela 2003). Suitable habitat in all PCTs however regrowth vegetation is less suitable. Superb Lyrebird is commonly observed (which Pilotbirds can often be associated with). Likely to be using surrounding unburnt forest areas in Morton National Park and Kangaroo Valley. Not recorded during site surveys.
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead	BioNet Atlas 2 records BAM C	Moderate – Not recorded. Many records in the locality. Reliable records from 2011/2012 in the locality. Associated with all plant communities on site. Not recorded during site surveys.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.		
<i>Pachycephala olivacea</i> <i>Olive Whistler</i>	V	-	The Olive Whistler inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes.	BioNet Atlas 1 record BAM C	Low – One reliable record in the locality from 2018. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Not recorded during site surveys.
<i>Glossopsitta pusilla</i> <i>Little Lorikeet</i>	V	-	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (<i>angophora</i> sp.), paperbarks (<i>melaleuca</i> sp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	BAM C	High – Five records in locality. One reliable and recent in 2019. Associated with the following plant communities on site: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion

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					Not recorded during site surveys.
<i>Neophema pulchella</i> <i>Turquoise Parrot</i>	V	-	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	BAM C	Moderate – No records in the locality. Nearest record north east near Barron Grounds. Associated with the following plant communities on site: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Not recorded during site surveys.
<i>Ptilinopus regina</i> <i>Rose-crowned Fruit Dove</i>	V	-	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	BAM C	Low –One record within the locality from 2006. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Ptilinopus superbus</i> <i>Superb Fruit-Dove</i>	V	-	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	BAM C	Low - No records in the locality. Nearest record is east near Gerringong. Associated with the following plant community on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Cercartetus nanus</i> <i>Eastern Pygmy-possum</i>	V	-	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.	BAM C	recorded in plateau areas. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

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					<p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion</p> <p>.</p>
<i>Miniopterus australis</i> <i>Little Bentwing-bat</i>	V	-	Eastern coast and ranges from Cape York to Wollongong. Roost in caves, tunnels, tree hollows, stormwater drains, culverts, bridges, and sometime buildings.	BAM C	<p>High – No records in the locality. Nearest record south near Bangalee.</p> <p>Associated with the following plant communities on site:</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Not recorded during site surveys.</p>
<i>Miniopterus schreibersii oceanensis</i> <i>Eastern Bentwing-bat</i>	V	-	East and north-west coasts of Australia. Primarily roost in caves, but also use abandoned mines, stormwater tunnels, buildings and other man-made structures.	BioNet Atlas 7 records BAM C	<p>High – Many records within the locality. Reliable and recent records from as recently as 2018.</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p>

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<p><i>Micronomus norfolkensis</i></p> <p><i>Eastern Coastal Freetail-bat</i></p>	V	-	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	<p>BioNet Atlas 6 records</p> <p>BAM C</p>	<p>High - High – Many records within the locality. Reliable and recent records from as recently as 2018.</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Modelled distribution overlaps study area.</p> <p>Not recorded during site surveys.</p>
<p><i>Myotis macropus</i></p> <p><i>Southern Myotis</i></p>	V		Roosts close to water in caves, mine shafts, hollow-bearing trees, buildings, bridges, and in dense foliage. Forages over streams and ponds.	<p>BioNet Atlas 2 records</p> <p>BAM C</p>	<p>High – Two records in locality from 1995.</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p>

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<i>Phoniscus papuensis</i> Golden-tipped Bat	V	-	The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. It also occurs in New Guinea. Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes.	BAM C	<p>Moderate – No records in the locality. Nearest record south near Tapitallee.</p> <p>Associated with the following plant communities on site:</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Modelled distribution overlaps study area.</p> <p>Not recorded during site surveys.</p>
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V	-	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	BAM C	<p>High – Three records in the locality, most recently from 2001.</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p>

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<i>Saccolaimus flaviventris</i> <i>Yellow-bellied Sheathtail Bat</i>	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	BAM C	<p>Moderate – No records in the locality. Nearest record is south east near Bangalee.</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion</p> <p>Modelled distribution overlaps study area.</p> <p>Not recorded during site surveys.</p>
<i>Phascolarctos cinereus</i> <i>Koala</i>	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	PMST BioNet Atlas 1 record BAM C	<p>Low – Five records in the locality, most recently in 2016. Not recorded during camera surveys, SAT surveys (20 plots and 344 trees searched for scats) and spotlighting (48 person hours).</p> <p>Associated with the following plant communities on site:</p> <p>River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p>

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<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Generally found within 200km of the eastern coast. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	PMST BioNet Atlas 4 records BAM C	<p>High – Recorded. Many records within the locality, most recently in 2016. One record near Bendeela Pondage in 2014.</p> <p>Associated with all plant communities on site.</p> <p>Modelled distribution overlaps study area.</p> <p>Recorded during site surveys.</p>
<i>Potorous tridactylus</i> Long-nosed Potoroo	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruited) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.	PSMT BioNet Atlas 8 records BAM C	<p>Low – Not recorded. Records in the locality, most recently from 2014. Two records close to Fitzroy Canal, but are spatially dubious. Not recorded during camera surveys and spotlighting.</p> <p>Associated with the following plant communities on site:</p> <p>Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion</p> <p>Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion</p> <p>Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion</p> <p>Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion</p> <p>Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion</p> <p>Modelled distribution overlaps study area.</p> <p>Not recorded during site surveys.</p>
<i>Pseudomys novaehollandiae</i> New Holland Mouse		V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	PMST BAM C	<p>Low – Not recorded. One record in the locality, but large amount of spatial uncertainty of record. Not recorded during camera surveys and spotlighting.</p> <p>Associated with the following plant communities on site:</p>

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					Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion The predicted distribution overlaps study area. Not recorded during site surveys.
<i>Petaurus norfolcensis</i> <i>Squirrel Glider</i>	V	-	Dispersed widely but sparsely through eastern Australia. Prefers mixed species stands with a shrub or Acacia midstorey.	BioNet Atlas 1 record BAM C	low – Not recorded. Two records in locality. Not recorded during camera surveys and spotlighting. Associated with the following plant communities on site: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Modelled distribution overlaps study area. Not recorded during site surveys.
<i>Petrogale penicillata</i> <i>Brush-tailed Rock-wallaby</i>	E	V	Range follows roughly the line of the Great Dividing Range. Occupies rocky escarpments, outcrops, and cliffs with a preference for complex structures. Browse on vegetation in and adjacent to rocky areas.	PMST BioNet Atlas 14 records BAM C	Low – Not recorded. Many records in the locality, most recently in 2012. Not recorded during camera surveys. Suitable habitat is outside development site (nearby escarpments). Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
					Not recorded during site surveys.
<i>Petaurus australis</i> <i>Yellow-bellied Glider</i>	V	-	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	BioNet Atlas 12 records BAM C PMST (south-eastern subspecies)	Low – recorded within the locality, most recently from 2012. Not recorded during camera surveys and spotlighting. Associated with the following plant communities on site: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Falsistrellus tasmaniensis</i> <i>Eastern False Pipistrelle</i>	V	-	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania.	BioNet Atlas 1 record BAM C	High – Multiple records from the locality, most recently in 2003 Associated with the following plant communities on site: River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Sydney sandstone hinterland dry sclerophyll forests of the Sydney Basin Bioregion Not recorded during site surveys.

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
<i>Rostratula australis</i> Painted Snipe	-	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	PMST	Unlikely – no suitable habitat
<i>Numenius madagascariensis</i> Eastern Curlew		CE, M	Generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets	PMST	Unlikely – no suitable habitat
<i>Haliaeetus leucogaster</i> White-bellied Sea Eagle	V	-	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	BAM C	Moderate – may be associated with the Kangaroo River. No nest sites found from targeted survey of the assessment area
<i>Hieraaetus morphnoides</i> Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. 1 Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	BAM C	Moderate – no nest sites found from targeted survey of the assessment area
<i>Lophoictinia isura</i> Square-tailed Kite	V	-	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	BAM C	Moderate – no nest sites found from targeted survey of the assessment area
<i>Pseudophryne australis</i> Red-crowned Toadlet	V	-	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	BAM C	Unlikely – No records in the locality and not known from Morton National Park
<i>Varanus rosenbergi</i> Rosenberg's Goanna	V	-	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and	BioNet Atlas 1 record BAM C	Low –records in the locality, most recently in 2017 near Lake Yarrunga. Not recorded during camera surveys and during all other surveys. Associated with the following plant communities on site: Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

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Species	BC Act	EPBC Act	Distribution and Habitat	Data Source *see notes on page 1	Likelihood of Occurrence / BAM assessment inclusion
			woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.		Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion Not recorded during site surveys.
<i>Macquaria australasica</i> <i>Macquarie Perch</i>	E	E (FM Act)	The Macquarie Perch is a riverine species that prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks. In Victorian parts of the Murray-Darling, only small natural populations remain in the upper reaches of the Mitta Mitta, Ovens, Broken, Campaspe and Goulburn Rivers; translocated populations occur in the Yarra River and Lake Eildon. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers. Populations of the eastern form are confined to the Hawkesbury-Nepean and Shoalhaven river systems. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam. In the ACT, it is restricted to the Murrumbidgee, Paddys and Cotter Rivers	PMST	Unlikely – No records in the locality. Study area within the “maybe” expert predicted distribution for the species. Not recorded during site surveys.
<i>Prototroctes maraena</i> <i>Australian Grayling</i>	-	V	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones. The species has also recorded in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea. It has been recorded from many rivers across its range, particularly in Tasmania and Victoria. In NSW it is found from the Shoalhaven River south, with important river systems for the species including the Shoalhaven River, Bega River and Clyde River systems.	PMST	Unlikely – No records in the locality. Study area within the “maybe” expert predicted distribution for the species. Not recorded during site surveys.

Appendix B. Vegetation survey data

Vegetation zone				Plot ID	Plot ID																														
					PCT	Area (Ha)	patch size	condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	fun Large Trees	fun Hollow trees	fun Litter Cover	fun Len Fallen Logs	fun Tree Stem 5to9	fun Tree Stem 10to19	fun Tree Stem 20to29	fun Tree Stem 30to49	fun Tree Stem 50to79	fun Tree Regen	fun High Threat Exotic
1	MV-1			Plot 2.11	1254	0.23	100	High	56	269723	6159724	29	5	9	7	10	1	8	63	1.5	5.4	1.5	0.5	6.7	0	0	98.6	6.0	1	1	1	1	1	1	0.0
1	MV-1			Plot 2.14	1254	0.23	100	High	56	269890	6159741	80	3	17	8	11	4	11	51.5	8.6	47.3	1.1	10.1	11.5	1	2	87.6	22.0	1	1	1	1	1	1	0.0
2	MV-2	ILL-1		Plot 2.6	1156	1.83	100	High	56	269391	6157430	321	6	17	7	3	6	5	44.7	29.5	8.5	0.4	10.4	2.4	0	1	90.0	58.0	1	1	1	1	0	1	0.0
2	MV-2	ILL-1		Plot 2.10	1156	1.83	100	High	56	269360	6158962	158	5	21	7	5	3	1	59.2	58.4	2.9	1.5	0.4	0.1	1	5	93.0	26.0	1	1	1	1	1	1	0.0
2	MV-2	ILL-1		Plot MC5	1156	1.83	100	High	56	269466	6156505	304	5	9	3	2	1	3	41.7	30.0	22.5	3.0	4.0	1.3	1	0	88.0	60.0	0	1	1	1	1	0	0.0
3	MV-3	ILL-2		Plot 2.1	1156	2.52	100	Mod_old_regrowth	56	269529	6159571	189	4	16	11	8	1	6	74.0	21.8	3.5	0.8	0.1	3.4	1	0	87.0	5.0	1	1	1	1	1	1	0.0
3	MV-3	ILL-2		Plot 2.7	1156	2.52	100	Mod_old_regrowth	56	269338	6158665	238	7	14	8	3	3	9	74.1	5.5	5.6	0.3	0.3	1.3	1	1	98.0	33.0	1	1	1	1	1	1	0.0
4	MV-4	ILL-3		Plot 2.5	1156	1.15	100	Mod_shrub_regrowth	56	269421	6157460	322	5	14	6	0	0	0	11.7	64.3	1.0	0.0	0.0	0.0	0	0	16.2	3.0	1	1	0	0	0	1	0.1
5	MV-5			Plot 2.2	1082	2.25	100	High	56	269527	6156863	319	4	20	8	3	1	1	16.5	35.1	90.5	0.3	0.1	0.1	0	1	96.0	23.0	1	0	1	1	0	1	0.0
5	MV-5			Plot 2.3	1082	2.25	100	High	56	269547	6156949	330	5	18	4	5	2	1	27.5	31.9	50.4	0.6	0.2	0.1	2	2	96.0	9.0	1	1	1	1	1	1	0.0
6	MV-6	ILL-4		Plot 2.4	1082	4.14	100	Mod_old_regrowth	56	269481	6157277	349	3	16	5	3	0	0	40.5	12.6	2.4	1.2	0.0	0.0	0	0	80.6	33.0	1	1	1	1	0	1	0.0
6	MV-6	ILL-4		Plot 2.13	1082	4.14	100	Mod_old_regrowth	56	269227	6158355	205	3	23	7	3	0	0	11.0	81.3	2.0	40.2	0.0	0.0	0	1	73.0	0.0	0	1	1	1	0	1	0.0
6	MV-6	ILL-4		Plot MC6	1082	4.14	100	Mod_old_regrowth	56	269226	6158789	175	4	11	3	1	0	0	20.0	83.8	36.5	20.0	0.0	0.0	0	0	82.0	4.0	1	1	1	1	0	1	0.0
7				Plot 2.8	1082	0.15	100	Mod_shrub_regrowth	56	269332	6158840	100	3	7	3	7	0	5	3.1	138.6	5.2	1.1	0.0	0.5	0	0	83.0	0.0	0	0	1	1	0	0	0.0
8		ILL-5	ETT-1	Plot 2.16	1283	2.50	100	Mod_old_regrowth	56	269047	6153967	120	3	10	3	9	0	5	9.0	51.9	31.5	2.1	0.0	4.5	0	0	58.0	30.0	0	1	0	1	0	0	0.1
8		ILL-5	ETT-1	Plot 2.19	1283	2.50	100	Mod_old_regrowth	56	268935	6153854	83	4	6	4	5	2	5	42.3	36.3	4.6	0.9	0.3	0.8	0	0	88.0	21.0	1	1	1	0	0	0	0.2
9		ILL-6	ETT-2	Plot 3.9	1283	0.10	101	Mod_young_regrowth	56	268686	615977	225	6	9	5	2	0	1	20.5	87.1	0.6	0.2	0.0	0.1	0	0	78.0	2.0	1	1	1	1	0	1	0.1
10		ILL-7		Plot 3.15	1283	0.03	100	Mod_sheoak_regrowth	56	268997	6154804	250	5	8	5	7	0	6	76.2	39.8	0.6	0.8	0.0	0.8	0	0	94.0	22.0	1	1	0	1	0	1	0.0
11		ILL-8		Plot MC1	1245	1.41	100	Moderate	56	269116	6154921	50	4	10	5	1	2	4	33.0	39.8	13.3	2.0	5.0	19.2	0	0	94.0	10.0	1	1	1	1	0	0	0.0
11		ILL-8		Plot MC2	1245	1.41	100	Moderate	56	269193	6154876	20	3	8	4	2	0	6	27.5	54.1	55.1	25.5	0.0	1.3	1	0	80.0	22.0	1	1	1	1	1	0	0.2
11		ILL-8		Plot MC3	1245	1.41	100	Moderate	56	269194	6154964	270	0	4	6	1	2	3	0.0	6.0	11.6	2.0	18.0	95.0	0	0	72.0	4.0	0	1	0	0	0	0	0.0
12			ETT-3	Plot 3.11	1083	2.98	100	High	56	269195	6153885	145	4	29	4	4	1	9	22.1	56.5	0.4	0.4	0.1	5.9	1	3	79.8	16.0	1	1	1	1	1	1	0.0
12			ETT-3	Plot 3.13	1083	2.98	100	High	56	269232	6153690	205	4	24	6	7	0	4	31.1	70.6	1.2	1.1	0.0	0.5	1	1	98.0	66.0	1	1	1	1	1	1	0.0
13			ETT-4	Plot 2.17	1083	3.70	100	Mod_old_regrowth	56	269021	6153694	109	4	4	5	2	0	3	54.1	69.0	0.9	0.2	0.0	1.7	1	2	94.0	12.0	1	1	1	0	1	1	0.1
13			ETT-4	Plot 2.18	1083	3.70	100	Mod_old_regrowth	56	268889	6153719	296	7	14	4	4	0	1	20.2	89.9	0.4	0.5	0.0	0.1	0	0	95.6	5.0	1	1	1	1	0	1	0.0
13			ETT-4	Plot 3.14	1083	3.70	100	Mod_old_regrowth	56	269429	6153995	83	2	5	1	5	0	0	68.0	7.8	0.1	0.7	0.0	0.0	0	0	70.8	10.0	1	1	1	0	0	1	1.2
14			ETT-5	Plot 2.15	1083	2.82	100	Mod_shrub_regrowth	56	269107	6153839	328	2	13	4	2	0	0	4.0	12.2	0.4	0.2	0.0	0.0	0	0	14.2	0.0	1	1	0	0	0	1	0.00
14			ETT-5	Plot 3.12	1083	2.82	100	Mod_shrub_regrowth	56	269101	6153726	322	3	7	6	6	2	2	9.2	97.7	0.7	0.6	0.2	0.2	0	0	48.8	5.0	1	1	0	0	0	1	0.00
15			ETT-6	Plot 3.6	1108	1.14	100	Mod_old_regrowth	56	267905	6153557	82	2	7	5	8	2	3	40.3	105.3	0.6	10.0	0.3	5	90	1	83.0	5.0	1	1	1	0	1	1	0.6

Vegetation zone				Plot ID		Detailed Data																													
						PCT	Area (Ha)	patch size	condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	fun Large Trees	fun Hollow trees	fun Litter Cover	fun Len Fallen Logs	fun Tree Stem 5to9	fun Tree Stem 10to19	fun Tree Stem 20to29	fun Tree Stem 30to49	fun Tree Stem 50to79	fun Tree Regen
15			ETT-6	Plot 3.4	1108	1.14	100	Mod_old_regrowth	56	268111	6153759	120	4	10	3	2	0	7	5.4	75.1	0.3	0.2	0.0	52.7	95	1	66.0	15.0	0	1	1	0	0	0	2.1
15			ETT-6	Plot 1.4	1108	1.14	100	Mod_old_regrowth	56	268069	6153848	142	1	4	3	9	2	3	0.5	51.6	70.2	1.0	0.3	0.3	0	0	92.8	44.0	0	0	0	0	0	0	0.1
16			ETT-7	Plot MC 7	1108	2.54	100	Low_derived_grass	56	267915	6153634	122	1	4	2	2	0	1	0.1	8.1	85.0	5.1	0.0	0.1	0	0	12.0	9.0	0	0	0	0	0	0	4.0
16			ETT-7	Plot MC 8	1108	2.54	100	Low_derived_grass	56	268012	6153757	237	1	3	2	1	1	2	2.0	8.0	90.0	2.0	1.0	1.5	0	0	7.0	12.0	0	0	0	0	0	0	8.0

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			Covers	Native	Trees	Shrubs	Grasses	Forbs	Fern	Other	Exotic	HighThreat
Plot 1.1		PCT	# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	51	51	4	19	6	12	3	7	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			99.3	99.3	14.6	78.7	3.6	1.2	0.3	0.9	0	0
Eucalyptus globoidea	6	5	TG		6							
Angophora floribunda	6	2	TG		6							
Syncarpia glomulifera	2.5	3	TG		2.5							
Kunzea ambigua	40	45	SG			40						
Melaleuca linariifolia	30	25	SG			30						
Banksia spinulosa	2	10	SG			2						
Leucopogon juniperinus	0.5	5	SG			0.5						
Hibbertia empetrifolia	0.1	5	SG			0.1						
Callistemon citrinus	2	25	SG			2						
Acacia obtusifolia	0.5	10	SG			0.5						
Melaleuca thymifolia	0.3	20	SG			0.3						
Lagenophora stipitata	0.1	100	FG					0.1				
Veronica plebeia	0.1	1	FG					0.1				
Entolasia marginata	0.5	1000	GG				0.5					
Microlaena stipoides	1	1000	GG				1					
Glycine tabacina	0.1	250	OG							0.1		
Pratia purpurascens	0.1	100	FG					0.1				
Oplismenus aemulus	1	500	GG				1					
Pultenaea retusa	0.1	1	SG			0.1						
Opercularia hispida	0.1	25	FG					0.1				
Lomandra longifolia	0.1	10	GG				0.1					
Persoonia linearis	0.25	5	SG			0.25						
Parsonsia straminea	0.1	100	OG							0.1		
Lindsaea linearis	0.1	100	EG						0.1			
Cissus hypoglauca	0.3	10	OG							0.3		
Cheilanthes sieberi	0.1	5	EG						0.1			
Marsdenia rostrata	0.1	3	OG							0.1		
Billardiera scandens	0.1	10	OG							0.1		
Leptospermum trinervium	2	10	SG			2						
Ozothamnus diosmifolius	0.1	2	SG			0.1						
Goodenia heterophylla	0.1	5	FG					0.1				
Pittosporum revolutum	0.1	1	SG			0.1						
Myrsine variabilis	0.1	20	SG			0.1						
Dianella caerulea	0.1	1	FG					0.1				
Pomax umbellata	0.1	1	FG					0.1				
Clematis aristata	0.1	10	OG							0.1		
Pteridium esculentum	0.1	5	EG						0.1			
Breynia oblongifolia	0.1	1	SG			0.1						
Poranthera microphylla	0.1	25	FG					0.1				

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.1		PCT	# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	51	51	4	19	6	12	3	7	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			99.3	99.3	14.6	78.7	3.6	1.2	0.3	0.9	0	0
Clerodendrum tomentosum	0.1	2	TG		0.1							
Hakea salicifolia	0.1	1	SG			0.1						
Oxalis perennans	0.1	5	FG					0.1				
Glycine clandestina	0.1	5	OG							0.1		
Boronia polygalifolia	0.1	1	FG					0.1				
Empodisma minus	0.5	500	GG				0.5					
Gonocarpus tetragynus	0.1	500	FG					0.1				
Notelaea venosa	0.1	3	SG			0.1						
Hypericum gramineum	0.1	100	FG					0.1				
Leptospermum polygalifolium	0.25	5	SG			0.25						
Entolasia stricta	0.5	100	GG				0.5					
Leptospermum spp.	0.1	5	SG			0.1						

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.2			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	42	42	8	11	3	10	1	9	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			62.5	62.5	24.3	33	3.2	1	0.1	0.9	0	0
Syncarpia glomulifera	15	46	TG		15							
Eucalyptus saligna	5	7	TG		5							
Eucalyptus globoidea	3	8	TG		3							
Angophora floribunda	0.5	1	TG		0.5							
Kunzea ambigua	25	30	SG			25						
Eucalyptus smithii	0.5	1	TG		0.5							
Leucopogon juniperinus	5	50	SG			5						
Bursaria spinosa	0.2	5	SG			0.2						
Notelaea venosa	1	10	SG			1						
Clerodendrum tomentosum	0.1	25	TG		0.1							
Leptospermum polygalifolium	0.3	5	SG			0.3						
Acacia mearnsii	1	15	SG			1						
Entolasia marginata	2	500	GG				2					
Gonocarpus tetragynus	0.1	50	FG					0.1				
Microlaena stipoides	1	250	GG				1					
Billardiera scandens	0.1	10	OG							0.1		
Dichondra repens	0.1	50	FG					0.1				
Dianella caerulea	0.1	5	FG					0.1				
Tylophora barbata	0.1	5	OG							0.1		
Marsdenia rostrata	0.1	10	OG							0.1		
Glycine tabacina	0.1	25	OG							0.1		
Glycine clandestina	0.1	50	OG							0.1		
Cheilanthes sieberi	0.1	50	EG						0.1			
Breynia oblongifolia	0.1	5	SG			0.1						
Solanum prinophyllum	0.1	1	FG					0.1				
Poranthera microphylla	0.1	5	FG					0.1				
Veronica plebeia	0.1	50	FG					0.1				
Gonocarpus teucroides	0.1	10	FG					0.1				
Clematis aristata	0.1	25	OG							0.1		
Hibbertia empetrifolia	0.1	2	SG			0.1						
Lagenophora stipitata	0.1	100	FG					0.1				
Myrsine variabilis	0.1	5	SG			0.1						
Oplismenus aemulus	0.2	150	GG				0.2					
Macrozamia communis	0.1	2	OG							0.1		
Opercularia hispida	0.1	15	FG					0.1				
Morinda jasminoides	0.1	5	OG							0.1		
Persoonia linearis	0.1	1	SG			0.1						
Glochidion ferdinandi	0.1	1	TG		0.1							
Guioa semiglauca	0.1	1	TG		0.1							
Oxalis perennans	0.1	5	FG					0.1				

Biodiversity development assessment report

			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.2			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	42	42	8	11	3	10	1	9	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			62.5	62.5	24.3	33	3.2	1	0.1	0.9	0	0
Acacia obtusifolia	0.1	5	SG			0.1						
Parsonsia straminea	0.1	5	OG							0.1		

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.3			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	52	48	6	10	10	15	2	5	4	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			22.6	22.2	16.8	1.6	1.3	1.6	0.3	0.6	0.4	0.2
Eucalyptus globoidea	15	8	TG		15							
Syncarpia glomulifera	1	1	TG		1							
Persoonia linearis	0.2	1	SG			0.2						
Leucopogon juniperinus	0.2	10	SG			0.2						
Cheilanthes sieberi	0.1	100	EG						0.1			
Hypochaeris radicata	0.1	25	EX								0.1	
Pittosporum undulatum	0.5	2	SG			0.5						
Breynia oblongifolia	0.1	5	SG			0.1						
Pteridium esculentum	0.2	50	EG						0.2			
Xanthorrhoea concava	0.2	10	OG							0.2		
Daviesia ulicifolia	0.1	2	SG			0.1						
Solanum pseudocapsicum	0.1	150	EX								0.1	
Angophora floribunda	0.1	1	TG		0.1							
Lagenophora stipitata	0.1	25	FG					0.1				
Glycine tabacina	0.1	150	OG							0.1		
Panicum simile	0.1	10	GG				0.1					
Microlaena stipoides	0.2	150	GG				0.2					
Dianella caerulea	0.1	10	FG					0.1				
Pomax umbellata	0.1	5	FG					0.1				
Paspalidium distans	0.2	200	GG				0.2					
Pratia purpurascens	0.1	250	FG					0.1				
Vernonia cinerea	0.2	250	FG					0.2				
Poranthera microphylla	0.1	5	FG					0.1				
Tricoryne elatior	0.1	100	FG					0.1				
Oxalis perennans	0.1	25	FG					0.1				
Lomandra obliqua	0.1	10	GG				0.1					
Opercularia hispida	0.1	25	FG					0.1				
Lomandra longifolia	0.1	2	GG				0.1					
Eragrostis brownii	0.1	5	GG				0.1					
Boronia polygalifolia	0.1	25	FG					0.1				
Hardenbergia violacea	0.1	10	OG							0.1		
Entolasia stricta	0.2	250	GG				0.2					
Hypericum gramineum	0.1	50	FG					0.1				
Clerodendrum tomentosum	0.1	20	TG		0.1							
Macrozamia communis	0.1	2	OG							0.1		
Podolobium ilicifolium	0.1	2	SG			0.1						

Biodiversity development assessment report

			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.3			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1283	52	48	6	10	10	15	2	5	4	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			22.6	22.2	16.8	1.6	1.3	1.6	0.3	0.6	0.4	0.2
Desmodium gunnii	0.1	50	FG					0.1				
Hibbertia scandens	0.1	1	OG							0.1		
Allocasuarina littoralis	0.5	6	TG		0.5							
Hydrocotyle laxiflora	0.1	250	FG					0.1				
Elaeocarpus reticulatus	0.1	1	SG			0.1						
Ligustrum sinense	0.1	2	HT									0.1
Bidens pilosa	0.1	15	HT									0.1
Dichondra repens	0.1	50	FG					0.1				
Echinopogon caespitosus	0.1	10	GG				0.1					
Lepidosperma laterale	0.1	25	GG				0.1					
Solanum prinophyllum	0.1	2	FG					0.1				
Bursaria spinosa	0.1	2	SG			0.1						
Ozothamnus diosmifolius	0.1	1	SG			0.1						
Oplismenus aemulus	0.1	50	GG				0.1					
Acacia mearnsii	0.1	1	SG			0.1						
Acacia binervia	0.1	1	TG		0.1							

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.4			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1108	28	22	1	4	3	9	2	3	6	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			124.6	123.9	0.5	51.6	70.2	1	0.3	0.3	0.7	0.2
Acacia mearnsii	50	38	SG			50						
Leucopogon juniperinus	1	50	SG			1						
Breynia oblongifolia	0.5	50	SG			0.5						
Dichondra repens	0.2	500	FG					0.2				
Ozothamnus diosmifolius	0.1	10	SG			0.1						
Clerodendrum tomentosum	0.5	10	TG		0.5							
Oplismenus aemulus	0.1	250	GG				0.1					
Pteridium esculentum	0.2	50	EG						0.2			
Solanum prinophyllum	0.1	10	FG					0.1				
Veronica plebeia	0.1	50	FG					0.1				
Microlaena stipoides	70	1000	GG				70					
Solanum pseudocapsicum	0.2	100	EX								0.2	
Sida rhombifolia	0.1	50	EX								0.1	
Bidens pilosa	0.1	25	HT									0.1
Solanum mauritianum	0.1	10	EX								0.1	
Pratia purpurascens	0.1	500	FG					0.1				
Sigesbeckia orientalis	0.1	50	FG					0.1				
Cheilanthes sieberi	0.1	10	EG						0.1			
Stephania japonica	0.1	5	OG							0.1		
Ligustrum sinense	0.1	5	HT									0.1
Hydrocotyle laxiflora	0.1	150	FG					0.1				
Oxalis perennans	0.1	10	FG					0.1				
Vernonia cinerea	0.1	1	FG					0.1				
Glycine tabacina	0.1	150	OG							0.1		
Lagenophora stipitata	0.1	50	FG					0.1				
Entolasia marginata	0.1	100	GG				0.1					
Morinda jasminoides	0.1	5	OG							0.1		
Conyza spp.	0.1	1	EX								0.1	

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 1.5			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1108	36	21	1	5	3	10	1	1	15	4
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			148	145.4	0.1	40.8	95.6	8.6	0.1	0.2	2.6	1.1
Acacia mearnsii	40	8	SG			40						
Microlaena stipoides	95	1000	GG				95					
Solanum mauritianum	0.2	25	EX								0.2	
Sigesbeckia orientalis	7	1000	FG					7				
Ligustrum sinense	0.3	50	HT									0.3
Verbascum virgatum	0.2	10	EX								0.2	
Conyza spp.	0.1	25	EX								0.1	
Rumex brownii	0.1	20	FG					0.1				
Melicytus dentatus	0.5	2	SG			0.5						
Solanum aviculare	0.1	1	SG			0.1						
Ageratina riparia	0.1	10	HT									0.1
Araujia sericifera	0.5	100	HT									0.5
Sida rhombifolia	0.1	50	EX								0.1	
Oxalis perennans	0.2	500	FG					0.2				
Pratia purpurascens	0.2	1000	FG					0.2				
Bidens pilosa	0.2	200	HT									0.2
Anagallis arvensis	0.1	25	EX								0.1	
Hydrocotyle laxiflora	0.1	100	FG					0.1				
Verbena bonariensis	0.1	5	EX								0.1	
Solanum chenopodioides	0.2	100	EX								0.2	
Clerodendrum tomentosum	0.1	1	TG		0.1							
Einadia hastata	0.2	25	FG					0.2				
Solanum pseudocapsicum	0.2	50	EX								0.2	
Oplismenus aemulus	0.5	500	GG				0.5					
Veronica plebeia	0.1	5	FG					0.1				
Commelina cyanea	0.5	150	FG					0.5				
Cheilanthes sieberi	0.1	10	EG						0.1			
Tagetes minuta	0.1	20	EX								0.1	
Cyperus spp.	0.1	30	GG				0.1					
Portulaca oleracea	0.1	3	FG					0.1				
Stephania japonica	0.2	5	OG							0.2		
Urochloa panicoides	0.1	5	EX								0.1	
Dichondra repens	0.1	250	FG					0.1				
Breynia oblongifolia	0.1	1	SG			0.1						
Leucopogon juniperinus	0.1	1	SG			0.1						
Chenopodium album	0.1	5	EX								0.1	

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11/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forbs	Fern	Other	Exotic	HighThreat
Plot 2.1		PCT	# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1156	46	46	4	16	11	8	1	6	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			103.6	103.6	74	21.8	3.5	0.8	0.1	3.4	0	0
Eucalyptus piperita	3	10	TG		3							
Eucalyptus sieberi	60	70	TG		60							
Calochlaena dubia	1	25	OG							1		
Allocasuarina littoralis	10	50	TG		10							
Banksia ericifolia	5	10	SG			5						
Leucopogon lanceolatus	0.5	10	SG			0.5						
Lomandra longifolia	2	50	GG				2					
Dianella caerulea	0.1	10	FG					0.1				
Entolasia stricta	0.2	200	GG				0.2					
Hardenbergia violacea	0.1	2	OG							0.1		
Persoonia linearis	0.2	1	SG			0.2						
Pultenaea daphnoides	0.3	30	SG			0.3						
Gahnia clarkei	0.1	5	GG				0.1					
Hibbertia aspera	0.1	20	SG			0.1						
Lepidosperma laterale	0.1	5	GG				0.1					
Cissus hypoglauca	2	10	OG							2		
Epacris pulchella	0.1	5	SG			0.1						
Elaeocarpus reticulatus	0.3	2	SG			0.3						
Lomandra filiformis subsp. filiformis	0.1	1	GG				0.1					
Gonocarpus teucrioides	0.1	10	FG					0.1				
Entolasia marginata	0.1	1	GG				0.1					
Acacia mearnsii	3	25	SG			3						
Lomandra obliqua	0.1	10	GG				0.1					
Opercularia hispida	0.1	30	FG					0.1				
Viola hederacea	0.1	50	FG					0.1				
Poranthera microphylla	0.1	20	FG					0.1				
Billardiera scandens	0.1	5	OG							0.1		
Dillwynia spp.	0.1	10	SG			0.1						
Leptospermum trinervium	1	15	SG			1						
Acacia obtusifolia	2	50	SG			2						
Hakea laevipes	6	25	SG			6						
Caustis flexuosa	0.1	5	GG				0.1					
Persoonia levis	0.1	1	SG			0.1						
Blechnum cartilagineum	0.1	1	EG						0.1			
Parsonia straminea	0.1	5	OG							0.1		
Pittosporum undulatum	2	1	SG			2						
Clematis aristata	0.1	1	OG							0.1		
Bursaria spinosa	1	10	SG			1						
Austrostipa pubescens	0.1	5	GG				0.1					
Tristaniopsis collina	1	1	TG		1							

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11/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.1		PCT	# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
		1156	46	46	4	16	11	8	1	6	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			103.6	103.6	74	21.8	3.5	0.8	0.1	3.4	0	0
Schoenus melanostachys	0.5	1	GG				0.5					
Microlaena stipoides	0.1	50	GG				0.1					
Oxalis perennans	0.1	10	FG					0.1				
Lagenophora stipitata	0.1	1	FG					0.1				
Leptospermum polygalifolium	0.1	5	SG			0.1						
Patersonia sericea	0.1	2	FG					0.1				

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11/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.2			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
1082			37	37	4	20	8	3	1	1	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			142.8	142.8	16.5	35.3	90.5	0.3	0.1	0.1	0	0
Banksia serrata	3	15	TG		3							
Eucalyptus consideniana	12	11	TG		12							
Eucalyptus sieberi	1	1	TG		1							
Lambertia formosa	5	40	SG			5						
Leucopogon lanceolatus	0.2	10	SG			0.2						
Epacris pulchella	0.1	10	SG			0.1						
Petrophile sessilis	0.2	20	SG			0.2						
Isopogon anethifolius	0.5	30	SG			0.5						
Hakea dactyloides	1	25	SG			1						
Platysace linearifolia	0.5	100	SG			0.5						
Hibbertia empetrifolia	0.2	50	SG			0.2						
Amperea xiphoclada	0.1	5	SG			0.1						
Cyathochaeta diandra	85	300	GG				85					
Patersonia sericea	0.1	25	FG					0.1				
Xylomelum pyriforme	0.1	2	SG			0.1						
Dampiera stricta	0.1	5	FG					0.1				
Lomandra multiflora	0.1	1	GG				0.1					
Persoonia levis	0.1	2	SG			0.1						
Leptospermum trinervium	25	50	SG			25						
Leptomeria acida	0.1	50	SG			0.1						
Lycopodium deuterodensum	0.1	1	EG						0.1			
Lomandra obliqua	0.1	50	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	25	GG				0.1					
Banksia paludosa	0.5	3	SG			0.5						
Entolasia stricta	0.1	5	GG				0.1					
Leptospermum polygalifolium	0.2	10	SG			0.2						
Leptospermum rotundifolium	1	20	SG			1						
Schoenus melanostachys	4	10	GG				4					
Banksia spinulosa	0.2	2	SG			0.2						
Gahnia clarkei	1	30	GG				1					
Cryptostylis subulata	0.1	1	FG					0.1				
Xanthorrhoea spp.	0.1	1	OG							0.1		
Allocasuarina littoralis	0.5	1	TG		0.5							
Lepyrodia scariosa	0.1	25	GG				0.1					
Bossiaea heterophylla	0.1	1	SG			0.1						
Hibbertia riparia	0.1	10	SG			0.1						
Kunzea ambigua	0.1	1	SG			0.1						

13/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
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Plot 2.3			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
1082			35	35	5	18	4	5	2	1	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			110.7	110.7	27.5	31.9	50.4	0.6	0.2	0.1	0	0
Eucalyptus sieberi	7	2	TG		7							
Eucalyptus sclerophylla	6	5	TG		6							
Leptospermum trinervium	5	50	SG			5						
Lambertia formosa	15	50	SG			15						
Leptospermum polygalifolium	0.2	5	SG			0.2						
Gahnia clarkei	0.2	10	GG				0.2					
Isopogon anemonifolius	1	30	SG			1						
Cyathochaeta diandra	50	150	GG				50					
Patersonia sericea	0.2	35	FG					0.2				
Platysace linearifolia	0.5	40	SG			0.5						
Persoonia levis	2	8	SG			2						
Banksia paludosa	2	20	SG			2						
Bossiaea scolopendria	0.1	5	SG			0.1						
Phyllota phyllicoides	0.1	1	SG			0.1						
Hibbertia aspera	1	60	SG			1						
Hakea laevipes	3	20	SG			3						
Eucalyptus considiana	10	8	TG		10							
Lindsaea linearis	0.1	200	EG						0.1			
Banksia serrata	4	2	TG		4							
Petrophile sessilis	1	15	SG			1						
Entolasia stricta	0.1	10	GG				0.1					
Allocasuarina littoralis	0.5	2	TG		0.5							
Banksia spinulosa	0.5	2	SG			0.5						
Acacia obtusifolia	0.1	10	SG			0.1						
Dampiera stricta	0.1	10	FG					0.1				
Gonocarpus teucrioides	0.1	15	FG					0.1				
Lycopodium deuterodensum	0.1	10	EG						0.1			
Lomandra obliqua	0.1	15	GG				0.1					
Cryptostylis erecta	0.1	1	FG					0.1				
Xylomelum pyriforme	0.1	1	SG			0.1						
Cassytha glabella	0.1	5	OG							0.1		
Tetradlea thymifolia	0.1	1	SG			0.1						
Acacia ulicifolia	0.1	1	SG			0.1						
Dianella caerulea	0.1	5	FG					0.1				
Bossiaea heterophylla	0.1	30	SG			0.1						

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13/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.4			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			27	27	3	16	5	3	0	0	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			56.7	56.7	40.5	12.6	2.4	1.2	0	0	0	0
Eucalyptus sieberi	35	35	TG		35							
Hakea laevipes	5	30	SG			5						
Persoonia levis	0.5	3	SG			0.5						
Allocasuarina littoralis	5	5	TG		5							
Kunzea ambigua	5	20	SG			5						
Cyathochaeta diandra	2	50	GG				2					
Acacia terminalis	0.2	20	SG			0.2						
Hibbertia aspera	0.2	30	SG			0.2						
Lomandra obliqua	0.1	30	GG				0.1					
Eucalyptus considiana	0.5	1	TG		0.5							
Patersonia sericea	1	50	FG					1				
Platysace linearifolia	0.2	30	SG			0.2						
Bossiaea ensata	0.1	10	SG			0.1						
Podolobium ilicifolium	0.1	5	SG			0.1						
Dampiera stricta	0.1	5	FG					0.1				
Lomandra filiformis subsp. filiformis	0.1	30	GG				0.1					
Gahnia sieberiana	0.1	1	GG				0.1					
Phyllota phylloides	0.1	10	SG			0.1						
Banksia spinulosa	0.5	2	SG			0.5						
Exocarpos strictus	0.1	2	SG			0.1						
Hovea linearis	0.1	2	FG					0.1				
Acacia ulicifolia	0.1	1	SG			0.1						
Entolasia stricta	0.1	10	GG				0.1					
Xylomelum pyriforme	0.1	3	SG			0.1						
Petrophile sessilis	0.1	1	SG			0.1						
Leptospermum trinervium	0.2	1	SG			0.2						
Leucopogon lanceolatus	0.1	1	SG			0.1						

Biodiversity development assessment report

13/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 2.5			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			26	25	5	14	6	0	0	0	1	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			77.1	77	11.7	64.3	1	0	0	0	0.1	0.1
Kunzea ambigua	40	200	SG			40						
Acacia mearnsii	2	50	SG			2						
Acacia terminalis	0.5	30	SG			0.5						
Leptospermum polygalifolium	20	100	SG			20						
Allocasuarina littoralis	0.5	15	TG		0.5							
Eucalyptus piperita	5	40	TG		5							
Hakea laevipes	0.5	30	SG			0.5						
Eucalyptus sieberi	1	2	TG		1							
Epacris pulchella	0.1	5	SG			0.1						
Dracophyllum secundum	0.1	1	SG			0.1						
Corymbia gummiifera	5	3	TG		5							
Eragrostis brownii	0.1	10	GG				0.1					
Persoonia levis	0.1	5	SG			0.1						
Entolasia stricta	0.1	50	GG				0.1					
Lomandra longifolia	0.5	5	GG				0.5					
Acacia obtusifolia	0.1	2	SG			0.1						
Monotoca scoparia	0.1	1	SG			0.1						
Acacia binervata	0.2	5	TG		0.2							
Microlaena stipoides	0.1	10	GG				0.1					
Leucopogon lanceolatus	0.1	1	SG			0.1						
Axonopus fissifolius	0.1	30	HT									0.1
Poa spp.	0.1	1	GG				0.1					
Pultenaea daphnoides	0.1	1	SG			0.1						
Callicoma serratifolia	0.1	1	SG			0.1						
Leptospermum continentale	0.5	20	SG			0.5						
Rytidosperma spp.	0.1	5	GG				0.1					

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13/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			43	43	6	16	7	3	6	5	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			95.8	95.8	44.7	29.4	8.5	0.4	10.4	2.4	0	0
Eucalyptus sieberi	30	30	TG		30							
Eucalyptus piperita	10	10	TG		10							
Lambertia formosa	15	75	SG			15						
Lycopodium deuterodensum	0.2	50	EG						0.2			
Pteridium esculentum	2	100	EG						2			
Cyathea australis	2	3	OG							2		
Gleichenia dicarpa	5	500	EG						5			
Gahnia sieberiana	5	10	GG				5					
Hakea laevipes	3	20	SG			3						
Entolasia marginata	0.1	50	GG				0.1					
Cyathochaeta diandra	3	50	GG				3					
Leptospermum polygalifolium	5	50	SG			5						
Corymbia gummifera	2	5	TG		2							
Persoonia linearis	0.5	1	SG			0.5						
Banksia spinulosa	4	10	SG			4						
Viola hederacea	0.1	10	FG					0.1				
Sticherus flabellatus	3	100	EG						3			
Cryptostylis erecta	0.1	10	FG					0.1				
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Entolasia stricta	0.1	10	GG				0.1					
Acacia mearnsii	0.1	5	SG			0.1						
Blechnum cartilagineum	0.1	20	EG						0.1			
Banksia serrata	1.5	2	TG		1.5							
Allocasuarina littoralis	1	5	TG		1							
Xylomelum pyriforme	0.1	20	SG			0.1						
Patersonia sericea	0.2	20	FG					0.2				
Tetratheca thymifolia	0.1	10	SG			0.1						
Cissus hypoglauca	0.1	10	OG							0.1		
Leptospermum trinervium	0.5	2	SG			0.5						
Banksia paludosa	0.1	2	SG			0.1						
Persoonia levis	0.5	3	SG			0.5						
Smilax glycyphylla	0.1	1	OG							0.1		
Lepyrodia scariosa	0.1	20	GG				0.1					
Acacia terminalis	0.1	5	SG			0.1						
Isopogon anemonifolius	0.1	1	SG			0.1						
Acacia binervata	0.2	1	TG		0.2							
Platysace linearifolia	0.1	1	SG			0.1						
Hibbertia aspera	0.1	30	SG			0.1						
Pandorea pandorana	0.1	3	OG							0.1		

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13/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			43	43	6	16	7	3	6	5	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			95.8	95.8	44.7	29.4	8.5	0.4	10.4	2.4	0	0
Lindsaea microphylla	0.1	5	EG						0.1			
Parsonsia straminea	0.1	20	OG							0.1		
Lomandra longifolia	0.1	1	GG				0.1					
Leucopogon lanceolatus	0.1	1	SG			0.1						

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13/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 2.7			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			44	44	7	14	8	3	3	9	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			87.1	87.1	74.1	5.5	5.6	0.3	0.3	1.3	0	0
Syncarpia glomulifera	15	30	TG		15							
Gahnia sieberiana	1.5	5	GG				1.5					
Leucopogon lanceolatus	2	10	SG			2						
Eucalyptus piperita	40	25	TG		40							
Acacia binervata	15	30	TG		15							
Entolasia marginata	0.1	100	GG				0.1					
Dianella caerulea	0.1	20	FG					0.1				
Clematis aristata	0.1	20	OG							0.1		
Lepidosperma laterale	0.1	10	GG				0.1					
Viola hederacea	0.1	200	FG					0.1				
Monotoca scoparia	0.1	1	SG			0.1						
Angophora floribunda	3	2	TG		3							
Hibbertia aspera	0.1	5	SG			0.1						
Morinda jasminoides	0.1	10	OG							0.1		
Gahnia clarkei	3	25	GG				3					
Smilax glycyphylla	0.1	1	OG							0.1		
Pandorea pandorana	0.1	2	OG							0.1		
Persoonia linearis	1	3	SG			1						
Podolobium ilicifolium	0.1	1	SG			0.1						
Acacia obtusifolia	0.2	10	SG			0.2						
Lindsaea microphylla	0.1	10	EG						0.1			
Gonocarpus teucroides	0.1	10	FG					0.1				
Cissus hypoglauca	0.1	5	OG							0.1		
Pittosporum undulatum	0.1	1	SG			0.1						
Pultenaea daphnoides	0.1	3	SG			0.1						
Parsonsia straminea	0.1	10	OG							0.1		
Leptospermum polygalifolium	0.3	10	SG			0.3						
Sticherus lobatus	0.1	5	EG						0.1			
Cyathea australis	0.5	1	OG							0.5		
Hakea laevipes	0.1	2	SG			0.1						
Pomaderris ligustrina	0.1	1	SG			0.1						
Elaeocarpus reticulatus	0.2	1	SG			0.2						
Pteridium esculentum	0.1	5	EG						0.1			
Calochlaena dubia	0.1	2	OG							0.1		
Microlaena stipoides	0.1	20	GG				0.1					
Eustrephus latifolius	0.1	1	OG							0.1		
Acmena smithii	0.5	1	TG		0.5							
Ceratopetalum apetalum	0.5	1	TG		0.5							
Lomandra longifolia	0.2	1	GG				0.2					

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13/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 2.7			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			44	44	7	14	8	3	3	9	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			87.1	87.1	74.1	5.5	5.6	0.3	0.3	1.3	0	0
Notelaea venosa	0.1	2	SG			0.1						
Callicoma serratifolia	1	1	SG			1						
Schoenus melanostachys	0.5	1	GG				0.5					
Opilismenus imbecillis	0.1	25	GG				0.1					
Allocasuarina littoralis	0.1	1	TG		0.1							

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14/02/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 2.8			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			25	25	3	7	3	7	0	5	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			148.5	148.5	3.1	138.6	5.2	1.1	0	0.5	0	0
Leptospermum polygalifolium	40	100	SG			40						
Melaleuca hypericifolia	1	5	SG			1						
Gahnia sieberiana	5	30	GG				5					
Hydrocotyle laxiflora	0.5	500	FG					0.5				
Veronica plebeia	0.1	20	FG					0.1				
Entolasia marginata	0.1	30	GG				0.1					
Dichondra repens	0.1	20	FG					0.1				
Acacia spp.	2	30	SG			2						
Gonocarpus tetragynus	0.1	5	FG					0.1				
Parsonsia straminea	0.1	5	OG							0.1		
Microlaena stipoides	0.1	50	GG				0.1					
Leptospermum petersonii	70	250	SG			70						
Elaeocarpus reticulatus	25	30	SG			25						
Clematis aristata	0.1	5	OG							0.1		
Oxalis perennans	0.1	10	FG					0.1				
Viola hederacea	0.1	50	FG					0.1				
Leucopogon lanceolatus	0.1	1	SG			0.1						
Morinda jasminoides	0.1	5	OG							0.1		
Hakea laevipes	0.5	2	SG			0.5						
Smilax glycyphylla	0.1	5	OG							0.1		
Hypericum japonicum	0.1	5	FG					0.1				
Allocasuarina littoralis	1	1	TG		1							
Hibbertia scandens	0.1	1	OG							0.1		
Eucalyptus piperita	2	1	TG		2							
Guioa semiglauca	0.1	1	TG		0.1							

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.9			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			31	31	3	14	5	6	3	0	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			89.3	89.3	21	66.5	0.5	1	0.3	0	0	0
Eucalyptus sclerophylla	5	6	TG		5							
Eucalyptus sieberi	1	1	TG		1							
Allocasuarina littoralis	15	200	TG		15							
Banksia ericifolia	10	100	SG			10						
Persoonia levis	0.5	5	SG			0.5						
Kunzea ambigua	30	200	SG			30						
Leptospermum trinervium	5	30	SG			5						
Leptospermum polygalifolium	10	200	SG			10						
Hakea laevipes	10	50	SG			10						
Patersonia sericea	0.5	30	FG					0.5				
Epacris pulchella	0.2	20	SG			0.2						
Viola hederacea	0.1	20	FG					0.1				
Entolasia stricta	0.1	50	GG				0.1					
Spiranthes australis	0.1	1	FG					0.1				
Leucopogon lanceolatus	0.1	5	SG			0.1						
Platysace linearifolia	0.1	5	SG			0.1						
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Lindsaea microphylla	0.1	10	EG						0.1			
Cryptostylis erecta	0.1	5	FG					0.1				
Petrophile pulchella	0.1	5	SG			0.1						
Grevillea linearifolia	0.1	1	SG			0.1						
Microtis spp.	0.1	5	FG					0.1				
Schizaea bifida	0.1	5	EG						0.1			
Lepyrodia scariosa	0.1	10	GG				0.1					
Gleichenia dicarpa	0.1	5	EG						0.1			
Leptomeria acida	0.2	5	SG			0.2						
Cyathochaeta diandra	0.1	10	GG				0.1					
Petrophile sessilis	0.1	5	SG			0.1						
Thysanotus tuberosus	0.1	5	FG					0.1				
Acacia obtusifolia	0.1	5	SG			0.1						
Rytidosperma spp.	0.1	1	GG				0.1					

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.10			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			42	42	5	21	7	5	3	1	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			122.5	122.5	59.2	58.4	2.9	1.5	0.4	0.1	0	0
Eucalyptus piperita	30	30	TG		30							
Eucalyptus sieberi	20	15	TG		20							
Allocasuarina littoralis	5	30	TG		5							
Amperea xiphoclada	1	5	SG			1						
Hakea laevipes	40	60	SG			40						
Melaleuca hypericifolia	1	5	SG			1						
Epacris pulchella	0.2	30	SG			0.2						
Gahnia clarkei	1	30	GG				1					
Schoenus melanostachys	0.5	3	GG				0.5					
Pultenaea daphnoides	0.2	5	SG			0.2						
Leptospermum polygalifolium	5	50	SG			5						
Leucopogon lanceolatus	0.2	10	SG			0.2						
Entolasia marginata	0.1	20	GG				0.1					
Lepyrodia scariosa	0.1	5	GG				0.1					
Banksia ericifolia	1	5	SG			1						
Banksia serrata	4	2	TG		4							
Dianella caerulea	0.2	30	FG					0.2				
Pteridium esculentum	0.2	10	EG						0.2			
Smilax glyciphylla	0.1	5	OG							0.1		
Panicum effusum	0.1	5	GG				0.1					
Lepidosperma laterale	1	25	GG				1					
Aotus ericoides	2	30	SG			2						
Lambertia formosa	2	10	SG			2						
Leptospermum trinervium	3	30	SG			3						
Hibbertia aspera	0.3	50	SG			0.3						
Lindsaea microphylla	0.1	10	EG						0.1			
Patersonia glabrata	1	30	FG					1				
Lomandra obliqua	0.1	20	GG				0.1					
Xylomelum pyriforme	0.1	5	SG			0.1						
Persoonia levis	0.2	5	SG			0.2						
Gleichenia dicarpa	0.1	30	EG						0.1			
Platysace linearifolia	0.1	5	SG			0.1						
Bossiaea kiamensis	0.2	15	SG			0.2						
Petrophile sessilis	0.1	1	SG			0.1						
Persoonia mollis subsp. ledifolia	0.5	5	SG			0.5						
Viola hederacea	0.1	30	FG					0.1				
Banksia paludosa	0.2	5	SG			0.2						
Elaeocarpus reticulatus	0.1	5	SG			0.1						
Dampiera stricta	0.1	10	FG					0.1				

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			Covers	Nati ve	Tree s	Shru bs	Gras s	Forb	Fern	Oth er	Exot ic	HighThr eat
Plot 2.10			# spp	Cou nt	Cou nt	Coun t	Cou nt	Cou nt	Cou nt	Cou nt	Cou nt	Count
			42	42	5	21	7	5	3	1	0	0
Species	Cov er	Abunda nce	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			122.5	122. 5	59.2	58.4	2.9	1.5	0.4	0.1	0	0
Syncarpia glomulifera	0.2	1	TG		0.2							
Cryptostylis erecta	0.1	5	FG					0.1				
Acacia obtusifolia	1	10	SG			1						

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.11			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			40	40	5	9	7	10	1	8	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			78.6	78.6	63	1.5	5.4	1.5	0.5	6.7	0	0
Eucalyptus cypellocarpa	45	20	TG		45							
Eucalyptus piperita	15	15	TG		15							
Eucalyptus globoidea	1	2	TG		1							
Glycine clandestina	0.1	100	OG							0.1		
Leucopogon lanceolatus	0.1	2	SG			0.1						
Lomandra longifolia	2	30	GG				2					
Dichondra repens	0.5	1000	FG					0.5				
Entolasia stricta	0.1	10	GG				0.1					
Hibbertia aspera	0.1	10	SG			0.1						
Exocarpos strictus	0.2	5	SG			0.2						
Gonocarpus tetragynus	0.1	2	FG					0.1				
Pteridium esculentum	0.5	50	EG						0.5			
Hibbertia scandens	1	30	OG							1		
Lepidosperma laterale	1	15	GG				1					
Notelaea venosa	0.1	5	SG			0.1						
Clematis aristata	0.1	50	OG							0.1		
Hydrocotyle laxiflora	0.1	5	FG					0.1				
Optismenus imbecillis	0.1	50	GG				0.1					
Calochlaena dubia	5	500	OG							5		
Acacia obtusifolia	0.1	10	SG			0.1						
Eustrephus latifolius	0.1	5	OG							0.1		
Oxalis perennans	0.1	50	FG					0.1				
Pittosporum multiflorum	0.1	2	SG			0.1						
Centella asiatica	0.1	20	FG					0.1				
Persoonia linearis	0.5	2	SG			0.5						
Dianella caerulea	0.1	10	FG					0.1				
Viola hederacea	0.2	500	FG					0.2				
Entolasia marginata	2	500	GG				2					
Cyathea australis	0.2	1	OG							0.2		
Gahnia clarkei	0.1	1	GG				0.1					
Elaeocarpus reticulatus	0.2	1	SG			0.2						
Parsonia straminea	0.1	10	OG							0.1		
Rytidosperma spp.	0.1	1	GG				0.1					
Lagenophora stipitata	0.1	1	FG					0.1				
Dipodium variegatum	0.1	1	FG					0.1				
Pandorea pandorana	0.1	1	OG							0.1		

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.11			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			40	40	5	9	7	10	1	8	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			78.6	78.6	63	1.5	5.4	1.5	0.5	6.7	0	0
Poranthera microphylla	0.1	10	FG					0.1				
Syncarpia glomulifera	1	1	TG		1							
Eucalyptus sieberi	1	2	TG		1							
Pultenaea daphnoides	0.1	1	SG			0.1						

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.12			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			31	30	6	6	2	1	6	9	1	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			133.7	133.6	100.6	25.8	0.2	0.1	1.6	5.3	0.1	0.1
Ceratopetalum apetalum	80	200	TG		80							
Blechnum cartilagineum	0.5	10	EG						0.5			
Eucalyptus piperita	10	5	TG		10							
Callicoma serratifolia	25	25	SG			25						
Syncarpia glomulifera	5	1	TG		5							
Cyathea australis	4	5	OG							4		
Tasmannia insipida	0.2	20	SG			0.2						
Morinda jasminoides	0.1	5	OG							0.1		
Acacia melanoxylon	5	5	TG		5							
Marsdenia rostrata	0.1	1	OG							0.1		
Schoenus melanostachys	0.1	1	GG				0.1					
Calochlaena dubia	0.5	30	OG							0.5		
Lycopodium deuterodensum	0.1	5	EG						0.1			
Smilax glycyphylla	0.1	10	OG							0.1		
Persoonia levis	0.2	2	SG			0.2						
Lindsaea microphylla	0.1	10	EG						0.1			
Lomandra longifolia	0.1	2	GG				0.1					
Sticherus flabellatus	0.2	20	EG						0.2			
Clematis aristata	0.1	5	OG							0.1		
Cissus hypoglauca	0.1	5	OG							0.1		
Leptospermum polygalifolium	0.1	1	SG			0.1						
Histiopteris incisa	0.2	1	EG						0.2			
Acmena smithii	0.5	1	TG		0.5							
Ageratina adenophora	0.1	20	HT									0.1
Pittosporum undulatum	0.1	1	SG			0.1						
Acacia binervata	0.1	1	TG		0.1							
Microseris lanceolata	0.1	1	FG					0.1				
Lastreopsis microsora subsp. Microsora	0.5	15	EG						0.5			
Todea barbara	0.2	2	OG							0.2		
Palmeria scandens	0.1	1	OG							0.1		
Prostanthera lasianthos	0.2	2	SG			0.2						

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.13			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			36	36	3	23	7	3	0	0	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			134.5	134.5	11	81.3	2	40.2	0	0	0	0
Leptomeria acida	7	50	SG			7						
Lambertia formosa	45	200	SG			45						
Patersonia glabrata	40	250	FG					40				
Hakea laevipes	15	100	SG			15						
Banksia ericifolia	0.2	2	SG			0.2						
Isopogon anemonifolius	0.5	20	SG			0.5						
Eucalyptus sclerophylla	7	15	TG		7							
Hibbertia aspera	0.5	200	SG			0.5						
Petrophile sessilis	0.5	30	SG			0.5						
Banksia paludosa	1	20	SG			1						
Platysace linearifolia	0.1	25	SG			0.1						
Eucalyptus considiana	3	3	TG		3							
Caustis flexuosa	0.2	100	GG				0.2					
Leptospermum trinervium	5	50	SG			5						
Acacia ulicifolia	0.1	1	SG			0.1						
Allocasuarina littoralis	1	5	TG		1							
Aotus ericoides	0.1	50	SG			0.1						
Persoonia levis	0.3	10	SG			0.3						
Xylomelum pyriforme	0.1	10	SG			0.1						
Isopogon anethifolius	5	100	SG			5						
Lepidosperma urophorum	0.5	30	GG				0.5					
Lomandra filiformis subsp. filiformis	0.1	10	GG				0.1					
Lomandra obliqua	0.1	30	GG				0.1					
Cryptostylis subulata	0.1	10	FG					0.1				
Schoenus melanostachys	0.5	5	GG				0.5					
Entolasia marginata	0.1	30	GG				0.1					
Leptospermum polygalifolium	0.1	10	SG			0.1						
Bossiaea ensata	0.1	15	SG			0.1						
Tetradlea thymifolia	0.1	30	SG			0.1						
Gompholobium latifolium	0.1	20	SG			0.1						
Leptospermum rotundifolium	0.1	1	SG			0.1						
Epacris pulchella	0.1	10	SG			0.1						
Cyathochaeta diandra	0.5	10	GG				0.5					
Kunzea ambigua	0.2	2	SG			0.2						
Cryptostylis erecta	0.1	5	FG					0.1				
Persoonia mollis	0.1	1	SG			0.1						

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.14			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
Species	Cover	Abundance	54	54	3	17	8	11	4	11	0	0
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			130.1	130.1	51.5	8.6	47.3	1.1	10.1	11.5	0	0
Acacia obtusifolia	0.2	10	SG			0.2						
Acacia terminalis	0.1	1	SG			0.1						
Allocasuarina littoralis	0.5	1	TG		0.5							
Amperea xiphoclada	0.1	5	SG			0.1						
Banksia spinulosa	2	10	SG			2						
Billardiera scandens	0.1	10	OG							0.1		
Blechnum cartilagineum	3	500	EG						3			
Calochlaena dubia	7	500	OG							7		
Commelina cyanea	0.1	10	FG					0.1				
Chiloglottis sp.	0.1	1	FG					0.1				
Cissus hypoglauca	0.5	20	OG							0.5		
Clematis aristata	0.1	5	OG							0.1		
Cryptostylis erecta	0.1	5	FG					0.1				
Cyathea australis	3	5	OG							3		
Dianella caerulea	0.1	100	FG					0.1				
Elaeocarpus reticulatus	2	100	SG			2						
Entolasia marginata	1	200	GG				1					
Eucalyptus piperita	50	30	TG		50							
Eucalyptus sieberi	1	1	TG		1							
Eustrephus latifolius	0.2	20	OG							0.2		
Gahnia clarkei	2	30	GG				2					
Gahnia sieberiana	1	20	GG				1					
Gonocarpus tetragynus	0.1	20	FG					0.1				
Gonocarpus teucroides	0.1	100	FG					0.1				
Hibbertia aspera	0.3	100	SG			0.3						
Hydrocotyle sibthorpioides	0.1	10	FG					0.1				
Lagenophora stipitata	0.1	10	FG					0.1				
Lambertia formosa	2	10	SG			2						
Lindsaea microphylla	0.1	1	EG						0.1			
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Lomandra longifolia	3	50	GG				3					
Leptospermum polygalifolium	0.1	5	SG			0.1						
Leucopogon lanceolatus	0.1	1	SG			0.1						
Marsdenia rostrata	0.2	10	OG							0.2		
Microlaena stipoides	0.1	10	GG				0.1					
Notelaea venosa	0.3	2	SG			0.3						
Panicum sp.	0.1	20	GG				0.1					
Pandorea pandorana	0.1	2	OG							0.1		
Parsonsia straminea	0.1	20	OG							0.1		
Persoonia linearis	0.5	2	SG			0.5						

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14/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.14			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			54	54	3	17	8	11	4	11	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			130.1	130.1	51.5	8.6	47.3	1.1	10.1	11.5	0	0
Persoonia levis	0.1	1	SG			0.1						
Persoonia mollis	0.2	1	SG			0.2						
Pittosporum multiflorum	0.1	2	SG			0.1						
Pittosporum undulatum	0.3	1	SG			0.3						
Pultenaea daphnoides	0.1	10	SG			0.1						
Pteridium esculentum	2	100	EG						2			
Senecio sp.	0.1	1	FG					0.1				
Schoenus melanostachys	40	100	GG				40					
Smilax glycyphylla	0.1	1	OG							0.1		
Sticherus lobatus	5	500	EG						5			
Viola hederacea	0.1	10	FG					0.1				
Xylomelum pyriforme	0.1	10	SG			0.1						
Chiloglottis spp.	0.1	1	FG					0.1				
Pandorea pandorana	0.1	2	OG							0.1		

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15/02/2019				Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.15				# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
				21	21	2	13	4	2	0	0	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			16.8	16.8	4	12.2	0.4	0.2	0	0	0	0	0
Kunzea ambigua	7	100	SG			7							
Aotus ericoides	0.2	30	SG			0.2							
Eucalyptus sclerophylla	1	5	TG		1								
Allocasuarina littoralis	3	100	TG		3								
Acacia mearnsii	0.1	10	SG			0.1							
Persoonia linearis	1	50	SG			1							
Leucopogon lanceolatus	0.1	10	SG			0.1							
Callistemon citrinus	0.5	2	SG			0.5							
Leucopogon juniperinus	0.1	10	SG			0.1							
Platysace linearifolia	0.1	5	SG			0.1							
Leptospermum laevigatum	0.2	30	SG			0.2							
Hakea salicifolia	0.5	10	SG			0.5							
Acacia elongata	0.2	10	SG			0.2							
Entolasia stricta	0.1	10	GG				0.1						
Panicum simile	0.1	5	GG				0.1						
Patersonia glabrata	0.1	1	FG					0.1					
Empodisma minus	0.1	10	GG				0.1						
Leptospermum polygalifolium	2	50	SG			2							
Melaleuca linariifolia	0.2	1	SG			0.2							
Caustis flexuosa	0.1	5	GG				0.1						
Goodenia hederacea	0.1	20	FG					0.1					

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15/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.16			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			32	30	3	10	3	9	0	5	2	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			99.2	99	9	51.9	31.5	2.1	0	4.5	0.2	0.1
Clerodendrum tomentosum	5	50	TG		5							
Eucalyptus saligna	2	1	TG		2							
Pittosporum undulatum	10	50	SG			10						
Persoonia linearis	0.5	2	SG			0.5						
Entolasia marginata	1	500	GG				1					
Leucopogon juniperinus	5	100	SG			5						
Pratia purpurascens	0.1	100	FG					0.1				
Microlaena stipoides	30	1000	GG				30					
Dichondra repens	1	1000	FG					1				
Sigesbeckia orientalis	0.1	20	FG					0.1				
Breynia oblongifolia	0.1	5	SG			0.1						
Bidens pilosa	0.1	1	HT									0.1
Commelina cyanea	0.2	100	FG					0.2				
Solanum prinophyllum	0.1	10	FG					0.1				
Hibbertia scandens	0.2	30	OG							0.2		
Oxalis perennans	0.3	500	FG					0.3				
Kunzea ambigua	3	30	SG			3						
Acacia mearnsii	30	100	SG			30						
Senecio sp.	0.1	5	FG					0.1				
Stephania japonica	2	50	OG							2		
Oplismenus aemulus	0.5	500	GG				0.5					
Cassinia cunninghamii	3	30	SG			3						
Parsonsia straminea	2	50	OG							2		
Veronica plebeia	0.1	50	FG					0.1				
Solanum pseudocapsicum	0.1	5	EX								0.1	
Trema tomentosa	0.1	1	SG			0.1						
Morinda jasminoides	0.2	20	OG							0.2		
Myrsine variabilis	0.1	10	SG			0.1						
Syncarpia glomulifera	2	1	TG		2							
Santalum obtusifolium	0.1	1	SG			0.1						
Senecio linearifolius	0.1	5	FG					0.1				
Cayratia clematidea	0.1	5	OG							0.1		

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15/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.17			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			21	18	4	4	5	2	0	3	3	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			126.2	125.9	54.1	69	0.9	0.2	0	1.7	0.3	0.1
Eucalyptus sclerophylla	50	10	TG		50							
Eucalyptus piperita	3.5	2	TG		3.5							
Kunzea ambigua	50	200	SG			50						
Acacia mearnsii	15	15	SG			15						
Leucopogon juniperinus	3	40	SG			3						
Dichondra repens	0.1	100	FG					0.1				
Microlaena stipoides	0.1	50	GG				0.1					
Rytidosperma racemosum	0.5	200	GG				0.5					
Parsonia straminea	1.5	15	OG							1.5		
Clerodendrum tomentosum	0.5	2	TG		0.5							
Persoonia linearis	1	2	SG			1						
Clematis aristata	0.1	10	OG							0.1		
Entolasia stricta	0.1	50	GG				0.1					
Pratia purpurascens	0.1	20	FG					0.1				
Billardiera scandens	0.1	10	OG							0.1		
Echinopogon caespitosus	0.1	10	GG				0.1					
Rytidosperma tenuius	0.1	2	GG				0.1					
Allocasuarina littoralis	0.1	1	TG		0.1							
Hypochaeris radicata	0.1	2	EX								0.1	
Axonopus fissifolius	0.1	1	HT									0.1
Verbascum virgatum	0.1	1	EX								0.1	

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15/02/2019				Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.18				# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
				29	29	6	14	4	4	0	1	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			111.1	111.1	20.2	89.9	0.4	0.5	0	0.1	0	0	0
Kunzea ambigua	85	500	SG			85							
Eucalyptus sclerophylla	10	9	TG		10								
Entolasia stricta	0.1	100	GG				0.1						
Leptospermum trinervium	2	5	SG			2							
Patersonia sericea	0.2	20	FG					0.2					
Mitrasacme polymorpha	0.1	10	FG					0.1					
Leptospermum polygalifolium	0.5	20	SG			0.5							
Persoonia linearis	0.3	5	SG			0.3							
Caustis flexuosa	0.1	20	GG				0.1						
Platysace linearifolia	0.1	5	SG			0.1							
Digitaria spp.	0.1	5	GG				0.1						
Leucopogon lanceolatus	0.1	1	SG			0.1							
Pimelea linifolia	0.1	10	SG			0.1							
Lambertia formosa	1	5	SG			1							
Persoonia levis	0.1	1	SG			0.1							
Corymbia gummifera	7	20	TG		7								
Eucalyptus piperita	2	1	TG		2								
Arthropodium milleflorum	0.1	1	FG					0.1					
Billardiera scandens	0.1	10	OG							0.1			
Hakea dactyloides	0.2	5	SG			0.2							
Allocasuarina littoralis	0.1	1	TG		0.1								
Eucalyptus eugenioides	1	2	TG		1								
Banksia spinulosa	0.2	5	SG			0.2							
Banksia paludosa	0.1	1	SG			0.1							
Syncarpia glomulifera	0.1	1	TG		0.1								
Lomandra obliqua	0.1	10	GG				0.1						
Pomax umbellata	0.1	20	FG					0.1					
Hakea salicifolia	0.1	1	SG			0.1							
Aotus ericoides	0.1	20	SG			0.1							

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15/02/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 2.19			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			36	27	5	6	4	5	2	5	9	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			86.7	85.4	42.5	36.3	4.6	0.9	0.3	0.8	1.3	0.2
Syncarpia glomulifera	20	5	TG		20							
Leucopogon juniperinus	5	100	SG			5						
Acacia mearnsii	10	20	SG			10						
Dichondra repens	0.5	500	FG					0.5				
Kunzea ambigua	20	100	SG			20						
Stephania japonica	0.3	20	OG							0.3		
Veronica plebeia	0.1	5	FG					0.1				
Microlaena stipoides	2	1000	GG				2					
Solanum prinophyllum	0.1	10	FG					0.1				
Allocasuarina littoralis	12	5	TG		12							
Eucalyptus microcorys	10	1	TG		10							
Pellaea falcata	0.2	50	EG						0.2			
Cayratia spp.	0.1	5	OG							0.1		
Clerodendrum tomentosum	0.3	5	TG		0.3							
Pratia purpurascens	0.1	50	FG					0.1				
Persoonia linearis	0.2	1	SG			0.2						
Sida rhombifolia	0.1	1	EX								0.1	
Santalum obtusifolium	0.1	1	SG			0.1						
Carex spp.	0.1	5	GG				0.1					
Pittosporum undulatum	1	10	SG			1						
Araujia sericifera	0.1	10	HT									0.1
Modiola caroliniana	0.1	1	EX								0.1	
Oplismenus aemulus	2	1000	GG				2					
Entolasia marginata	0.5	100	GG				0.5					
Cheilanthes sieberi	0.1	10	EG						0.1			
Oxalis perennans	0.1	50	FG					0.1				
Centaurium erythraea	0.1	20	EX								0.1	
Anagallis arvensis	0.1	20	EX								0.1	
Solanum pseudocapsicum	0.5	50	EX								0.5	
Hypochaeris radicata	0.1	1	EX								0.1	
Bidens pilosa	0.1	5	HT									0.1
Conyza bilbaoana	0.1	1	EX								0.1	
Morinda jasminoides	0.2	10	OG							0.2		
Hibbertia scandens	0.1	5	OG							0.1		
Pandorea pandorana	0.1	5	OG							0.1		
Pennantia cunninghamii	0.2	3	TG		0.2							

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4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.1			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			43	41	4	14	10	7	0	6	2	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			90.9	90.7	45.1	40.8	3.1	0.7	0	1	0.2	0
Angophora floribunda	25	20	TG		25							
Eucalyptus saligna	12	3	TG		12							
Eucalyptus globoidea	8	4	TG		8							
Melaleuca thymifolia	3	150	SG			3						
Hypochoeris radicata	0.1	20	EX								0.1	
Pratia purpurascens	0.1	50	FG					0.1				
Lomandra longifolia	1	9	GG				1					
Gonocarpus tetragynus	0.1	100	FG					0.1				
Parsonsia straminea	0.1	1	OG							0.1		
Kunzea ambigua	35	150	SG			35						
Leptospermum continentale	0.2	20	SG			0.2						
Acacia irrorata	0.3	10	SG			0.3						
Acacia obtusifolia	0.2	15	SG			0.2						
Lepyrodia scariosa	0.1	20	GG				0.1					
Echinopogon caespitosus	0.1	20	GG				0.1					
Entolasia marginata	0.1	10	GG				0.1					
Microlaena stipoides	0.3	200	GG				0.3					
Entolasia stricta	0.2	100	GG				0.2					
Lagenifera stipitata	0.1	50	FG					0.1				
Dianella caerulea	0.1	100	FG					0.1				
Imperata cylindrica	1	200	GG				1					
Hakea dactyloides	0.5	5	SG			0.5						
Themeda triandra	0.1	15	GG				0.1					
Glycine tabacina	0.1	100	OG							0.1		
Marsdenia rostrata	0.1	1	OG							0.1		
Melaleuca linariifolia	0.2	3	SG			0.2						
Oxalis perennans	0.1	5	FG					0.1				
Hardenbergia violacea	0.1	1	OG							0.1		
Desmodium gunnii	0.1	2	FG					0.1				
Leucopogon juniperinus	0.2	10	SG			0.2						
Xanthorrhoea glauca	0.5	7	OG							0.5		
Hakea salicifolia	0.2	5	SG			0.2						
Leptospermum polygalifolium	0.5	50	SG			0.5						
Pittosporum undulatum	0.1	1	SG			0.1						
Eustrephus latifolius	0.1	50	OG							0.1		

Biodiversity development assessment report

4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.1			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			43	41	4	14	10	7	0	6	2	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			90.9	90.7	45.1	40.8	3.1	0.7	0	1	0.2	0
Clerodendrum tomentosum	0.1	5	TG		0.1							
Aristida vagans	0.1	5	GG				0.1					
Cryptostylis erecta	0.1	3	FG					0.1				
Lambertia formosa	0.2	1	SG			0.2						
Breynia oblongifolia	0.1	2	SG			0.1						
Lomandra multiflora	0.1	5	GG				0.1					
Freesia hybrid	0.1	1	EX								0.1	
Pimelea linifolia	0.1	1	SG			0.1						

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4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.2			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			53	52	11	9	7	10	3	12	1	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			203.7	203.6	144.9	42.8	3	1.1	2.3	9.5	0.1	0.1
Livistona australis	3	1	OG							3		
Eucalyptus saligna X botryoides	30	5	TG		30							
Angophora floribunda	60	50	TG		60							
Pteridium esculentum	2	150	EG						2			
Smilax australis	0.1	10	OG							0.1		
Dianella caerulea	0.2	100	FG					0.2				
Microlaena stipoides	0.2	100	GG				0.2					
Desmodium varians	0.1	100	OG							0.1		
Hydrocotyle sibthorpioides	0.1	200	FG					0.1				
Oxalis perennans	0.1	100	FG					0.1				
Dichondra repens	0.1	50	FG					0.1				
Oplismenus imbecillis	0.3	250	GG				0.3					
Glycine clandestina	0.1	50	OG							0.1		
Geitonoplesium cymosum	0.1	50	OG							0.1		
Breynia oblongifolia	1	20	SG			1						
Marsdenia rostrata	3	30	OG							3		
Cissus hypoglauca	0.5	30	OG							0.5		
Myrsine variabilis	0.2	50	SG			0.2						
Lomandra longifolia	2	30	GG				2					
Bidens pilosa	0.1	5	HT									0.1
Backhousia myrtifolia	40	20	SG			40						
Eustrephus latifolius	0.1	10	OG							0.1		
Schelhammerya undulata	0.1	100	FG					0.1				
Carex appressa	0.1	2	GG				0.1					
Hibbertia aspera	0.1	30	SG			0.1						
Acacia binervia	10	10	TG		10							
Adiantum aethiopicum	0.1	150	EG						0.1			
Tristanopsis laurina	40	50	TG		40							
Acmena smithii	3	1	TG		3							
Clerodendrum tomentosum	0.1	10	TG		0.1							
Plectranthus parviflorus	0.1	50	FG					0.1				
Leucopogon juniperinus	0.1	10	SG			0.1						
Calochlaena dubia	2	100	OG							2		
Entolasia marginata	0.2	150	GG				0.2					
Ficus coronata	0.2	2	SG			0.2						
Allocasuarina littoralis	1	1	TG		1							
Melaleuca linariifolia	0.5	1	SG			0.5						

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4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.2			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			53	52	11	9	7	10	3	12	1	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			203.7	203.6	144.9	42.8	3	1.1	2.3	9.5	0.1	0.1
Guioa semiglaucula	0.5	5	TG		0.5							
Clematis aristata	0.1	5	OG							0.1		
Notelaea spp.	0.1	10	TG		0.1							
Persoonia linearis	0.5	5	SG			0.5						
Imperata cylindrica	0.1	10	GG				0.1					
Doodia aspera	0.2	100	EG						0.2			
Tylophora barbata	0.1	50	OG							0.1		
Acacia maidenii	0.1	2	TG		0.1							
Solanum prinophyllum	0.1	5	FG					0.1				
Lagenifera stipitata	0.1	10	FG					0.1				
Senecio velleioides	0.1	1	FG					0.1				
Eucalyptus paniculata	0.1	1	TG		0.1							
Veronica plebeia	0.1	1	FG					0.1				
Lomandra obliqua	0.1	3	GG				0.1					
Elaeocarpus reticulatus	0.2	1	SG			0.2						
Cissus antarctica	0.3	5	OG							0.3		

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4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.3			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			49	44	7	9	5	9	2	12	5	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			111.4	110.9	66.7	4	32.4	0.9	5.1	1.8	0.5	0.3
Angophora floribunda	13	1	TG		13							
Allocasuarina littoralis	45	50	TG		45							
Bursaria spinosa	1	30	SG			1						
Pteridium esculentum	5	250	EG						5			
Banksia spinulosa	0.1	1	SG			0.1						
Parsonia straminea	0.1	3	OG							0.1		
Entolasia marginata	0.2	100	GG				0.2					
Cissus hypoglauca	0.2	10	OG							0.2		
Desmodium brachypodium	0.1	10	FG					0.1				
Lomandra longifolia	30	150	GG				30					
Clerodendrum tomentosum	0.5	20	TG		0.5							
Glycine tabacina	0.1	30	OG							0.1		
Cheilanthes sieberi	0.1	50	EG						0.1			
Polymeria calycina	0.2	200	OG							0.2		
Syncarpia glomulifera	1	1	TG		1							
Pandorea pandorana	0.1	20	OG							0.1		
Senecio sp.	0.1	5	FG					0.1				
Lagenophora stipitata	0.1	30	FG					0.1				
Microlaena stipoides	0.1	100	GG				0.1					
Pratia purpurascens	0.1	25	FG					0.1				
Ligustrum sinense	0.1	5	HT									0.1
Marsdenia rostrata	0.3	10	OG							0.3		
Persoonia linearis	1	5	SG			1						
Leucopogon lanceolatus	0.1	1	SG			0.1						
Guioa semiglauca	0.1	1	TG		0.1							
Eustrephus latifolius	0.2	20	OG							0.2		
Eucalyptus globoidea	7	3	TG		7							
Oplismenus imbecillis	0.1	50	GG				0.1					
Rubus fruticosus agg.	0.1	1	HT									0.1
Kunzea ambigua	1	10	SG			1						
Lepidosperma laterale	2	15	GG				2					
Elaeocarpus reticulatus	0.1	1	SG			0.1						
Passiflora spp.	0.1	1	OG							0.1		
Leucopogon juniperinus	0.1	5	SG			0.1						
Vernonia cinerea	0.1	25	FG					0.1				
Dichondra repens	0.1	50	FG					0.1				
Clematis aristata	0.1	5	OG							0.1		
Gonocarpus tetragynus	0.1	10	FG					0.1				

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4/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.3			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			49	44	7	9	5	9	2	12	5	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			111.4	110.9	66.7	4	32.4	0.9	5.1	1.8	0.5	0.3
Macrozamia communis	0.1	2	OG							0.1		
Leptospermum polygalifolium	0.1	1	SG			0.1						
Eucalyptus saligna X botryoides	0.1	1	TG		0.1							
Hibbertia aspera	0.5	30	SG			0.5						
Glycine clandestina	0.2	5	OG							0.2		
Lantana camara	0.1	1	HT									0.1
Solanum pseudocapsicum	0.1	1	EX								0.1	
Geitonoplesium cymosum	0.1	5	OG							0.1		
Dianella caerulea	0.1	20	FG					0.1				
Brunoniella australis	0.1	1	FG					0.1				
Solanum mauritianum	0.1	1	EX								0.1	

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			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.4			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			29	26	4	10	3	2	0	7	3	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			135.9	133.7	5.4	75.1	0.3	0.2	0	52.7	2.2	2.1
Eucalyptus amplifolia	4	30	TG		4							
Cissus hypoglauca	50	100	OG							50		
Ligustrum sinense	2	200	HT									2
Morinda jasminoides	2	50	OG							2		
Melaleuca linariifolia	1	5	SG			1						
Eustrephus latifolius	0.1	10	OG							0.1		
Gymnostachys anceps	0.1	1	FG					0.1				
Clerodendrum tomentosum	1	10	TG		1							
Carex inversa	0.1	1	GG				0.1					
Pittosporum multiflorum	0.1	1	SG			0.1						
Hibbertia scandens	0.3	50	OG							0.3		
Elaeocarpus reticulatus	70	40	SG			70						
Stephania japonica	0.1	5	OG							0.1		
Ficus coronata	0.1	2	SG			0.1						
Breynia oblongifolia	1	5	SG			1						
Guioa semiglauca	0.2	1	TG		0.2							
Parsonsia straminea	0.1	1	OG							0.1		
Bidens pilosa	0.1	1	HT									0.1
Synoum glandulosum	0.1	5	SG			0.1						
Pandorea pandorana	0.1	5	OG							0.1		
Acacia mearnsii	2	1	SG			2						
Acmena smithii	0.2	1	TG		0.2							
Solanum mauritianum	0.1	2	EX								0.1	
Microlaena stipoides	0.1	50	GG				0.1					
Veronica plebeia	0.1	5	FG					0.1				
Pittosporum undulatum	0.5	1	SG			0.5						
Leptospermum polygalifolium	0.2	1	SG			0.2						
Entolasia stricta	0.1	100	GG				0.1					
Leucopogon juniperinus	0.1	1	SG			0.1						

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5/03/2019			Covers	Native	Trees	Shrubs	Grasses	Forb	Fern	Other	Exotic	HighThreat
Plot 3.5			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			24	13	1	3	3	4	0	2	11	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			136.3	105	0.1	41.5	31.1	32.1	0	0.2	31.3	5.3
Acacia mearnsii	40	20	SG			40						
Solanum mauritianum	10	100	EX								10	
Solanum pseudocapsicum	15	200	EX								15	
Sigesbeckia orientalis	25	500	FG					25				
Ligustrum sinense	5	100	HT									5
Oxalis perennans	2	250	FG					2				
Dichondra repens	5	500	FG					5				
Trifolium repens	0.1	5	EX								0.1	
Carex inversa	0.1	5	GG				0.1					
Optismenus aemulus	1	100	GG				1					
Microlaena stipoides	30	1000	GG				30					
Sida rhombifolia	0.5	100	EX								0.5	
Araujia sericifera	0.2	10	HT									0.2
Parsonsia straminea	0.1	1	OG							0.1		
Conyza spp.	0.1	10	EX								0.1	
Tagetes minuta	0.1	5	EX								0.1	
Pratia purpurascens	0.1	30	FG					0.1				
Bursaria spinosa	1	1	SG			1						
Melicytus dentatus	0.5	15	SG			0.5						
Cirsium vulgare	0.1	5	EX								0.1	
Stephania japonica	0.1	2	OG							0.1		
Verbena spp.	0.1	5	EX								0.1	
Bidens pilosa	0.1	5	HT									0.1
Guioa semiglauca	0.1	1	TG		0.1							

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.6			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			32	27	2	7	5	8	2	3	5	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			158.1	157	40.1	105.5	0.6	10	0.3	0.5	1.1	0.6
Acacia mearnsii	5	15	SG			5						
Bursaria spinosa	50	100	SG			50						
Angophora floribunda	40	15	TG		40							
Leucopogon juniperinus	20	100	SG			20						
Microlaena stipoides	0.1	100	GG				0.1					
Oplismenus aemulus	0.2	100	GG				0.2					
Plectranthus parviflorus	3	200	FG					3				
Sigesbeckia orientalis	0.5	100	FG					0.5				
Einadia hastata	4	500	FG					4				
Dichondra repens	0.2	100	FG					0.2				
Solanum pseudocapsicum	0.3	30	EX								0.3	
Cassinia aculeata	0.2	5	SG			0.2						
Eragrostis leptostachya	0.1	5	GG				0.1					
Commelina cyanea	2	200	FG					2				
Tradescantia fluminensis	0.5	100	HT									0.5
Backhousia myrtifolia	30	50	SG			30						
Sida rhombifolia	0.1	50	EX								0.1	
Cheilanthes sieberi	0.1	5	EG						0.1			
Glycine clandestina	0.1	20	OG							0.1		
Carex inversa	0.1	10	GG				0.1					
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Ozothamnus diosmifolius	0.1	1	SG			0.1						
Eustrephus latifolius	0.3	10	OG							0.3		
Solanum prinophyllum	0.1	5	FG					0.1				
Pellaea falcata	0.2	100	EG						0.2			
Bidens pilosa	0.1	1	HT									0.1
Entolasia marginata	0.1	100	GG				0.1					
Desmodium gunnii	0.1	5	FG					0.1				
Olearia viscidula	0.2	5	SG			0.2						
Marsdenia rostrata	0.1	1	OG							0.1		
Clerodendrum tomentosum	0.1	5	TG		0.1							
Solanum mauritianum	0.1	3	EX								0.1	

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.7			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			31	31	5	16	6	3	1	0	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			242.8	242.8	7.5	178.4	56.5	0.3	0.1	0	0	0
Banksia ericifolia	80	500	SG			80						
Allocasuarina littoralis	3	10	TG		3							
Hakea laevipes	70	50	SG			70						
Leptospermum trinervium	20	150	SG			20						
Petrophile pulchella	0.1	5	SG			0.1						
Eucalyptus sieberi	1	3	TG		1							
Schoenus spp.	15	200	GG				15					
Leptospermum polygalifolium	5	75	SG			5						
Leucopogon lanceolatus	0.1	5	SG			0.1						
Entolasia marginata	0.2	150	GG				0.2					
Epacris pulchella	0.1	10	SG			0.1						
Lindsaea linearis	0.1	200	EG						0.1			
Dianella caerulea	0.1	5	FG					0.1				
Kunzea spp.	0.2	50	SG			0.2						
Vernonia cinerea	0.1	10	FG					0.1				
Acrotriche divaricata	2	15	SG			2						
Cyathochaeta diandra	35	1000	GG				35					
Pultenaea daphnoides	0.1	5	SG			0.1						
Hibbertia aspera	0.2	15	SG			0.2						
Pimelea linifolia	0.1	5	SG			0.1						
Banksia serrata	2	2	TG		2							
Lepidosperma laterale	0.3	20	GG				0.3					
Grevillea spp.	0.1	1	SG			0.1						
Eucalyptus sclerophylla	0.5	1	TG		0.5							
Persoonia mollis	0.2	5	SG			0.2						
Elaeocarpus reticulatus	0.1	2	SG			0.1						
Eucalyptus piperita	1	2	TG		1							
Lepyrodia scariosa	2	1000	GG				2					
Lomandra longifolia	4	1	GG				4					
Persoonia levis	0.1	1	SG			0.1						
Chiloglottis spp.	0.1	5	FG					0.1				

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.8			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			29	29	4	16	4	3	0	2	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			181.5	181.5	38.2	77.5	65.3	0.3	0	0.2	0	0
Hakea laevipes	20	100	SG			20						
Petrophile sessilis	5	200	SG			5						
Isopogon anemonifolius	2	100	SG			2						
Banksia paludosa	2	100	SG			2						
Epacris pulchella	0.2	50	SG			0.2						
Cyathochaeta diandra	65	1000	GG				65					
Leptospermum trinervium	20	200	SG			20						
Banksia ericifolia	5	50	SG			5						
Eucalyptus sclerophylla	20	15	TG		20							
Eucalyptus consideriana	15	10	TG		15							
Eucalyptus sieberi	3	1	TG		3							
Lambertia formosa	20	100	SG			20						
Lomandra multiflora	0.1	5	GG				0.1					
Xylomelum pyriforme	0.1	10	SG			0.1						
Platysace linearifolia	0.1	5	SG			0.1						
Allocasuarina littoralis	0.2	5	TG		0.2							
Gonocarpus teucrioides	0.1	50	FG					0.1				
Bossiaea rhombifolia	0.1	10	SG			0.1						
Persoonia mollis	0.2	5	SG			0.2						
Patersonia sericea	0.1	5	FG					0.1				
Acrotriche divaricata	2	50	SG			2						
Persoonia levis	0.5	5	SG			0.5						
Cassytha pubescens	0.1	20	OG							0.1		
Hibbertia aspera	0.1	15	SG			0.1						
Lomandra obliqua	0.1	25	GG				0.1					
Banksia spinulosa	0.2	2	SG			0.2						
Billardiera scandens	0.1	1	OG							0.1		
Austrostipa pubescens	0.1	1	GG				0.1					
Patersonia glabrata	0.1	10	FG					0.1				

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.9			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			27	23	6	9	5	2	0	1	4	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			108.9	108.5	20.5	87.1	0.6	0.2	0	0.1	0.4	0.1
Eucalyptus globoidea	2	15	TG		2							
Syncarpia glomulifera	3	15	TG		3							
Acacia binervia	2	5	TG		2							
Eucalyptus piperita	12	25	TG		12							
Kunzea ambigua	75	500	SG			75						
Leucopogon juniperinus	1	50	SG			1						
Hypochaeris radicata	0.1	20	EX								0.1	
Glycine clandestina	0.1	30	OG							0.1		
Hypericum gramineum	0.1	50	FG					0.1				
Eragrostis brownii	0.2	100	GG				0.2					
Cymbopogon refractus	0.1	30	GG				0.1					
Cassinia denticulata	0.1	1	SG			0.1						
Cynodon dactylon	0.1	50	GG				0.1					
Leptospermum polygalifolium	10	100	SG			10						
Allocasuarina littoralis	0.5	10	TG		0.5							
Senecio sp.	0.1	5	FG					0.1				
Axonopus fissifolius	0.1	10	HT									0.1
Centaurium erythraea	0.1	1	EX								0.1	
Leucopogon lanceolatus	0.1	5	SG			0.1						
Richardia brasiliensis	0.1	50	EX								0.1	
Corymbia gummifera	1	3	TG		1							
Acacia mearnsii	0.2	3	SG			0.2						
Persoonia linearis	0.1	1	SG			0.1						
Lomandra multiflora	0.1	5	GG				0.1					
Themeda triandra	0.1	1	GG				0.1					
Elaeocarpus reticulatus	0.5	8	SG			0.5						
Pittosporum undulatum	0.1	1	SG			0.1						

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.10			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			39	39	7	12	6	7	1	6	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			105.9	105.9	86.1	7.4	1.8	1.7	5	3.9	0	0
Syncarpia glomulifera	35	25	TG		35							
Corymbia gummifera	15	10	TG		15							
Parsonia straminea	0.1	10	OG							0.1		
Eucalyptus eugenoides	0.5	1	TG		0.5							
Eucalyptus piperita	10	11	TG		10							
Persoonia linearis	2	6	SG			2						
Banksia spinulosa	4	20	SG			4						
Macrozamia communis	3	20	OG							3		
Pteridium esculentum	5	200	EG						5			
Patersonia sericea	1	100	FG					1				
Hardenbergia violacea	0.1	5	OG							0.1		
Lomandra obliqua	0.1	10	GG				0.1					
Hybanthus monopetalus	0.1	10	FG					0.1				
Entolasia stricta	0.2	50	GG				0.2					
Acacia maidenii	0.1	3	TG		0.1							
Tetratheca thymifolia	0.1	50	SG			0.1						
Leucopogon lanceolatus	0.2	10	SG			0.2						
Xanthorrhoea concava	0.5	4	OG							0.5		
Podolobium ilicifolium	0.1	2	SG			0.1						
Bossiaea rhombifolia	0.1	5	SG			0.1						
Bossiaea obcordata	0.1	5	SG			0.1						
Pomax umbellata	0.1	5	FG					0.1				
Bossiaea spp.	0.1	1	SG			0.1						
Lomandra filiformis subsp. filiformis	0.2	30	GG				0.2					
Platysace linearifolia	0.1	5	SG			0.1						
Digitaria parviflora	0.1	1	GG				0.1					
Angophora floribunda	25	5	TG		25							
Goodenia hederacea	0.1	30	FG					0.1				
Lomandra longifolia	0.2	3	GG				0.2					
Kunzea ambigua	0.3	1	SG			0.3						
Patersonia glabrata	0.2	10	FG					0.2				
Cymbidium suave	0.1	1	OG							0.1		
Elaeocarpus reticulatus	0.2	5	SG			0.2						
Acacia binervia	0.5	1	TG		0.5							
Arthropodium milleflorum	0.1	5	FG					0.1				
Opercularia hispida	0.1	10	FG					0.1				
Schoenus melanostachys	1	5	GG				1					
Calochlaena dubia	0.1	10	OG							0.1		
Myrsine variabilis	0.1	5	SG			0.1						

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5/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.11			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			49	49	4	27	4	4	1	9	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			85.4	85.4	22.1	56.5	0.4	0.4	0.1	5.9	0	0
Corymbia gummifera	7	5	TG		7							
Eucalyptus sclerophylla	5	4	TG		5							
Banksia spinulosa	15	100	SG			15						
Banksia paludosa	1	30	SG			1						
Cissus hypoglauca	5	50	OG							5		
Pittosporum undulatum	10	50	SG			10						
Persoonia linearis	2	5	SG			2						
Acacia mearnsii	0.3	5	SG			0.3						
Hibbertia aspera	0.2	10	SG			0.2						
Gonocarpus teucrioides	0.1	50	FG					0.1				
Parsonia straminea	0.1	200	OG							0.1		
Lagenifera stipitata	0.1	50	FG					0.1				
Glycine clandestina	0.1	100	OG							0.1		
Acacia suaveolens	0.1	1	SG			0.1						
Tetratheca thymifolia	0.1	100	SG			0.1						
Leptospermum trinervium	20	15	SG			20						
Lomandra filiformis subsp. filiformis	0.1	10	GG				0.1					
Caustis flexuosa	0.1	10	GG				0.1					
Hibbertia riparia	0.2	50	SG			0.2						
Leucopogon lanceolatus	0.2	10	SG			0.2						
Xylomelum pyriforme	0.1	10	SG			0.1						
Entolasia stricta	0.1	50	GG				0.1					
Platysace linearifolia	0.1	25	SG			0.1						
Pittosporum revolutum	0.1	2	SG			0.1						
Melaleuca thymifolia	0.1	5	SG			0.1						
Leptospermum juniperinum	0.1	1	SG			0.1						
Leptospermum continentale	0.2	20	SG			0.2						
Clematis aristata	0.1	20	OG							0.1		
Bossiaea obcordata	0.1	2	SG			0.1						
Myrsine variabilis	0.1	1	SG			0.1						
Elaeocarpus reticulatus	0.5	20	SG			0.5						
Angophora bakeri	10	15	TG		10							
Pandorea pandorana	0.1	30	OG							0.1		
Dianella caerulea	0.1	20	FG					0.1				
Lambertia formosa	5	30	SG			5						
Leucopogon juniperinus	0.1	5	SG			0.1						
Syncarpia glomulifera	0.1	1	TG		0.1							
Xanthorrhoea concava	0.2	1	OG							0.2		
Microlaena stipoides	0.1	10	GG				0.1					
Callistemon linearis	0.5	1	SG			0.5						

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Persoonia levis	0.1	1	SG			0.1						
Lindsaea linearis	0.1	25	EG					0.1				
Cryptostylis subulata	0.1	5	FG				0.1					
Hakea dactyloides	0.1	1	SG			0.1						
Hibbertia scandens	0.1	10	OG						0.1			
Acacia terminalis	0.1	1	SG			0.1						
Billardiera scandens	0.1	1	OG						0.1			
Livistona australis	0.1	1	OG						0.1			
Micromyrtus ciliata	0.1	1	SG			0.1						

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.12			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			32	25	3	7	6	5	2	2	7	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			110.2	108.5	9.2	97.7	0.7	0.5	0.2	0.2	1.7	0
Kunzea ambigua	90	250	SG			90						
Leucopogon juniperinus	1	50	SG			1						
Acacia mearnsii	5	20	SG			5						
Hakea salicifolia	1	5	SG			1						
Leptospermum polygalifolium	0.5	20	SG			0.5						
Eragrostis brownii	0.2	200	GG				0.2					
Lomandra glauca	0.1	20	GG				0.1					
Entolasia marginata	0.1	50	GG				0.1					
Cyathochaeta diandra	0.1	10	GG				0.1					
Persoonia linearis	0.1	2	SG			0.1						
Eucalyptus saligna	5	1	TG		5							
Eucalyptus sclerophylla	4	5	TG		4							
Cyperus imbecillis	0.1	100	GG				0.1					
Pratia purpurascens	0.1	10	FG					0.1				
Themeda triandra	0.1	50	GG				0.1					
Pittosporum undulatum	0.1	1	SG			0.1						
Allocasuarina littoralis	0.2	1	TG		0.2							
Centaurium erythraea	0.1	10	EX								0.1	
Pellaea falcata	0.1	25	EG						0.1			
Oxalis perennans	0.1	50	FG					0.1				
Cayratia clematidea	0.1	10	OG							0.1		
Richardia stellaris	0.2	1000	EX								0.2	
Veronica plebeia	0.1	5	FG					0.1				
Plectranthus parviflorus	0.1	1	FG					0.1				
Verbena spp.	0.1	5	EX								0.1	
Conyza spp.	0.1	5	EX								0.1	
Verbascum thapsus	0.1	1	EX								0.1	
Dichondra repens	0.1	100	FG					0.1				
Stephania japonica	0.1	2	OG							0.1		
Manihot grahamii	1	3	EX								1	
Yucca aloifolia	0.1	1	EX								0.1	
Cheilanthes sieberi	0.1	5	EG						0.1			

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.13			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			45	45	4	24	6	7	0	4	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			104.5	104.5	31.1	70.6	1.2	1.1	0	0.5	0	0
Corymbia gummifera	20	25	TG		20							
Eucalyptus sclerophylla	10	10	TG		10							
Leptospermum trinervium	30	150	SG			30						
Lambertia formosa	15	50	SG			15						
Banksia paludosa	2	50	SG			2						
Hakea dactyloides	0.5	5	SG			0.5						
Caustis flexuosa	0.1	10	GG				0.1					
Patersonia sericea	0.5	20	FG					0.5				
Entolasia stricta	0.2	100	GG				0.2					
Cissus hypoglauca	0.1	1	OG							0.1		
Lepyrodia scariosa	0.2	100	GG				0.2					
Acacia suaveolens	0.1	5	SG			0.1						
Banksia spinulosa	5	30	SG			5						
Aotus ericoides	0.1	10	SG			0.1						
Platysace linearifolia	0.2	50	SG			0.2						
Tetratheca thymifolia	0.1	50	SG			0.1						
Leucopogon lanceolatus	0.1	5	SG			0.1						
Leptospermum continentale	0.1	5	SG			0.1						
Kunzea ambigua	15	15	SG			15						
Xanthorrhoea concava	0.2	10	OG							0.2		
Persoonia mollis	1	5	SG			1						
Persoonia linearis	0.2	5	SG			0.2						
Leptospermum polygalifolium	0.1	5	SG			0.1						
Hardenbergia violacea	0.1	2	OG							0.1		
Acacia terminalis	0.2	5	SG			0.2						
Hovea linearis	0.1	5	FG					0.1				
Gonocarpus teucrioides	0.1	20	FG					0.1				
Lomandra obliqua	0.1	10	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	30	GG				0.1					
Phyllanthus hirtellus	0.1	5	SG			0.1						
Hibbertia empetrifolia	0.2	20	SG			0.2						
Bossiaea heterophylla	0.1	30	SG			0.1						
Patersonia glabrata	0.1	5	FG					0.1				
Billardiera scandens	0.1	5	OG							0.1		
Dillwynia sericea	0.1	15	SG			0.1						
Bossiaea obcordata	0.1	5	SG			0.1						
Lobelia spp.	0.1	5	FG					0.1				
Monotoca scoparia	0.1	5	SG			0.1						
Cyathochaeta diandra	0.5	10	GG				0.5					
Dianella caerulea	0.1	2	FG					0.1				

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.13			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			45	45	4	24	6	7	0	4	0	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			104.5	104.5	31.1	70.6	1.2	1.1	0	0.5	0	0
Brachyloma daphnoides	0.1	1	SG			0.1						
Xylomelum pyriforme	0.1	5	SG			0.1						
Lagenifera stipitata	0.1	5	FG					0.1				
Allocasuarina littoralis	1	1	TG		1							
Syncarpia glomulifera	0.1	1	TG		0.1							

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.14			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			16	13	2	5	1	5	0	0	3	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			77.8	76.6	68	7.8	0.1	0.7	0	0	1.2	1.2
Eucalyptus sclerophylla	65	200	TG		65							
Kunzea ambigua	5	30	SG			5						
Leptospermum polygalifolium	2	15	SG			2						
Entolasia stricta	0.1	75	GG				0.1					
Acacia mearnsii	0.5	15	SG			0.5						
Einadia hastata	0.2	50	FG					0.2				
Bidens pilosa	1	200	HT									1
Acetosa sagittata	0.1	5	HT									0.1
Dichondra repens	0.2	50	FG					0.2				
Senecio sp.	0.1	20	FG					0.1				
Ehrharta erecta	0.1	10	HT									0.1
Acacia binervia	3	10	TG		3							
Banksia paludosa	0.2	5	SG			0.2						
Leptospermum continentale	0.1	1	SG			0.1						
Patersonia sericea	0.1	1	FG					0.1				
Stylidium spp.	0.1	5	FG					0.1				

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.15			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			36	31	5	8	5	7	0	6	5	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			123.6	118.2	76.2	39.8	0.6	0.8	0	0.8	5.4	0
Allocasuarina littoralis	60	30	TG		60							
Leucopogon juniperinus	25	100	SG			25						
Parsonsia straminea	0.1	10	OG							0.1		
Stephania japonica	0.3	10	OG							0.3		
Solanum pseudocapsicum	5	100	EX								5	
Kunzea ambigua	5	50	SG			5						
Entolasia stricta	0.1	100	GG				0.1					
Glycine tabacina	0.1	50	OG							0.1		
Pittosporum undulatum	5	50	SG			5						
Solanum mauritianum	0.1	1	EX								0.1	
Dichondra repens	0.2	100	FG					0.2				
Acacia mearnsii	4	30	SG			4						
Angophora floribunda	5	10	TG		5							
Eucalyptus eugenoides	10	2	TG		10							
Desmodium gunnii	0.1	25	FG					0.1				
Pratia purpurascens	0.1	30	FG					0.1				
Melicytus dentatus	0.5	5	SG			0.5						
Sigesbeckia orientalis	0.1	50	FG					0.1				
Sida rhombifolia	0.1	5	EX								0.1	
Microlaena stipoides	0.1	100	GG				0.1					
Plantago lanceolata	0.1	5	EX								0.1	
Oplismenus aemulus	0.2	200	GG				0.2					
Commelina cyanea	0.1	5	FG					0.1				
Trema tomentosa	0.1	1	SG			0.1						
Breynia oblongifolia	0.1	5	SG			0.1						
Santalum obtusifolium	0.1	1	SG			0.1						
Eragrostis leptostachya	0.1	10	GG				0.1					
Opercularia diphylla	0.1	5	FG					0.1				
Melia azedarach	1	1	TG		1							
Oxalis perennans	0.1	50	FG					0.1				
Eucalyptus bosistoana	0.2	4	TG		0.2							
Dichelachne micrantha	0.1	1	GG				0.1					
Pandorea pandorana	0.1	1	OG							0.1		
Clematis aristata	0.1	1	OG							0.1		
Hypochaeris radicata	0.1	5	EX								0.1	
Cymbidium suave	0.1	1	OG							0.1		

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6/03/2019			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3.16			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			31	22	4	8	5	2	0	3	9	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			158.6	96.6	4.1	1.7	90.3	0.2	0	0.3	62	60.2
Eucalyptus bosistoana	1.5	1	TG		1.5							
Eucalyptus eugenioides	2	1	TG		2							
Acacia mearnsii	1	5	SG			1						
Kunzea ambigua	0.1	25	SG			0.1						
Eragrostis brownii	50	1000	GG				50					
Microlaena stipoides	40	1000	GG				40					
Kennedia rubicunda	0.1	1	OG							0.1		
Rytidosperma laeve	0.1	50	GG				0.1					
Hypochaeris radicata	0.1	50	EX								0.1	
Glycine tabacina	0.1	50	OG							0.1		
Hypericum gramineum	0.1	20	FG					0.1				
Leucopogon juniperinus	0.1	50	SG			0.1						
Axonopus fissifolius	60	500	HT									60
Centaurium erythraea	0.1	50	EX								0.1	
Gamochaeta purpurea	0.3	300	EX								0.3	
Sida rhombifolia	1	250	EX								1	
Conyza spp.	0.2	100	EX								0.2	
Breynia oblongifolia	0.1	2	SG			0.1						
Pittosporum undulatum	0.1	1	SG			0.1						
Bidens pilosa	0.1	25	HT									0.1
Lomandra longifolia	0.1	25	GG				0.1					
Cymbopogon refractus	0.1	5	GG				0.1					
Hibbertia empetrifolia	0.1	5	SG			0.1						
Cissus antarctica	0.1	1	OG							0.1		
Trema tomentosa	0.1	1	SG			0.1						
Clerodendrum tomentosum	0.1	1	TG		0.1							
Rubus fruticosus agg.	0.1	1	HT									0.1
Richardia brasiliensis	0.1	25	EX								0.1	
Eucalyptus piperita	0.5	50	TG		0.5							
Hypericum gramineum	0.1	1	FG					0.1				
Daviesia ulicifolia	0.1	1	SG			0.1						

Appendix C. EPBC Act significance assessments

C.1 Critically Endangered Ecological Community

C.1.1 Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion CEEC

The Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion ecological community is dominated by eucalypt trees and typically has an herbaceous understorey, but is variable in vegetation structure, ranging from a tall wet sclerophyll forest to more open, grassy woodland. It occurs in the New South Wales Southern Highlands region and is associated with soils derived from Wianamatta Shale (DAWE).

Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254) corresponds to this CEEC and was recorded in the far-northern end of the development site, surrounding the edges of Promised Lands Track, Nowra/Moss Vale Rd and Fitzroy Canal. Approximately 0.23 hectares occurs within development site (proposed construction footprint). Using available vegetation mapping, the vegetation recorded within the edges of the development site is part of a large patch (patch size) of around 22 hectares. The CEEC is considered present if it meets the key diagnostic characteristics and condition thresholds in the listing advice (Threatened Species Scientific Committee, 2012).

The key diagnostic characteristics of this ecological community are:

- Is an open forest or woodland with a canopy dominated by one or more eucalypt species listed in Table 1 (of the Conservation Advice)
- Has a ground layer including native grasses and/or other herbs (although it may vary in development and composition (refer Appendix A, Tables A1 and A2 of Conservation Advice)
- Occurs in the Southern Highlands in the Sydney Basin Bioregion (IBRA v7)
- Occurs at elevations between 470 m – 830 m ASL on clay soils derived from Wianamatta shale.

The areas of PCT 1254 occurring in the northern end of the assessment area were found to meet the above key diagnostic characteristics for the CEEC. Furthermore, vegetation integrity assessments of this vegetation (in accordance with the NSW Biodiversity Assessment Method) find that it meets the 'High Condition' thresholds outlined in the Conservation Advice for Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion. Specifically, the vegetation has:

- Patch size > 2 ha
- At least 50% of the perennial understorey vegetation cover is made up of native species, or:
- > 30 native understorey species per ha.

The project footprint is predicted to impact a total of 0.23 hectares of this CEEC.

An action is likely to have a significant impact on a CEEC if there is a real chance or possibility that it will:

1) **reduce the extent of an ecological community**

The listing advice for the community concluded that the ecological community now exists in a highly fragmented state with remnants mostly in isolated pockets, of which many may be in low quality and not meet the condition thresholds for national listing. The community has undergone a decline in extent estimated at 75-90% of its original extent and has less than 6,000 hectares remaining of which potentially less than 1,000 hectares remains in moderate to high condition.

The proposed activity would remove approximately 0.23 hectares of the community along south side of Promised Land Track and narrow strips along Nowra/Moss Vale Road. The condition of this patch was determined as Category A.1 High condition class according to the approved conservation advice (DoE, 2013) and is estimated to have an extent (patch size) of around 22 hectares. The impact of the proposed activity would occur in the western portion of this patch near Morton National Park, however clearing would be restricted to fringes of the patch along track and road which was mostly cleared 45 years ago. The proposed activity is likely to result in a reduction in the extent of this patch by around 1%. This would equate to no more than around 0.03% of the estimated total extent of the community in moderate to high condition.

The reduction in the extent of the community is considered to be moderate at a local context, but low in the context of the total remaining extent of the community.

2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed activity would cause a minor increase in fragmentation of this local patch by removing vegetation edges along the Promised Land Track (creating a further 10 metre gap (20m in total)) at the Nowra/Moss Vale Road around the intersection. The increase in isolation of the existing patch as a result of widening is unlikely to significantly impact its long-term viability, particularly at a local scale and is unlikely to affect fauna movement into the north-western corner of the existing patch.

3) adversely affect habitat critical to the survival of an ecological community

According to the Department of the Environment and Energy (DoE, 2013) Habitat critical to the survival of an ecological community refers to areas that are necessary:

- for the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

There are very few undisturbed patches of the community remaining in existence (approximately 1,000 hectares); most remaining patches have some degree of disturbance and degradation. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of large patches in 'High' and 'Moderate' condition classes as defined in the condition thresholds for the community (Table 2 of Approved Conservation Advice, DoE, 2015).

Most of the occurrence of the community in the impact area and broader assessment area meets the thresholds for inclusion in Category A.1 High condition class, including edge areas and past disturbances that have been subject to a high level of disturbance (from previous construction activities over 45 years ago). The patch affected is considered to be of high importance to the survival of the community and is fairly large (~22 hectares) in size compared to 93% of all other remaining patches of this community which are less than 10 hectares in size.

The proposed action will result in the removal of approximately 0.23 hectares of habitat for the community, from a patch considered to be critical to the survival of the ecological community. Given that the affected patch is relatively large and the impact would only be to existing edge areas, the proposed action is considered unlikely to have a substantial adverse impact on habitat critical to the survival of the community.

4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed activity is expected to remove 0.23 hectares of this community and likely to reduce the quality of soil in the impact area where it would be compacted or buried with new material for vehicle and machinery access from Nowra/Moss Rd (confined to existing track and road edges).

Some of the abiotic and biotic features of the adjacent retained area of the community may suffer from edge effects. Abiotic effects would include increased light/temperature, increased wind, altered hydrology, air moisture change. Biotic effects would include changes to the relative abundance of plant species and altered vegetation structure at the edges of the existing patch. The impact would increase cleared gaps to 12 metre along Promised Land Track and 20 metres along Nowra/Moss Vale Road, but this is unlikely to affect animal pollination, seed dispersal, fauna movements or increase predation.

Weed establishment and spread may occur during and after construction with increased access activities. Weed management will be detailed in a Biodiversity Management Plan.

These edge effects have potential to modify the condition of retained vegetation and habitat for threatened species at the edge of the existing vegetation community patch. However, the overall modification of these factors is unlikely to cause decline of the whole patch.

- 5) **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

The proposed activity is expected to remove 0.23 hectares of this community from the edge of an approximately 22 hectare patch of TEC.

The composition of the edge of the TEC patch is likely to be modified as a result of the action through weed invasion and altered abiotic conditions. The patch of the TEC to be impacted is determined as Category A.1 High condition class and minor reduction in ecological function can be expected from a small reduction in patch size. Species composition in the patch is considered very high, even after past disturbances, with little to no weed invasion. Functionally important species will remain in the patch and the proposed activity is not considered likely to cause any further substantial change in species composition.

The proposed activity is likely to reduce the quality of a small proportion of the immediately adjacent retained area of the community due to edge effects such as increased wind, altered hydrology and weed invasion. These changes in environmental conditions are unlikely to result in a substantial change in the species constitution and vegetation structure of the patch overall. Any changes on the edge of the patch would likely involve a proliferation of tolerant species (typically grasses), or increased leaf litter (increased canopy regrowth), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or dense leaf litter. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader patch of the community. Edge effects are already occurring in this vegetation from the existing Promised Land Track and Nowra/Moss Vale Rd.

- 6) **cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
 - a) **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
 - b) **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposed activity includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created edge. Weeds have potential to invade the adjacent edges of the community with fertile shale soils. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader patch of the community. Given the high floristic value of the patch and proximity to the National Park, native vegetation is likely to be more resilient to weed invasion and many weeds controlled by National Parks staff either directly or through hazard reduction burns. The current levels of weeds on Promised Lands Track are low, with higher amounts on the edges of Nowra/Moss Vale Road, likely due to regular vegetation management (and spread propagules or seeds on machinery).

- 7) **interfere with the recovery of an ecological community.**

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following high priority actions of relevance to the proposed activity:

- Avoid further clearance and fragmentation of patches of the ecological community that meet the condition thresholds and surrounding native vegetation:
 - Individual patches more than 10 ha in size must be retained and patches should not be reduced to below 2 ha
 - Overall, the extent of the ecological community meeting at least minimum condition thresholds should not be reduced below a critical viability threshold (e.g. 800 ha)
- Minimise impacts from any developments and activities in and adjacent to patches that might result in further degradation (for example, by avoiding disturbances to native vegetation and soil, applying

- recommended buffer zones around the ecological community, controlling runoff and avoiding significant hydrological changes and eutrophication)
- The highest priority and most cost effective habitat measure is to protect mature trees with hollows and a range of age cohorts in each patch (including ensuring that trees are left to grow to maturity). In addition, plant hollow-producing locally native species and supplement retention of habitat trees by planting artificial hollows (e.g. nest boxes) in or near to the ecological community and monitor outcomes. Whilst 6 hollow-bearing trees will be removed, hollows should be cut out of limbs and retained for new use in adjacent vegetation (attached to retained trees)
 - Retain fallen logs and habitat for fauna, noting different log requirements for different species (e.g. logs embedded in the soil are necessary for some species and hollow logs are required by other species). Supplement with re-introducing logs to degraded patches
 - Retain other native vegetation remnants, derived native grasslands or shrublands and paddock trees near patches of the ecological community, particularly patches of the community less than 5 ha. Increase the size and condition of patches by promoting regeneration of and replanting canopy trees and a diversity of understorey species. As part of this create or restore appropriate wildlife corridors and linkages, including stepping stones
 - Control introduced pest animals, including limiting access by domestic pets, to avoid vegetation damage and allow natural regeneration and to manage threats especially to threatened species
 - Use appropriate hygiene and management protocols to prevent contain weed incursions and aim to eradicate them
 - Keep vehicles and machinery out of remnants. If vehicles must be taken into remnants, ensure they are washed first to remove soil and weed seeds
 - Do not plant potential environmental weeds in gardens and other landscaping from which they may spread into the remnant, nor dump garden waste beyond the confines of the garden on private or public land
 - Manage weeds before and after ecological burns, and during revegetation works to maximise success of restoration.

The proposed activity would interfere with the first of these actions as it would impact a greater than 10 hectares remnant patch that may otherwise be suitable for conservation through loss of 0.23 hectares of the community (limited to edges of existing tracks and roads).

There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposed activity in another location or in the same location after construction. Mitigation measures for the proposed activity would be designed to ensure that the proposed activity does not interfere with the remaining actions relating to weed prevention and control.

Conclusion

The proposed activity would have a minor increase in fragmentation of this local patch by removing habitat on the central western portion, creating an additional four (4) metre gap (12m in total) to the Promised Land Track and additional 10 metre gap (20m in total) to Nowra/Moss Vale Road around the intersection. The increase in isolation of the existing patch as a result of widening is unlikely to significantly impact the long-term viability, particularly at a local scale and unlikely to affect fauna movement into the north western corner of existing patch.

Most of the occurrence of the community in the impact area and broader assessment area meets the thresholds for inclusion in Category A.1 High condition class, including edge areas and past disturbances that have been subject to a high level of disturbance (from previous construction activities over 45 years ago). The patch affected is considered to be of high importance to the survival of the community and is fairly large (~22 hectares) in size compared to 93% of all other remaining patches of this community which are less than 10 hectares in size. However, the overall modification of these factors is unlikely to cause decline of the whole patch.

Indirect impacts are unlikely to change in the species constitution and vegetation structure. Any changes on the edge of the patch would likely involve a proliferation of tolerant species (typically grasses), or increased leaf litter (increased canopy regrowth), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or dense leaf litter. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader patch of the community.

The 0.23 ha reduction in the extent of the community is considered to contribute to the cumulative loss of this community in the locality although is not substantial in terms of the proportion of the local occurrence. The proposed action is considered unlikely to have a significant adverse effect on the extent and condition of this community in this locality.

The selection of the preferred route and design development has resulted in avoiding and minimising impacts to this community as much as possible and the residual impact of the proposed action is unlikely to be significant.

C.2 Critically Endangered Species

C.2.1 Scrub Turpentine (*Rhodamnia rubescens*)

Rhodamnia rubescens is known to occur from coastal districts of NSW north from Batemans Bay to Bundaberg in Queensland. The distribution of *R. rubescens* occasionally extends inland onto the escarpment up to 600 m a.s.l. in areas with rainfall of 1,000–1,600 mm (Benson & McDougall 1998).

Six *Rhodamnia rubescens* were recorded in one small part of the assessment area during the 2021/22 surveys. Two of these specimens are within the development site (approximately 300m west of the Kangaroo Valley Power Station) and are likely to be impacted by the proposed action. These plants all occur in Illawarra Escarpment Blue Gum wet forest (PCT 1245). Nearby areas of Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283) are also suitable habitat for this species (according to the BioNet threatened species description for the species (DPE, 2022)). Given the abundance of forests remaining on the surrounding escarpments (containing the same PCTs and geology), suitable habitat for *Rhodamnia rubescens* is likely to be widespread in the locality (with other plants records within 1km west of the development site (near McPhails fire trail), (Atlas of Living Australia, 2022).

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

The number of distinct populations of *Rhodamnia rubescens* is unknown but is expected to be large given the wide distribution of the species (NSW Threatened Species Scientific Committee, 2019).

According to the *Conservation Advice for Rhodamnia rubescens*, (DAWE, 2020; NSW Scientific Committee, 2018): *There are 2,740 records associated with the name R. rubescens in Australia in the Atlas of Living Australia. Of these records, 329 are associated with vouchered herbarium specimens and 2,266 with the NSW Office of Environment & Heritage Atlas of NSW Wildlife (BioNet).*

Little is known about the reproductive ecology of the species (Snow, 2007), yet they are known to resprout from rootstock after fire and produce suckers (Benson & McDougall, 1998). Seed dispersal is via birds, bees and water movement with germination taking about 1–2 months (Beardsell, Obrien, Williams, Knox, & Calder, 1993; Benson & McDougall, 1998). The species is expected to have a generation length of at least 30–40 years (Floyd, 2008). There are numerous recent records of the species within Kangaroo Valley, and six individuals of the species were recorded during the field surveys. Considering the proximity of these records and the methods of seed dispersion, they may be considered part of the local population.

It is considered an important population as it is within a region of extensive protected areas which may support dispersal and genetic diversity of the population.

The project would result in the direct impact (removal) of two individual plants and the removal of about 4 hectares of suitable habitat (PCT 1283 and 1245). PCT 1245 (Illawarra Escarpment Blue Gum wet forest) and PCT 1283 (Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion) forms suitable habitat for this species, and is widespread in the surrounding forest areas, particularly beneath the cliff lines of the escarpment. The loss of 1.4 hectares of PCT 1245 and 2.64 hectares of PCT 1283 is considered minor when compared to the amount of similar vegetation along Kings Creek, and along the surrounding escarpments. Much of these PCTs remain uncleared in Kangaroo Valley, as they are often occurring in steeper gullies and escarpment areas.

Potentially suitable habitat for *Rhodamnia rubescens* is likely to be widespread in the locality (with other plants recorded within 1km west of the development site (near McPhails fire trail). Only a small amount of time was spent searching nearby forest areas (west of Kangaroo Valley Power Station) due to time constraints and private property constraints. Suitable habitat extends far up the slopes towards the cliff lines and along Kings Creek and these areas may contain more plants. The size of the population is unknown and is measured as the six plants which were recorded.

The two plants to be removed were both in poor health due to Myrtle Rust (See photo below). The four plants to the west (outside the development site) appeared less affected by the disease.

The direct removal and risk of importation of Myrtle Rust into the site during construction does risk the long term decline of the population. As such, it is possible the project may result in a long-term decrease in the size of the local population.

2) reduce the area of occupancy of the species

The project would remove approximately 4 ha of suitable habitat (in varying conditions) in the locality. This would comprise the removal of about 0.001% of the area of occupancy of the species in NSW (about 3,360km²) (NSW Threatened Species Scientific Committee, 2019), yet a notable area in the locality. As such, on a State level, the project would not likely reduce the area of occupancy of the species, however it would marginally reduce the area for the local population.

3) fragment an existing population into two or more populations

The project is generally linear infrastructure, with the widest sections of vegetation disturbance at about 500m wide, but usually between 20m – 50m (consisting of widening of existing clearings). However, the location in which direct impact would occur to two plants (adjacent to Kangaroo Valley Power station) is a wide section. The clearing would further increase edge effects on the patch of suitable habitat. However, due to the methods of seed dispersal, this distance would not fragment the remaining population in two. The four plants located outside the development site boundary will be retained and large areas of habitat (PCT 1283 and PCT 1245) surrounding would not be affected. The nearest other plants are located near McPhails Trail (approximately 1km west) and forest linkages between here will remain.

4) adversely affect habitat critical to the survival of a species

There is no critical habitat listed for the species and no federal recovery plan for the species, however the NSW priority management area for the species covers its entire extent (NSW Threatened Species Scientific Committee, 2019). The PCTs in the impact area provide suitable habitat for the species, however the condition of the vegetation varies in its habitat value. The project would not impact habitat critical to the survival of the species.

Considering there are known individuals present within the site, it is considered to comprise habitat critical to the survival of the species, in which the project would remove about 4 ha. Potentially suitable habitat for *Rhodamnia rubescens* (PCT 1283 and PCT 1245) is likely to be widespread in the locality (with other plants recorded within 1km west of the development site (near McPhails fire trail). Only a small amount of time was spent searching nearby forest areas (west of Kangaroo Valley Power Station) due to time constraints and private property constraints. Suitable habitat extends far up the slopes towards the cliff lines and along Kings Creek and these areas may contain more plants. Large areas of these PCTs remain uncleared in Kangaroo Valley, as they are often occurring in steeper gullies and escarpment areas.

5) disrupt the breeding cycle of a population

The species flowers in late winter through to spring, with a peak in October, and fruits typically begin to appear in December (NSW Threatened Species Scientific Committee, 2019). The removal of two individual plants would have an unknown impact on breeding potential as both plants are in very poor health due to Myrtle rust and flowering capacity may already be lost. No flowers or fruit have been observed on either plant during 2021 season). Construction and operational impacts outside of direct vegetation removal are not expected to impact any of the other plants in surrounding areas. Without evidence of the reproductive capacity of the two individuals to be removed, it is unknown if the project would disrupt the breeding cycle of the local population of the species.

6) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The project would remove four hectares of suitable habitat (including mostly regrowth and some remnant vegetation). The removal of two plants would also mean there is a decline in the species. The current health of these plants is poor as a result of Myrtle rust and this sub-population may already be in decline. The four plants (in better condition) outside the development site will be retained and are unlikely to be affected by the proposed action. Nonetheless, a small area of habitat will be lost and modified, with a minor species decline expected.

7) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Threats to the species include "degradation of habitat and competition from transformer weed species" (DPE, 2021b). Construction activities and operational vehicle movements increases risk of introduction and invasion of weed species in adjacent habitat. Weed material may be introduced by wind, vehicles and road runoff. The expansion of edge effects (from widening of existing clearings) would reduce the resilience of adjacent vegetation, thus making it more vulnerable to weed incursion. The patches of PCT 1245 where *Rhodamnia rubescens* was recorded have historically been cleared and already contain significant weed growth in some areas (particularly in the ground layer). These weed infestations extend across the forest habitat of PCT 1245 and further west to the private properties (west of Kangaroo Valley Power Station). Given this, it is unlikely that the proposed action will increase weed proliferation in the habitat of *Rhodamnia rubescens*. Mitigation measures to prevent weed spread during construction will be outlined in the project BDAR and CEMP.

8) introduce disease that may cause the species to decline, or

Austropuccinia psidii (Myrtle Rust) is present in the assessment area and both plants to be removed are infected (see **Photo 7.4**). It is unknown whether these individuals have the capacity to produce flowers or fruit due to their poor health (observed during breeding season). The prognosis for both plants is uncertain, and they may already be in decline (unless suckering from mature plants occurs). The four other Scrub Turpentine plants outside the assessment area appeared to be in better condition, however still showed minor signs of Myrtle Rust.

Machinery associated with vegetation clearance and subsequent construction has the potential to transmit and move Myrtle Rust (another other pathogens) within the site. Increased access by construction personnel may spread disease on footwear. It is possible that works could introduce and move disease around the site. This species is highly sensitive to the Myrtle Rust and a known population is present (although already infected). It is unlikely that the proposed action will introduce disease, given Myrtle rust is already present. Nonetheless, mitigation measures will be detailed in the project CEMP.

9) interfere with the recovery of the species.

There is no federal recovery plan for the species, however the NSW Saving our Species strategy (DPE, 2021a) includes actions such as data collection, species monitoring, collection of genetic material, propagation, weed management, community engagement and education and fire management. Management actions relevant to the project include:

- Control transformer weeds (particularly vine weeds and lantana) where impacting on the species. Where appropriate use a staged approach and use methods that reduce off-target damage. Schedule regular follow up work
- Clearing of native vegetation reduces the area of occupancy of Myrtaceae host species, this may have consequences for genetic diversity and their resilience to infection. Liaise with Forestry Corporation of NSW to ensure habitat is protected and forestry operation impacts are minimised.

The project would remove two plants and about 4ha of suitable habitat. Although the project is not on Forest land, it would reduce the area of occupancy and genetic diversity of the local population to a minor degree.

As such, the project does interfere with the recovery of the species.

Conclusion

The project would remove approximately 4 ha of suitable habitat (in varying conditions) in the development site. This would equal the removal of about 0.001% of the area of occupancy of the species in NSW. This vegetation removal affects mostly regrowth vegetation on the edges of existing clearings, and may increase the risk of weed and pathogen encroachment to a minor extent. The likely removal of two individual plants

would have an unknown impact on breeding potential as both plants are in very poor health due to Myrtle rust and flowering capacity may already be lost. No flowers or fruit have been observed on either plant during 2021 season). Without evidence of the reproductive capacity of the two individuals to be removed, it is unknown if the project would disrupt the breeding cycle of the local population of the species. Whilst the species will suffer a minor decline of two infected plants, the proposed action is unlikely to result in a significant impact to the *Rhodamnia rubescens*. Four nearby plants which are in better health will be avoided by the proposed action.

C.3 Endangered Species

C.3.1 Gang-gang Cockatoo (*Callocephalon fimbriatum*)

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

There are an estimated 25,300 mature individuals in the wild with a declining trend (high reliability) (Cameron et al. forthcoming). The species' extent of occurrence (EOO) and area of occupancy (AOO) is estimated to be stable at 400,000 km² and 30,000 km², respectively (Cameron et al. forthcoming).

There is no adopted or made Recovery Plan for this species.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

There are an estimated 25,300 mature individuals in the wild with a declining trend (high reliability) (Cameron et al. forthcoming).

This species was recorded numerous times during surveys. Observations were usually of a single bird flying over the assessment area, except for one observation of up to 5 birds foraging in the eucalypt canopy near Fitzroy Canal. During targeted breeding surveys in October 2022, an adult female and juvenile male were recorded perched and foraging near three suitable hollow-bearing trees at the southern end of the existing pipeline (on plateau). It was assumed that one of these trees is a potential nest. These trees are to the east of the development site and will not be cleared. The proposed action will remove up to 22.2 ha of regrowth and 7.6 hectares of potentially remnant native vegetation from the edges of existing cleared corridors. This vegetation does contain fruiting eucalypts which constitutes suitable foraging resources. Similar foraging habitat is widespread in the surrounding areas of Morton National Park and Kangaroo Valley. There are twelve hollow-bearing trees which are potentially suitable as breeding habitat within the development site. The loss of these trees is unlikely to affect breeding success of the population (these 12 trees were uninhabited during observations in December 2021 and October 2022). This species already crosses above the existing hydro scheme areas, and forages in the vegetation edges. The proposed action is unlikely to cause a long-term decrease in the size of a population.

2) reduce the area of occupancy of the species

The species' extent of occurrence (EOO) and area of occupancy (AOO) is estimated to be stable at 400,000 km² and 30,000 km², respectively (Cameron et al. forthcoming).

The proposed action will remove up to 22.2 ha of regrowth and 7.6 hectares of potentially remnant native vegetation from the edges of existing cleared corridors. Much of this vegetation is likely used by the Gang-gang Cockatoo as part of their wider foraging areas and home ranges. The loss of this vegetation (from along the edges of an existing cleared corridor) is unlikely to reduce the area of occupancy. The loss of up to 12 hollow-bearing trees which may be suitable for this species is only a minor component of breeding habitat compared to what is available in the surrounding forested landscape.

3) fragment an existing population into two or more populations

As discussed above, the Gang-gang Cockatoo is part of a single population across south-eastern Australia. This is a highly mobile species, which migrates between altitudes during different seasons.

The project would clear about 29 hectares native vegetation, largely along the edges of the existing cleared footprints of the pipeline and power station areas. Access tracks would be widened in some areas and may be about 10 m wide. The pipeline easement will remain the same, with the clearing of occasional laydown areas at various points. Power station areas will be widened, and stockpile emplacement areas will require larger clearing amounts (however have been designed to affect lower-quality regrowth vegetation on disturbed land). It is obvious that Gang-gang cockatoos are able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the forest patches surrounding the existing pipeline and power stations. As such, the works would not fragment the landscape to a degree in which would separate a population.

4) adversely affect habitat critical to the survival of a species

Gang-gang Cockatoos favour old growth forest and woodland assemblages for nesting and roosting. The species roosts in the hollows of tree trunks and limbs, or within the dead sprout of large, living eucalypts (Gibbons 1999; Gibbons & Lindenmayer 2000).

Foraging is mainly arboreal, occurring in the canopy of woodland assemblages (particularly within eucalypts) and less often within the understory (more often during *Acacia* seeding) (Higgins 1999). Feeding rarely occurs within shrubs and at ground-level.

Within their natural habitat, Gang-gang Cockatoos mostly forage in the canopy of trees at heights >10 m, especially eucalypts within forests and woodlands. Approximately 72 % of feeding occurs in canopy >10 m height; 21 % in the subcanopy between 4–10 m; and 7 % in the shrub layer between 0.2–4 m. No feeding occurs at ground level (Higgins 1999).

Favourable breeding habitat is tree hollows at least 5m above the ground and with a >9cm diameter entrance and 20cm diameter internal space. The refined development site contains approximately 12 suitable habitat trees, with a further 332 suitable habitat trees recorded within a 200m buffer of the site. The trees within the development site did not contain evidence of breeding during surveys in October 2022. However, the observation of an adult female with juvenile male foraging and perched close to three hollow-bearing trees to the east of the site indicates potential breeding in one of the trees. These trees are approximately 40m east of the existing pipeline and will be retained. The wider forest areas of Morton National Park (containing old-growth forest) are likely to contain a much higher density of suitable hollow-bearing trees for this species. Whilst much of Morton National Park was burnt in the 2019/2020 bushfires, large areas around the development site, and vast areas to the north were not burnt. Inspections during the breeding season (December 2021 and October 2022) did not record any usage or breeding activity in the hollow-bearing trees on site. Nonetheless, given the impact of the 2019/2020 bushfires to the south, it is likely that hollow-bearing trees remaining in the locality are important and could be used during future breeding seasons. The loss of twelve hollow-bearing trees from edges of existing clearings would only be a tiny proportion of what is available in the surrounding landscape, and alone would not constitute critical habitat for this species.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

5) disrupt the breeding cycle of a population

Gang-gang Cockatoos favour old growth forest and woodland assemblages for nesting and roosting. The species roosts in the hollows of tree trunks and limbs, or within the dead sprout of large, living eucalypts (Gibbons 1999; Gibbons & Lindenmayer 2000). Twelve hollow bearing trees will likely be removed which are considered suitable breeding habitat. These trees were not inhabited during observations during the 2022/2023 breeding season. Nonetheless, their removal will be a minor loss of suitable habitat. Similar habitat is widespread in the surrounding forest areas of Kangaroo Valley, Morton National Park, and Budderoo National Park to the north. 332 recorded hollow bearing trees will be retained within the wider assessment area (adjacent to proposed clearing). As described above, 29.8 hectares will be removed consisting of mostly regrowth and some remnant native vegetation (suitable for foraging). Given the proposed action utilises an already cleared corridor (to be widened), and surrounding land contains large areas of suitable (unburnt) forest habitat, it is unlikely that the breeding cycle of a population would be affected by the project. Future operation of the proposed action would unlikely exacerbate any disturbances already occurring at the existing hydro scheme.

6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Whilst much of Morton National Park was burnt in the 2019/2020 bushfires, large areas around the development site, and vast areas to the north were not burnt and remain in high condition.

The project would clear about 29 hectares native vegetation, largely along the edges of the existing cleared footprints of the pipeline and power station areas. Access tracks would be widened in some areas and may be about 10 m wide. The pipeline easement will remain the same, with the clearing of occasional laydown areas at various points. Power station areas will be widened, and stockpile emplacement areas will require larger clearing amounts (however have been designed to affect lower-quality regrowth vegetation on already modified land). It is obvious that Gang-gang cockatoos are able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the high-quality forest patches surrounding the existing pipeline and power stations. The proposed action will not isolate quality habitats.

The habitats to be affected are already modified to an extent by previous vegetation clearing for the original power scheme. The habitats are already affected by cleared corridors (pipeline, power station, dams, access tracks) and these corridors will not be expanded to any point where they would isolate habitats (for a highly mobile species). There will be a small decrease to availability of habitats (foraging and home-ranges) however this won't be at a scale large enough to cause a decline in the species.

7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

Intra/interspecies competition for hollows is a threat to Gang-gang Cockatoo, which has been exacerbated by the 2019/2020 bushfires along the Great Dividing Range. Feral honeybees, possums, and other bird species such as starlings, Noisy Miners and Common Mynas are likely to dominate such habitat features, particularly in areas with scarce hollows. Given the development site is located within large tracts of unburnt forest, the scarcity of hollows is less of a threat than in a burnt landscape, or a highly fragmented landscape.

Competition from Mynas is worse in urban and over cleared settings where Mynas have found an ecosystem niche. Common Mynas and Starlings were absent from the assessment area during all surveys, and Noisy Miners were only recorded in very low numbers and were absent in most surveys. Similarly, no Feral honeybees were observed within the development site. The Common Brushtail Possum was recorded on numerous occasions but isn't considered an invasive species.

The proposed vegetation clearing is largely confined to the edges of existing clearings such as the pipeline, power stations, infrastructure footprints, dams and access tracks. The proposed widening of these areas could theoretically improve the landscape for the Myna birds which prefer fragmented woodland habitats. However, given the existing cleared proportions of the development site and the relative absence of these species, it is unlikely that the proposed action would exacerbate their movement into these habitats.

Given the nature of the proposed works, weed spread is possible on the widened track edges and laydown areas. Whilst the plateau section of the assessment area contains only low-level weed growth (confined mostly to the intersection of Nowra/Moss Vale Rd), the valley areas are moderately to severely affected by weed infestations. The spread of weeds can be controlled through strict mitigation measures and vehicle/equipment cleaning protocols. Any potential impact would be restricted to areas immediately adjacent to the proposed activity and is not likely to substantially affect the broader sections of forest. The Gang-gang Cockatoo primarily forages in the canopy, and feeds mainly on eucalypt fruit. Any weeds introduced along the road edge or existing clearing edges are unlikely to impact significantly on the mature eucalypts in the area.

The proposed action is unlikely to result in invasive species becoming established in the landscape. The proposed action affects land which has long been cleared, and vegetation which has regrown or previously existed on the edges of clearings.

8) introduce disease that may cause the species to decline, or

Gang-gang Cockatoos are susceptible to Psittacine beak and feather disease (Sarker et al. 2014). It is spread through contaminated nest chambers.

The proposed action and removal of about twelve hollow-bearing trees (suitable for this species) would not affect the prevalence of this disease in the population.

9) interfere with the recovery of the species.

There is no recovery plan for this species, management actions would aim to address threats to the species such as weeds, invasive species / competition for hollows and loss of habitat. The proposed action will remove an area of suitable foraging habitat and potential breeding habitat (twelve hollow-bearing trees). None of known breeding trees recorded in the wider landscape (three hollow-bearing trees to the east of the development site) will be impacted. The proposed action avoids 332 hollow-bearing trees recorded in a 200m buffer of the development site (and similar resources would be widespread in surrounding forest areas). This species was impacted by the 2019/2020 NSW bushfires that affected large forest areas across its range, although the location of the development site is surrounded by very large areas of unburnt, high-quality habitat. Removal of habitat (largely regrowth) from the edges of an existing cleared corridor is not expected to affect the recovery of this species.

Conclusion

The Gang-gang Cockatoo would experience a relatively small modification of suitable habitat from the proposed action. No known breeding habitat will be impacted, and the loss of twelve suitable hollow-bearing trees would only be a minor decrease of what is available in the locality (which contains large areas of unburnt forest). The observation of an adult female with juvenile male foraging and perched close to three hollow-bearing trees to the east of the site indicates potential breeding in one of the trees. These trees are approximately 40m east of the existing pipeline and are not affected by the proposed action. The proposed action is unlikely to reduce the population size of the Gang-gang Cockatoo or decrease the reproductive success of this species. This species is already using the assessment area despite clearings and disturbance for the existing hydro scheme. The widening of the existing clearings in some areas would not limit the movement or dispersal capability of this highly mobile species in the landscape. The proposed action would not interfere with the recovery of the Gang-gang Cockatoo. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to the Gang-gang Cockatoo.

C.3.2 Spotted-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tailed Quoll is considered likely to occur based on the presence of large expanses of forested habitat extending within Morton National Park and west from Kangaroo Valley. This species was not recorded during comprehensive camera monitoring surveys and spotlighting.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The local populations of the species in the assessment area are considered to form an important population as they are:

- large and hence may constitute key source populations for dispersal
- distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats
- at or near the south-west limit of the species' known range.

Based on this assessment process, the population of the species in the assessment area can be considered an important population. Therefore, by this assessment process, the assessment area is likely to contain an important population of this species within suitable habitat.

The Spotted-tailed Quoll is considered likely to occur based on the presence of large expanse of forested habitat extending within Morton National Park and west from Kangaroo Valley. The area of potential habitat for a local population is very extensive and the area impacted by the proposed action is relatively small associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure

and temporary laydowns. The potential loss of foraging habitat for the species is approximately 40 hectares comprising all native vegetation communities in the assessment area. The extent of habitat remaining in the locality would provide sufficient resources to sustain this species, such that the proposed action is unlikely to lead to a long-term decrease in the size of the population.

2) reduce the area of occupancy of the species

Radio-tracking studies (Claridge et al., 2005) of the Spotted-tailed Quoll in Kosciuszko NP in 2002 resulted in home range estimates of 620–2560 hectares for males, and 90–650 hectares for females. It is evident that this species occupies very large areas of habitat. Whilst this species was not recorded within the development site, it is likely to occur within adjacent areas of Morton National Park, and would likely frequent the site during foraging and dispersal. The assessment area generally follows existing clearings and the vegetation to be impacted does not provide suitable den sites. All PCTs within development site are considered to be potential habitat for this species, meaning a total of 29.8 hectares of potential habitat will be removed. The area of occupancy will not be further fragmented as this species is likely to already cross through the existing pipeline footprint and through bushland surrounding existing power stations and man-made dams. Minor widening of Promised Lands Track wouldn't affect the ability to cross between bushland patches. The proposed action would contribute to the loss of habitat for this species from the wider locality, however given the location of this habitat along the edge of a considerably larger core area of habitat it is not likely that the area of occupancy would be reduced.

3) fragment an existing population into two or more populations

Importantly, the proposed action will not result in fragmentation of habitat for the Spotted-tailed Quoll. The new development site generally follows the existing footprint, and is not expected to create any new barriers to dispersal for this species. Any locally occurring individuals would already likely avoid the existing cleared corridors and Power station areas. The widening of these areas into the surrounding forest patches may decrease the amount of habitat and home-ranges to a small degree but is unlikely to exacerbate habitat fragmentation in the locality.

4) adversely affect habitat critical to the survival of a species

The Spotted-tailed Quoll has a preference for mature wet forest habitat (Belcher, 2000; Green & Scarborough, 1990; Watt, 1993), especially in areas with rainfall 600 millimetres per year (Edgar & Belcher, 2008; Mansergh, 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). Habitat within the Morton National Park is intact with very little disturbance, suggesting that it may be critical for the survival of this species in the region. The proposed action would remove up to 40 hectares of habitat with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of the surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns that would likely be of lower value for the species. Although the affected habitat is likely to be at the edge of a broader area of critical habitat, due to its edge location and generally modified condition it is unlikely to be critical to the survival of the species.

5) disrupt the breeding cycle of a population

The development site and proposed impacts are generally confined to the edges of the existing cleared footprint of the pipeline, access tracks, power stations and man-made dams. Most of the vegetation to be impacted is in a stage of regrowth and high quality habitat for this species is scarce. Potential den sites are absent with no large hollow logs or rocky shelters available in the footprint. The local population of the species is unlikely to be directly dependent on the edge habitats for breeding. The large expanses of core habitat provide sufficient opportunities for breeding pairs, and the proposed action is not expected to disrupt the breeding cycle of the local population of the species.

6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would have an impact on up to 29.8 hectares of suitable habitat within a large expanse of similar and better-quality habitat extending in all directions with Morton National Park and extending west in Kangaroo Valley and east to Kangaroo Valley Nature Reserve. The area of disturbance in the construction footprint represents a small proportion of the potential habitat available in the locality for this species. This species is expected to continue to use the remaining habitats surrounding the construction footprint and the

proposed action is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

Weed invasion is a potential issue with a project of this nature and appropriate controls are required during construction and operation of the project. Unless the proposed activity includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created road edge. Weeds have potential to invade the adjacent edges of clearings and tracks, particularly in areas with fertile shale soils. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader vegetated areas. Given the high floristic value of the patch and proximity to the National Park, native vegetation is likely to be more resilient to weed invasion and many weeds controlled by National Parks staff either directly or through hazard reduction burns. The management of invasive species would be managed under the CEMP and during operation of the pipeline using best practice methods.

8) introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species of relevance to the proposed action. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations of the species.

9) interfere with the recovery of the species.

There is no recovery plan for this species, important management actions would aim to address threats to the species such as predation and loss of habitat. The proposed action will remove an area of potential habitat. It is not expected to increase the threat of predation.

Conclusion

The proposed action would result in a relatively small reduction of potential habitat for the Spotted tailed Quoll from the large expanse of available habitat for this species in the locality. The proposed action is unlikely to reduce the population size of this species or decrease its reproductive success. The proposed action is unlikely to result in a significant impact to the Spotted-tailed Quoll.

A.1.1 Greater Glider (*Petauroides volans*)

The Greater Glider is listed as Endangered under the EPBC Act.

The Greater Glider was recorded four times within the plateau section of the assessment area during the surveys undertaken for the BDAR. Two likely den trees were also recorded nearby to Greater Gliders (large hollow-bearing trees). Both den trees are outside the development site and will not be impacted. This species was not recorded in the valley section of the development site, despite potentially suitable habitat existing. Impacts to this species includes vegetation clearing of all PCTs within the plateau portion of development site. This includes approximately 12.3 hectares, made up of PCT 1254 (0.23ha), PCT 1156 (5.5ha) and PCT 1082 (6.54ha).

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The Greater Gliders in the assessment area are considered to be part of a large population which is likely to be linked to the Morton National Park population. This population would likely be necessary for maintaining genetic diversity.

There is no adopted or made recovery plan for the Greater Glider.

Greater Glider individuals were identified during the 2019 spotlighting surveys at two different locations. One individual was detected in Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion, 50 metres from the project footprint) with a den tree located nearby (80m from footprint). The other individual was detected in Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion within the footprint and den tree located 20 metres from the project footprint. During further surveys in December 2021, two more individuals were recorded, both in the southern areas of the plateau, in Silvertop Ash - Red Bloodwood - Sydney Peppermint forest. Both records were in forest adjacent to the pipeline and Promised Lands Track (and outside the current development site). Greater Gliders were not recorded in the valley areas of the development site.

The Approved Conservation advice for the Greater Glider indicates that the species is particularly sensitive to forest clearance. The proposed activity would result in the removal of 12.3 ha of known habitat (in the plateau areas). The recorded den trees are outside the development site and will be retained. The project will remove approximately three medium diameter (>10cm) hollow-bearing trees, and three large diameter (>20cm) hollow-bearings (which are potentially suitable hollows for this species). It is likely a population of this species would inhabit the vast areas of Morton National Park and Budderoo National Park to the north. While the proposed activity might impact on foraging opportunities of individuals in the immediate area, it is not likely to result in a long-term decrease in the population, given the area's connectivity to broader areas of habitat in Morton National Park.

2) reduce the area of occupancy of the species

The proposed activity would result in the removal of 12.3 ha of known habitat (in the plateau areas). The approved conservation advice for the Greater Glider highlights the species' relatively small home range and low dispersal ability, and indicates the species is particularly sensitive to forest clearance.

Individual home ranges are small (1-4ha), and the proposed clearing of marginal foraging habitat could affect the home ranges of individuals. While the den trees identified during surveys are not impacted by the proposed activity, the impacted forest would likely be foraging habitat for the known Greater Glider currently utilising the habitat with den trees nearby. The Greater Glider population appeared to be absent from the suitable habitats in the valley portions of the development site, and vegetation clearing in these sections is unlikely to affect any home ranges.

The proposed vegetation clearing generally affects the edges of the existing cleared corridors (pipeline, access tracks and power station infrastructure) and has been designed to target areas of low-quality regrowth vegetation. Whilst the widening of these clearings may reduce available habitat, the population is already living with the effects of an existing cleared pipeline corridor, access tracks and man-made dams. High-quality habitats (which remain unburnt) are widely available to the east and west of the development site.

The proposed activity is unlikely to substantially reduce the area of occupancy of the local population of the species.

3) fragment an existing population into two or more populations

The proposed vegetation clearing generally affects the edges of the existing cleared corridors (pipeline, access tracks and power station infrastructure) and has been designed to target areas of lower quality regrowth vegetation. Whilst the widening of these clearings may reduce available habitat, the Greater Glider population is already living with the effects of an existing cleared pipeline corridor, access tracks and man-made dams. High-quality habitats (which remain unburnt) are widely available to the east and west of the development site.

Direct impacts would result in a small increase in habitat fragmentation creating an additional four (4) metre gap (12m in total) to the Promised Land Track and additional 10 metre gap (20m in total) to Nowra/Moss Vale Road around the intersection. The wider proposed laydown areas along the pipeline are infrequent and contain only marginal habitat for this species (majority of vegetation is in regrowth stages). The larger laydown areas are located in regrowth PCT 1082, which is characterized by low heath vegetation with young-regrowth eucalypts (unlikely to be utilised by Greater Gliders). This is unlikely to substantially change the existing level of fragmentation for this species. The Greater Glider is known to glide up to 100m and expected to continue to move across clearings after construction. Increases in vehicle strike is expected to be low.

4) adversely affect habitat critical to the survival of a species

According to the Department of Environment and Energy (DoEE 2013), habitat critical to the survival of the species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting or dispersal
- For the long-term maintenance of the species
- To maintain genetic diversity and long term evolutionary development, or
- For the reintroduction of populations or recovery of the species.

All PCTs recorded in the plateau areas are associated PCTs for the Greater Glider. The development site has been designed to avoid large areas of remnant forest. Of the 12.3 hectares to be impacted on the plateau, approximately 8 hectares are regrowth forms of the PCTs, and considered to be only marginal quality for Greater Gliders. Many regrowth patches lack a Eucalypt canopy, and others have only sparse, young Eucalypts. Many of these areas lack the structural complexity required by Greater Gliders for breeding and foraging. Only six hollow-bearing trees are likely to be removed by the project. Furthermore, most vegetation clearing will affect existing clearing edges. The habitat that will be impacted by the project is considered to be marginal foraging and dispersal habitat, it is unlikely to contain breeding or shelter (den) sites and is unlikely to be critical to the survival of the species. Whilst den sites were recorded, they are outside the development site and will not be impacted.

The proposed action is unlikely to remove habitat critical to the survival of the species.

5) disrupt the breeding cycle of a population

Mating occurs in late summer and females give birth to single young in the autumn and winter. The young live in the pouch for the first three months, then live in the hollow (den) for the next three months.

As the identified den trees do not occur within assessment area, it is not likely that the project will disrupt the breeding cycle of the population. However, the vegetation clearance for the proposed activity may impact upon the foraging abilities of individuals located near the cleared areas, as discussed in the previous sections. Although, foraging abilities are already affected by the existing pipeline, access tracks and power station infrastructure. Foraging habitat within the development site is only marginal when compared to the large expanses of remnant (and unburnt) forest to the east and west of the development site. The proposed action is unlikely to disrupt the breeding cycle of this species.

6) Modify, modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

While the habitat clearance is likely to have a negative impact on foraging for the local population, the extent of remaining habitat in the area is considered sufficient and a decline of the species on the whole is unlikely. The development site is highly connected to Morton National Park, a large, forested reserve of approximately 2000km². The proposed activity would result in the removal of 12.3 ha of known habitat in the plateau areas. The 17 ha of vegetation to be cleared in the valley portions of the development site is unlikely to affect this species as it was not recorded below the plateau.

The development site has been designed to avoid large areas of remnant forest. Of the 12.3 hectares to be impacted on the plateau, approximately 7.96 hectares are regrowth forms of the PCTs, and considered to be only marginal quality for Greater Gliders. Many regrowth patches lack a Eucalypt canopy, and others have only sparse, young Eucalypts. Many of these areas lack the structural complexity required by Greater Gliders for breeding and foraging. Only six hollow-bearing trees are likely to be removed by the project. Furthermore, most vegetation clearing will affect existing clearing edges. The habitat that will be impacted by the project is considered to be marginal foraging and dispersal habitat, it is unlikely to contain breeding or shelter (den) sites and is unlikely to be critical to the survival of the species. Whilst den sites were recorded, they are outside the development site and will not be impacted.

7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

Given the nature of the proposed works, weed spread is possible on the widened track edges and laydown areas. Whilst the plateau section of the assessment area contains only low-level weed growth (confined mostly to the intersection of Nowra/Moss Vale Rd), the valley areas are moderately to severely affected by

weed infestations. The spread of weeds can be controlled through strict mitigation measures and vehicle/equipment cleaning protocols. Any potential impact would be restricted to areas immediately adjacent to the proposed activity and is not likely to substantially affect the broader sections of forest. The Greater Glider is primarily an arboreal species, and feeds mainly on eucalypt leaves. Any weeds introduced along the road edge are unlikely to impact significantly on the mature eucalypts in the area, which the Gliders rely upon for food and dispersal.

8) introduce disease that may cause the species to decline, or

There are no known diseases that impact the Greater Glider that are likely to be introduced by this project.

There is a low possibility that the equipment used may result in the spread or proliferation of *Phytophthora* (root rot) fungus, which would impact on the eucalyptus that the Greater Gliders feed upon. However, this fungus is not currently widespread in New South Wales, and the risks from *Phytophthora* are considered minimal. Mitigation measure for spread of *Phytophthora* will be detailed in a CEMP.

9) Interfere substantially with the recovery of the species

There is currently no published recovery plan for the Greater Glider. However, the species Conservation Advice lists two high priority actions which were deemed relevant to this proposed activity. They are:

- Constrain clearing in forests with significant subpopulations, to retain hollow bearing trees and suitable habitat,
- Avoid fragmentation and habitat loss due to development and upgrade of transport corridors.

While the identified den trees will not be impacted by the clearing of the construction footprint, the clearing will still occur in a forest with a known population of Greater Gliders, and is considered clearing of suitable habitat. However, the total clearance will be a small portion of the overall habitat within the area, and while it will have some impact on the local population, it is not likely to substantially interfere with the species.

The development site has been designed to avoid large areas of remnant forest. Of the 12.3 hectares to be impacted on the plateau portion of the development site, approximately 7.96 hectares are regrowth forms of the PCTs, and considered to be only marginal quality for Greater Gliders. Many regrowth patches lack a Eucalypt canopy, and others have only sparse, young Eucalypts. Many of these areas lack the structural complexity required by Greater Gliders for breeding and foraging. Only six hollow-bearing trees are likely to be removed by the project. Furthermore, most vegetation clearing will affect existing cleared edges.

As discussed above, the proposed clearance of vegetation will not likely increase the fragmentation of the species beyond what it is currently experienced.

Conclusion

The Greater Glider population in the assessment area would experience a small reduction in extent of suitable foraging habitat from the proposed action. No identified den trees will be impacted. While some individuals may experience a direct reduction in foraging habitat (or home range), the proposed action is unlikely to reduce the overall population size of the Greater Glider given the areas high level of connectivity to Morton National Park. The proposed action is not likely to interfere with the recovery of the species and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to the Greater Glider.

A.1.2 Littlejohn's Tree Frog (*Litoria littlejohni*) (and *Litoria watsoni*)

A recent taxonomic revision divided *L. littlejohni* s.l. into two species: *L. littlejohni* s.s. (Littlejohn's Tree Frog) and *L. watsoni* (Watson's Tree Frog) (Mahony et al. 2020). Following a taxonomic revision, the distribution of Littlejohn's Tree Frog is now confined to the Sydney Basin Bioregion, New South Wales (NSW) (Mahony et al. 2020). *Litoria littlejohni* is 'found over a distance of roughly 180 km, from the Watagan Mountains (90 km north of Sydney) to just north of Kangaroo Valley (90 km south of Sydney)' (Mahony et al. 2020). The distribution of *Litoria watsoni* is to the south of *Litoria littlejohni* and extends to Victoria. This means that Kangaroo Valley is an intergrade of the two species' distributions. For the purposes of this assessment the historical records of *Litoria littlejohni* (to the north and south of Kangaroo Valley) have been used, with the

southern records now assumed as *Litoria watsoni*. Records are taken from NSW BioNet and Atlas of Living Australia. The species are discussed as one species in text below (due to their similar habitat requirements).

This species was not recorded during amphibian surveys of the development site which targeted natural creek lines, Trimbles Creek and Kings Creek. However, the amphibian surveys carried out in February and March 2019, and December 2021 are outside the recommended survey period for this species (July – November, according to the NSW Survey Guide for Threatened Frogs (DPIE, 2020)). However, according to the SPRAT Profile; Lemckert (2004) presents evidence that calling can occur at any time of year with a possible peak from February to April. Nonetheless, due to a potential survey gap, and suitable habitats within or adjacent to the proposed action, the presence of this species remains unknown, and it is considered moderately likely to occur. There are no historical records of this species in Kangaroo Valley or the plateau areas. The highest density of records occurs in Budderoo National Park (approximately 15km east of the development site). A small number of records also occur in forest areas east of Fitzroy reservoir (approximately 7km north-east of the development site). The nearest records to the south are west of South Nowra (approximately 30km from Kangaroo Valley).

According to the NSW Survey Guide for Threatened Frogs (DPIE, 2020); *Suitable breeding habitat consists of a range of still or slow-moving waterbodies including permanent streams, pools, ponds, swamps and dams, located within areas of suitable native vegetation. Non-breeding habitat is native vegetation located within 300 metres of breeding sites, through which the species can migrate to locate non-breeding habitat.*

Non-breeding habitat is heath-based forests and woodlands where individuals shelter under leaf litter and low vegetation. This species is associated with three PCTs occurring in the development site;

- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156)
- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083).

Determining an area of potential habitat requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats).

Suitable habitat is limited to Trimbles Creek and various other 1st order streams or drainage lines on the plateau and in the valley. Kings Creek is outside the development site and amphibian habitats will be avoided. Trimbles Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is likely to be further vegetation clearing at this location and small amounts of riparian vegetation may be removed here – impacting some good-quality amphibian habitat.

Assuming Trimbles Creek and other small (1st order) drainage lines are suitable for breeding (and excluding man-made power station dams), the habitat buffer (300m) of these waterways could be up to 12.1 ha of potentially suitable habitat (to be investigated further during BDAR stages. The PCTs along Kings Creek are not associated PCTs for this species and a 300m habitat buffer of Kings Creek will not be applied.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

It is possible the nearby Budderoo National Park population could extend into Kangaroo Valley and the assessment area as there is suitable forest habitat (PCTs 1082, 1083, 1156) with nearby creek lines. As surveys for this species were outside the recommended survey period (July – November) it is assumed present for the purposes of the BDAR. Given there are no historical records in Kangaroo Valley, the presence and size of any population is unknown. Due to the lack of nearby records, it is unlikely a population of the species in the development site can be considered an important population.

The project would impact about 3 ha of suitable forest habitat for the species (PCTs 1082, 1083, 1156). This comprises forest habitat with long lasting pools with sufficient leaf litter. Long lasting pools are scarce in the

development site however do occur in numerous adjacent creeks and drainage lines – and most PCTs have dense leaf litter (including in regrowth vegetation).

The project would remove narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of spoil sites, surface infrastructure and temporary laydowns.

The proposed action would involve direct clearing of up to 29.8ha of native vegetation, which may contain up to 12.1 ha of suitable habitat for this species (vegetation within 300m of a watercourse), however larger areas of connecting habitat will remain. The impact to potential habitat is considered moderate, however is not expected to lead to a long-term decrease in the size of a population (and a population is not known to extent into the area).

2) reduce the area of occupancy of the species

The main reason for the listing as endangered is the limited area of occupancy of the species, suspected ongoing population decline (due to the threats), and the extent of the overlap of its distribution range with burnt areas from the 2019-20 bushfires. (DAWE, 2022).

Whilst it is unknown if a population occurs in the development site or within Kangaroo Valley, the loss of approximately three hectares of suitable (unburnt) habitat would be a minor reduction of the area of occupancy for this species. The moderate number of records to the north and east of Kangaroo Valley (mainly in Budderoo National Park) indicate the area of occupancy is likely to be further north (almost 15km). Budderoo National Park was not affected by the 2019/2020 bushfires and the area of occupancy of the population should remain the same.

3) fragment an existing population into two or more populations

The new pipeline and associated infrastructure will occur largely within existing clearings, and the proposed vegetation removal mostly avoids creek lines suitable for this species. This species is capable of moving up to 300m between breeding and non-breeding habitats (likely more during dispersal) and would be able to cross the development site along Creeks and ephemeral drainage lines. Assuming suitable habitat is a 300m buffer surrounding edges of Trimbles Creek on the plateau and Kings Creek in the valley (and some other small drainage lines on the plateau), the proposed action could impact up to 12.1 ha of adjacent vegetation (likely less). However, the riparian corridor of Trimbles Creek is already intersected by the existing pipeline (with the creek flowing beneath via a concrete culvert). The additional pipeline proposed will expand this barrier however it will not be to a scale that would fragment any amphibian populations occurring in Trimbles creek. Upstream and downstream habitats of Trimbles creek will remain in high condition. Kings Creek is outside the development site and vegetation clearing would only encroach on some of the peripheries of the 300m riparian buffer – which would not be substantial enough to fragment any populations of amphibians found along Kings Creek. Likewise, other small creeks on the plateau are outside the development site (mostly in areas below the Promised Lands Trail) and would not be modified or cleared to a scale which would affect any locally occurring population. The proposed action is unlikely to create (or exacerbate) a significant barrier for this species due to the general avoidance of aquatic habitats and large expanses of nearby suitable habitats. The project would not fragment an existing population into two or more populations.

4) adversely affect habitat critical to the survival of a species

The typical breeding habitat is ponds of an area between 1–3000 m² and less than 1.5 m deep. These ponds have low salinity (<0.25 ppt), are slightly acidic (between 4.5–7 pH) and contain high levels of leaf litter. They also lack fish (invasive or native) and contain little algae (DAWE, 2022).

Suitable habitat is limited to Trimbles Creek on the plateau and Kings Creek in the valley. Kings Creek is outside the development site and amphibian habitats will be avoided. The PCTs along Kings Creek are not associated PCTs for this species. Trimbles Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is likely to be further vegetation clearing at this location and small amounts of riparian vegetation may be removed here – impacting some areas of PCT 1156. Assuming Trimbles Creek (and some other small drainage lines nearby to the development site) are suitable for breeding, the habitat buffer (300m) of these waterways could be up to 3 ha of potentially suitable habitat (to be investigated further during BDAR stages).

The section of development site along Kangaroo River provides only marginal amphibian habitat. The riparian vegetation here is characterized by PCT 1108 (not associated habitat for the species) growing on a near-vertical bank (extending 10m above the river). Habitat features such as rocks, pools or slow-flowing streams are absent here, and weed infestations are severe in some areas.

The man-made power station dams (Fitzroy canal and Bendeela pondage) are considered to be poor habitats for this species as they contain fish, lack emergent or riparian vegetation, lack small pools, lack ponds and have highly fluctuating water levels and temperatures (and are much deeper than 1.5m).

As such, the vegetation being disturbed may equate to 12.1 ha, and is not considered to be critical to the species. However, numerous nearby creek lines and riparian environments (including downstream of Trimbles Creek and other plateau drainage lines) likely are important (if a population exists here). With the observation of standard mitigation measures, indirect impacts to nearby habitats are considered unlikely.

5) disrupt the breeding cycle of a population

The typical breeding habitat of Littlejohn's Tree Frog is ponds of an area between 1–3000 m² and less than 1.5 m deep. These ponds have low salinity (<0.25 ppt), are slightly acidic (between 4.5–7 pH) and contain high levels of leaf litter. They also lack fish (invasive or native) and contain little algae (DAWE, 2022). The project is located on the ridge top and does generally not comprise small streams, however Trimbles Creek does intersect the existing pipeline. The open water bodies used for the pumped hydro are not considered suitable breeding habitat for the species. Calling activity has been recorded at various times of year, however survey guidelines recommend survey between Late winter to Spring. Although construction would likely occur during breeding times, the lack of key breeding habitat in the assessment area indicate that impacts are unlikely. Moreover, there are no records of a population in the development site (or Kangaroo Valley) and it is unlikely a key area for breeding. As such, the project is not likely to impact the breeding cycle of a population.

6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The project would impact about three hectares of potential habitat for the species (confined mainly to the edges of Trimbles Creek (PCT 1156)). However larger areas of connecting habitat through this area will remain. Suitable habitat (and unburnt) is also abundant in nearby areas, particularly downslope of the plateau (small waterways). Future mitigation measures (as part of the EIS) will prevent indirect impacts to downslope habitats and impacts to water quality are unlikely and avoidable. The impact to potential habitat is considered minor and would not decrease the availability of habitat to the extent that the species is likely to decline.

7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

There is a strong negative relationship between Littlejohn's Tree Frog tadpole presence and fish presence. Mosquito Fish (*Gambusia affinis*) and Plague Minnow (*Gambusia holbrooki*) are a threat to frog recruitment (DAWE, 2022). The construction and operation of the project is not expected to introduce or spread these species in nearby environments.

Trimbles Creek and other natural drainage lines on the plateau will not receive water from Fitzroy Dam (above) as the existing and proposed pipelines travel over the landscape in a fully contained pipe. The risk of introductions of predatory fish from Fitzroy reservoir is highly unlikely.

The extent of predation by the feral cat and the European red fox on Littlejohn's Tree Frog is unknown. The widening of tracks and existing cleared areas could theoretically assist the travel of feral cat and foxes in the area. However, as the vegetation surrounding the site is not considered critical habitat and there is extensive preferred habitat in surrounding areas, the increased risk on predation is considered low.

8) introduce disease that may cause the species to decline, or

The presence and spread of the Chytrid Fungus is recognised as a Key Threatening Process in Australia and is widely regarded as playing an important role in the decline of the many frog species. Chytrid Fungus is already widespread in NSW. Specific hygiene protocols to minimise the risk of the spread of Chytrid Fungus are detailed in the Frog Hygiene Protocols (DECC, 2008). Measures include, clothing and equipment wash down procedures and the sourcing of suitable materials that are not likely to be contaminated with the

Chytrid Fungus. It is unknown if Chytrid Fungus is present among frog populations around the assessment area. Best practice hygiene protocols will be detailed in the project CEMP to prevent the introduction or spread of pathogens. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) interfere with the recovery of the species.

There is no published recovery plan for this species, and it is not recommended by the Conservation Advice. The site is not within a NSW management area for the species (DPE, 2017). The project is not considered likely to interfere with the recovery of the species.

Conclusion

The proposed action would remove about 12.1 ha of potential habitat for these species (mainly within PCT 1156 near Trimble Creek), however, it is not considered critical habitat. There is extensive preferred habitat surrounding the development site throughout Morton National Park. The proposed action is unlikely to reduce the population size of this species or decrease its reproductive success. The proposed action is unlikely to result in a significant impact to *Litoria littlejohni* or *Litoria watsoni*.

A.1.3 Bauer's Midge Orchid (*Genoplesium baueri*)

Genoplesium baueri is endemic to NSW and has a distribution spanning between the Hunter Valley in the north to Ulladulla in the south (OEH 2017). Generally, the species occurs within coastal areas, although it has been recorded from as far west as Woodford in the Blue Mountains, Bargo in Southern Sydney and Penrose State Forest in the southern highlands. Across its range, this species has a patchy distribution and is currently known from a small number of sites (OEH 2017b).

Genoplesium baueri only flowers intermittently when conditions are suitable, and even when seasonal growing conditions are favourable, some plants can remain dormant. This means that quantifying the numbers of the population is difficult. The species may be nearly impossible to detect in areas that have not been burnt for several years, but conservatively estimates a minimum population size of 488 individuals (Copeland, 2008). 162 individuals of this species were recorded within the Shoalhaven area in 2016 (ELA 2017).

This is a leafless orchid species and can only be detected if it happens to be flowering (which is between February and March according to the NSW Bionet TBDC). Due to the difficulty in counting the population size of *Genoplesium baueri*, it is suitable to measure the area of suitable habitat as opposed to trying to count individuals.

Given the 2022 surveys for late summer-early autumn flowering orchids were outside the recommended February-March survey window (by one month approximately), the species will be assumed present in accordance with the NSW Biodiversity Assessment Method (to be detailed in the Project BDAR). However, by applying the geographical constraint (20km distance from Nowra as specified in the BAM-C) only the valley portions of the development site will be considered as suitable habitat. According to the TBDC, suitable habitat within the development site is PCT 1083 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion. Lower-intensity flora surveys in February 2019 (which do not meet the 2020 *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method*) did not detect this species.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of a population

The assessment area is at the western extent of the predicted population of the Bauer's Midge Orchid. The known extent is just west of Nowra with the predicted range extending to Marulan (NSW Scientific Committee, 2004). The closest known records are near Bomaderry about 15km south-east (DPE, 2022), however there is suitable habitat present in the assessment area (10.21 ha of PCT 1083). As the comprehensive surveys were not undertaken in the recommended survey window for this species, it is assumed present for the purposes of the NSW Biodiversity Assessment Method. The presence of a local population is unknown.

The species is only known from a few extant populations which are managed as priority sites in NSW (DPE, 2018a).

The proposed action will involve direct clearing and disturbance to about 10.21 ha of potential habitat for this species, however larger areas of connecting habitat will remain. The impact to potential habitat is considered minor and would not lead to a long-term decrease in the size of a population.

2) reduce the area of occupancy of the species

It is unknown if the development site supports a population of the species, however considering the lack of any historical records west of Bomaderry, it is considered unlikely. The proposed action would reduce the area of potential habitat for the species in the region (by approximately 10.2 hectares) but not the occupancy of a known population.

3) Fragment an existing important population into two or more populations

It is considered unlikely that a population occurs in the development site, and if there were one it would likely be restricted to the valley areas (which are in closer proximity to Nowra known records). Any population would occur in areas of PCT 1083 (according to the TBDC) and would likely be on the peripheries of the range for this species in Shoalhaven, meaning that removal of this habitat would unlikely fragment a population into two populations. There is already a significant degree of habitat fragmentation by existing power station infrastructure, pipelines, access tracks, public roads and transmission lines. The proposed action has been designed to predominantly affect areas already disturbed by clearing 45 years ago (for original hydro scheme), and if a population does occur, it would likely already be fragmented in the immediate assessment area. The proposed action is not expected to fragment a population of this species.

4) Adversely affect habitat critical to the survival of the species

There is no critical habitat listed for the species (DoE, 2014; NSW Scientific Committee, 2004). The species is only known from a few locations, of which the closest management area is Bomaderry about 15km south-east (DPE, 2022).

Although features critical to its habitat and survival are not well known, as the species has not been recorded west of Bomaderry it is unlikely that the site provides critical habitat not yet identified (i.e. a population).

The project would not result in indirect impacts to the nearest critical habitat. As such, the project is not expected to adversely affect habitat critical to the survival of the species.

5) disrupt the breeding cycle of a population

The species typically flowers in February to March. Although construction would likely occur during this time, it is considered unlikely that a significant population occurs in the construction footprint. As such, the proposed action would not directly impact on breeding of the species and such as unlikely to disrupt the breeding cycle of this species. Given the proposed action largely impacts land that was previously cleared for the original hydro scheme construction, there are already gaps in vegetation and small dispersal barriers. The proposed widening of some of these barriers may have adverse impacts to spread of genetic material for orchids, however it is unlikely to be to a scale that would disrupt a populations breeding cycle (if any exists).

6) Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would impact about 10.21 hectares of potential habitat within the valley portions of the development site. As already mentioned, the plateau areas are outside the geographical constraint for this species according to the BAM-C. PCT 1083 occurs throughout the locality and often wherever soils become sandstone influenced (alternatively PCT 1082 also occurs). Following the proposed action, larger areas of connecting habitat through this area will remain. The impact to potential habitat is moderate however, as it is unlikely a population is present in the construction footprint and no indirect impacts would occur to the known populations near Nowra and Bomaderry, the project is not likely to decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

Weed invasion is likely to be a key threat to the species. The potential for weed invasion is considered possible with a project of this nature and appropriate controls are required during construction and operation of the project. Unless the proposed activity includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to expand into newly created edges. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader vegetated areas. Cleared edges of PCT 1083 already contain weed growth, however given the high floristic value of much of surrounding PCT 1083, native vegetation is likely to be more resilient to weed invasion. The management of invasive species would be managed under the CEMP and during operation of the pipeline using best practice methods.

8) introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the proposed action. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interferes with the recovery of the species

A recovery plan does not exist for the Bauer's Midge Orchid and is not recommended by the Commonwealth government (DAWE,2022). In NSW, the recovery plan focusses on known populations and is limited to their extent (DPE, 2018a). The closest management area is Bomaderry about 15km south-east in which the project would not have any direct or indirect impacts. As such, the project is not expected to interfere with the recovery of the species.

Conclusion

The proposed action would impact about 10.21 hectares of potential habitat within the valley portions of the development site. Much of this area has been cleared previously and topsoil has also been removed from a previous a borrow-pit area (meaning mycorrhizal fungi may have been lost). As already mentioned, the plateau areas are outside the geographical constraint for this species according to the BAM-C.

The site does not contain a known population and the proposed action is unlikely to reduce the population size of this species or decrease its reproductive success. The proposed action is unlikely to result in a significant impact to the Bauer's Midge Orchid.

C.4 Vulnerable Species

C.4.1 Large-eared Pied Bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat was recorded as 'probable' using AnaBat detectors. The record was made in PCT 1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion, to the east of Bendeela Pondage (within the development site).

Breeding and roosting habitat for this species consists of Sandstone cliffs with caves or shelter features. Foraging habitat includes fertile woodland valley habitat within close proximity to cliffs and caves. The recorded individual(s) was likely foraging throughout an expansive home range. The development site does not contain any cliff lines or suitable breeding habitats; however, such features are available in the surrounding areas of Kangaroo Valley escarpment (and along the plateau edges). Numerous cliff lines occur in close proximity to the development site (some within 100m distance). The large cliffs on the edges of the plateau could not be explored due to safety reasons. Some smaller cliffs on top of the plateau and adjacent to the development site were investigated, and small crevasses were searched for roosting bats. Man-made features such as concrete culverts and tunnels were also checked. The sandstone cuttings along the existing pipeline corridor have engineered/smooth faces and do not contain any crevasses or caves suitable for this species.

According to the NSW Bionet profile for this species, foraging habitat within the development site includes all native forest within 100m of cliff lines or breeding habitat features. This area hasn't been calculated at the time of writing but will be investigated during the BDAR stages of the project. The PCTs occurring on the development site and within 100m of cliff lines include:

- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156)

- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083)
- Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (PCT 1283).

There are no historical records of this species in Kangaroo Valley, however regular records occur to the south around Nowra and the Shoalhaven River, as well as Illawarra coastal districts. Along with these records, the species is also known to occur throughout the southern highlands. A lack of records in Kangaroo Valley and on the plateau areas is likely due to a lack of survey more than an absence of the species.

According to the National Recovery Plan for this species; *the largest concentration of populations appears to be in the sandstone escarpments of the Sydney basin and northwest slopes of NSW. Much of this habitat occurs within state reserves and should be the subject of recovery actions. The species has also been recorded from a few locations in the sandstone escarpments of the Morton National Park at the southern end of its range. Further survey is required throughout its known range to determine the size and distribution of existing populations* (DERM, 2011).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1) Lead to a long-term decrease in the size of an important population

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The local populations of the species in the assessment area are considered to form an important population as they would likely be part of a large population occurring within Morton National Park and Budderoo National Park. Any population would also be distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats

Impacts to cave-roosting bats associated with the project relate to the direct removal of potential foraging habitat as there are no cave-roosting opportunities within the assessment area. The extent of removal of vegetation varies at each site but given the existing layout of the pipeline, dams and power station infrastructure, there are already many breaks between forest patches in the landscape (which would already affect the foraging behaviours of this species). Furthermore, this species is already adapted to foraging in areas with large transmission lines and substations nearby. The large extent of forest surrounding the development site would mean that decreases of the density and abundance of insect prey are unlikely to change. Aquatic habitats which may assist in insect breeding will not be impacted.

The potential loss of foraging habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the development site. Loss of habitat is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. It is likely that this species already utilises clearing corridors such as access tracks to forage, and the widening of some corridors is unlikely to affect foraging potential.

The clearing of 29.8 ha with the development site is not expected to have a significant impact on the foraging life-cycle activities of this species, particularly in the context of the widespread extent of similar habitats throughout the locality.

This species uses a variety of habitat types including disturbed habitats, forests and woodlands. Important life-cycle activities include roosting and breeding and both are typically associated with caves, as well as foraging for insect prey which occurs in a variety of habitat types. Breeding habitat for insect prey includes a very diverse range of wetlands, swamps and open modified and artificial landscapes.

The size of local population is not known, although expected to be potentially large. Potential foraging habitat in the assessment area is generally widespread, including natural habitats such as remnant woodlands, as well as regrowth vegetation and other disturbed vegetation. Impacts to these habitats would impact on the potential breeding habitat for prey species (invertebrates), however any potential overall

reductions to the abundance of prey species is likely to be minimal, considering the widespread nature of these habitats in the locality.

Potential impacts to the life-cycle activities of this species mainly relates to disruption of foraging activities.

Mitigation measures would include avoiding disturbance of potential roosting habitats, pre-clearance surveys and staged habitat removal. Considering the absence of preferred roosting habitats from the development site and the proposed mitigation measures, the proposed activity is unlikely to lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population

The impact on foraging habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the assessment area. This species could also utilise cleared areas such as the development site (50 hectares) (although power stations and transmission lines would likely deter individuals). Modification of habitat is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of the surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. While the proposed action would result in the modification of foraging habitat, as the species is an aerial forager this modification is unlikely to have a substantial impact on the area of occupancy of the population.

The habitat to be removed does exhibit important values for cave-roosting bats as it is likely to contribute to the availability of foraging habitat for local populations.

Kangaroo Valley is nearing the southern limit of the species distribution (near Ulladulla region) however, it is likely that the absence of database points in Morton National Park could be attributed to a lack of survey. Records also exist west to Goulburn. Suitable habitats are widespread throughout the region particularly further south and north of the assessment area throughout the forested escarpments of Morton National Park and Budderoo National Park. The proposed action would be unlikely to reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations

Highly mobile species such as bats are expected to be less impacted by fragmentation. The local population of Large-eared Pied Bat are persisting in an area which already contains clearing corridors for the existing pipeline, dams and power station infrastructure. This species is capable of accessing widely spaced habitat resources given its mobility. The proposed action will widen some existing cleared corridors but would not fragment an important population. Individuals will still be able to disperse between forest patches, and between cliff lines and escarpments (where potential breeding caves exist).

The project would not fragment an important population of this species.

4) Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The potential loss of foraging habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the assessment area. Loss of habitat on the development site is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of the surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. The proposed area of disturbance represents a very small fraction of the potential of foraging habitat for the Large-eared Pied-bat in the wider landscape. Impacts to areas of roosting habitat are not anticipated as the development site avoids suitable rocky areas and cliff lines. Large cliff lines are likely far enough from the proposed footprint to remain unaffected during drilling works on the plateau. Artificial habitats such as concrete culverts and tunnels were checked for roosting bats, although none were recorded. The proposed activity is unlikely to impact habitat critical to the survival of the species.

5) Disrupt the breeding cycle of an important population

The size of the local population is not known, although expected to be potentially large (occurring throughout the surrounding Morton National Park and Budderoo National Park areas). Potential foraging habitat in the assessment area is generally widespread including natural habitats such as remnant woodlands, as well as regrowth vegetation and other clearings or disturbed vegetation. Impacts to these habitats would impact on the potential breeding habitat for prey species (invertebrates), however any potential overall reductions to the abundance of prey species is likely to be minimal, considering the widespread nature of these habitats in the locality.

The proposed area of disturbance represents a small fraction of the potential foraging habitat for the Large-eared Pied-bat. The project would not directly impact on a known roost or maternity site and as such is unlikely to disrupt the breeding cycle of this species.

6) Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The potential loss of foraging habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the development site. Loss of habitat is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. Many areas will be only temporarily lost, and revegetation of laydown and stockpile areas would bring back some foraging habitat following construction. Clearings can also be used for foraging.

The proposed area of disturbance represents a small fraction of the potential foraging habitat for the Large-eared Pied-bat, and it is considered unlikely the species would decline as a result of the proposed activity.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The potential for weed invasion was considered possible with a project of this nature and appropriate controls are required during construction and operation of the project. Unless the proposed activity includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created edges. This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader vegetated areas. Given the high floristic value of the patch and proximity to the National Park, native vegetation is likely to be more resilient to weed invasion and many weeds controlled by National Parks staff either directly or through hazard reduction burns. The management of invasive species would be managed under the CEMP and during operation of the pipeline using best practice methods.

8) Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposed action. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interferes substantially with the recovery of the species

The national recovery plan for the Large-eared Pied Bat outlines the following objectives:

To ensure the persistence of viable populations of the large-eared pied bat throughout its geographic range

- Identify priority roost and maternity sites for protection
- Implement conservation and management strategies for priority sites
- Educate the community and industry to understand and participate in the conservation of the large-eared pied bat
- Research the large-eared pied bat to augment biological and ecological data to enable conservation management
- Determine the meta-population dynamics throughout the distribution of the large-eared pied bat.

The recovery actions listed above are largely not applicable to the proposed action and accordingly the proposed action is not expected to interfere substantially with the recovery of the species.

Conclusion

The Large-eared Pied Bat would experience a relatively small modification of suitable foraging habitat from the proposed action. No breeding habitat or other important habitat will be impacted. The proposed action is unlikely to reduce the population size of the Large-eared Pied Bat or decrease the reproductive success of this species. The proposed action would not interfere with the recovery of the Large-eared Pied Bat and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to the Large-eared Pied Bat.

C.4.2 Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-Fox was recorded within the development site foraging in Eucalypt trees during spotlighting surveys in 2019. Most of the forest areas of Kangaroo Valley provide foraging habitat for this species which feeds on nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. All PCTs occurring within the assessment area provide foraging habitat for this species, meaning that the proposed clearing of 29.8 hectares of native vegetation will reduce foraging habitat in the location. This amount of foraging habitat is negligible when compared to the vast areas of similar vegetation types throughout the Kangaroo Valley and Fitzroy localities.

No breeding or roosting was recorded within the assessment area, and the nearest known maternity camp is in Kangaroo Valley township.

This species was not recorded in the plateau section of the development site, despite suitable habitat existing.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1) Lead to a long-term decrease in the size of an important population

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The Grey-headed Flying-fox was identified in the development site during the surveys. All forest and woodland habitat in the survey area is considered foraging habitat critical to the survival of the species. The Grey-headed Flying-fox exists as a single interconnected population in Australia. As such, it is considered an important population.

There are no roost camps in the development site and the proposed action will not impact on any known permanent roosting, breeding / maternity site. Therefore, it is likely that the impacts of construction and operation of the proposed action would be confined to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase. There is also a low risk of vehicle strike during operation.

The proposed action would directly remove up to 29.8 hectares of potential foraging habitat. The project will remove narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 km radius of the proposed action and the six nationally important roost camps within a 50 km radius (Kangaroo Valley, Moss Vale, Berry, Nowra (Bugong Creek, Brinawarr and Bomaderry Creek). Given the relative widespread nature of similar native vegetation and planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the proposed action is not expected to lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population

The area of occupancy of the Grey-headed Flying-fox is not known but the species exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. The area occupied by this species will remain the same after the proposed action. No impact to area of occupancy is expected.

3) Fragment an existing important population into two or more populations

Highly mobile species such as bats are expected to be less impacted by fragmentation. The Grey-headed Flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom in differing parts of the landscape. The proposed action would not fragment an important population of the Grey-headed Flying-fox. Individuals will still be able to disperse between forest patches, and between roosts along the east Australian coast.

4) Adversely affect habitat critical to the survival of the species

This species typically exhibits very large home ranges and Grey-headed Flying-fox is known to travel distances of at least 50 km from roost sites to access seasonal foraging resources. There are no known roost camps within the survey area or the construction footprint and the construction footprint does not provide critical roosting habitat. However, there are six nationally important roost camps within a 50 km radius (Kangaroo Valley, Moss Vale, Berry, Nowra (Bugong Creek, Brinawarr and Bomaderry Creek). The draft recovery plan for the Grey-headed Flying-fox identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50 km radius of a camp site
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site.

Native vegetation within the construction footprint would constitute critical foraging habitat. However, the affected area of critical foraging habitat would represent a tiny percentage of the total extent of important foraging vegetation types present within a 50 km radius of the camp sites described. Given the relative widespread nature of similar vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the proposed action is not expected to adversely affect foraging habitat critical to the survival of this species in this region.

5) Disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat identified as important during the breeding cycle of the species. The proposed action would not directly impact on a known roost camp / breeding or maternity site.

6) Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No evidence of a roost camp has been identified within the survey area. Further, there would be a relatively minor impact on critical foraging habitat as a result of the proposed action. This impact is not expected to lead to a decline in the species in this region.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The potential for weed invasion was considered possible with a project of this nature and appropriate controls are required during construction and operation of the project. Unless the proposed activity includes very careful soil management, weed monitoring and management and vegetation restoration (where suitable), weed proliferation is likely to occur on the newly widened edges. Weeds have potential to invade the adjacent edges of clearings and tracks, particularly in areas with fertile shale soils (valley sections). This impact would be restricted to areas immediately adjacent to the proposed activity and would not substantially affect the broader vegetated areas. Given the high floristic value of the plateau vegetation areas and proximity to the National Park, native vegetation is likely to be more resilient to weed invasion and many weeds controlled by National Parks staff either directly or through hazard reduction burns. The valley sections of the development site already have weed invasion, with significant growth surrounding Bendeela Power Station and the edges of Kangaroo River. The management of invasive species would be managed under the CEMP and during operation of the pipeline using best practice methods.

8) Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposed action. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interferes substantially with the recovery of the species

The Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan.

The recovery actions listed above are largely not applicable to the proposed action and accordingly the proposed action is not expected to interfere substantially with the recovery of the species.

Conclusion

The Grey-headed Flying-fox would experience a small reduction in extent of suitable foraging habitat from the proposed action. No breeding camps or other important habitat will be impacted. The proposed action is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The proposed action would not interfere with the recovery of the Grey-headed Flying-fox and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to the Grey-headed Flying-fox.

C.4.3 Giant Burrowing Frog (*Heleioporus australiacus*)

This species was not recorded during amphibian surveys of the development site which targeted natural creek lines Trimbles Creek and Kings Creek (as well as various other micro habitats). However, the amphibian surveys carried out in February and March 2019, and December 2021 did not meet the duration of 8 repeat surveys following heavy rainfall as recommended in the NSW Survey Guide for Threatened Frogs (DPIE, 2020). Whilst survey effort was 6 nights, with 4 surveys during light to moderate rainfall, the rainfall amounts did not meet the >50 millimetres in 24 hours OR >100 millimetres over three days guidelines. Therefore, due to a potential survey gap, and suitable habitats within or adjacent to the proposed action, the presence of this species remains unknown, and it is considered moderately likely to occur (it will likely be assumed present for the purposes of the BDAR). There are no historical records of this species in Kangaroo Valley or the plateau areas. The nearest records occur between Fitzroy Reservoir and Budderoo National Park (approximately 15km east of the development site). A small number of records also occur in forest areas in Nowra (approximately 10km south of the development site). The nearest records to the west are near Bundanoon (approximately 20km from Kangaroo Valley).

According to the NSW Survey Guide for Threatened Frogs suitable habitat is described as (DPIE, 2020); *ephemeral flowing streams that have permanent pools, or in upland swamps, and are located within native vegetation. Most typically breeding occurs in streams with a bed width of up to five metres (e.g. 2nd order and 3rd order streams) and upland swamps located on suitable geologies. Non-breeding habitat is native vegetation adjacent to the breeding sites.*

This species is associated with five PCTs occurring in the development site;

- Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (PCT 1156)
- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (PCT 1082)
- Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (PCT 1083)
- Illawarra Escarpment Blue Gum wet forest (PCT 1245)
- Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (PCT 1254).

Determining an area of potential habitat requires incorporating the PCTs with which the species is associated (using the NSW BioNet species profile) and adding 300 metres radius from the top of bank (to potential breeding habitats).

Suitable habitat is limited to Trimbles Creek on the plateau and Kings Creek in the valley (and potentially some other drainage lines off site). Kings Creek is outside the development site and amphibian habitats will be avoided. Trimbles Creek briefly intersects the plateau development site (through a concrete culvert beneath the existing pipeline). There is likely to be further vegetation clearing at this location and small amounts of riparian vegetation may be removed here – impacting some good-quality amphibian habitat.

Assuming Trimbles Creek and other small (1st order) drainage lines are suitable for breeding (and excluding man-made power station dams), the habitat buffer (300m) of these waterways encompasses 25.8 ha of potentially suitable habitat in the development site.

If this species occurs within the development site, individuals would likely be part of a large population which exists in Morton National Park and Kangaroo Valley escarpment and floor. Such a population would likely be considered an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1) Lead to a long-term decrease in the size of an important population

There are no specific populations listed in the SPRAT profile or conservation advice for the species. According to the Conservation advice, *The Giant Burrowing Frog may exist as two distinct subpopulations: a northern population largely confined to the sandstone geology of the Sydney Basin and south to Jervis Bay, and a southern population occurring in disjunct regions from around Narooma southwards to eastern Victoria (Penman et al. 2004). Smaller breeding populations appear to be scattered within these two broad areas and the connectivity of these smaller populations is not known (DoE, 2014)*

Any local populations of this species in the locality would be considered to form an important population as they are likely to be:

- large and hence may constitute key source populations for dispersal
- distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats
- at or near the central western limit of the species' known range.

The Giant Burrowing Frog was not identified within the assessment area during field surveys with only a few records in the broader Morton National Park. The assessment area is near the central western limit of this species known range. Potential habitat is known to be associated with moderate to high condition vegetation communities including five communities present within the development site; PCT 1156, PCT 1083, PCT 1082, 1245 and PCT 1254. By applying the 300m habitat buffer to Trimbles Creek, Kings Creek and various other 1st order drainage lines in the peripheries of the assessment area, an area of up to 29.8 ha of vegetation is likely to be suitable for this species. These 29.8 hectares will be removed, potentially having negative impacts to an important population if present. Proposed impacts to Trimbles Creek riparian zone (at intersection of Plateau pipeline) may also adversely affect a local population. The small section of Trimbles Creek is already affected by a concrete culvert passing beneath the existing pipeline, and it is unlikely that this area is important breeding habitat (given the large amount of similar creek lines further downstream and

in other waterways of the plateau and escarpments in Morton National Park). No tadpoles were recorded during surveys at the culvert entry and exit locations.

The loss of the non-breeding habitat is associated with mostly regrowth vegetation with ground disturbance in the past and (>45 years ago). The project will remove narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns.

The proposed action will involve direct clearing and disturbance to suitable habitat for this species, however larger areas of connecting habitat will remain. The impact to potential habitat is considered minor and would not lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population

Whilst it is unknown if a population occurs in the development site or within Kangaroo Valley, the loss of approximately three hectares of suitable (unburnt) habitat would be a minor reduction of the area of occupancy for this species. The moderate number of records to the north and east of Kangaroo Valley (mainly in Budderoo National Park) indicate the area of occupancy is likely to be further north (almost 15km). Budderoo National Park was not affected by the 2019/2020 bushfires and the area of occupancy of the population should remain the same.

3) Fragment an existing important population into two or more populations

Direct impacts would result in a small increase in habitat fragmentation. This is unlikely to substantially change the existing level of fragmentation for this species which is capable of crossing narrow clearings such as roadways during wet conditions. Any local population would already be affected by fragmentation due to the existing pipeline, access tracks and power station infrastructure. Widening of existing clearings is unlikely to increase fragmentation to levels where this species could no longer disperse through habitats.

4) Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

Potential habitat is known to be associated with moderate to high condition vegetation communities including five communities present within the development site; PCT 1156, PCT 1083, PCT 1082, 1245 and PCT 1254. By applying the 300m habitat buffer (non-breeding habitat extent) to Trimble Creek, Kings Creek and various other drainage lines in the peripheries of the assessment area, an area of up to 29.8 ha of vegetation is likely to be suitable for this species. Up to 29.8 hectares will be removed, potentially having negative impacts to an important population if present.

The section of development site along Kangaroo River provides only marginal amphibian habitat. The riparian vegetation here is characterized by PCT 1108 (not associated habitat for the species) growing on a near-vertical bank (extending 10m above the river). Habitat features such as rocks, pools or slow-flowing streams are absent here, and weed infestations are severe in some areas.

The man-made power station dams (Fitzroy canal and Bendeela pondage) are considered to be poor habitats for this species as they are surrounded by steep cuttings or rock scree, lack emergent or riparian vegetation, lack small pools, lack ponds and have highly fluctuating water levels and temperatures. No tadpoles were observed in man-made dams.

The proposed action would impact up to 29.8 hectares of potential habitat between Fitzroy Falls and Kangaroo Valley that would likely present the most suitable potential habitat for the Giant Burrowing Frog. A population was not confirmed through surveying of these habitats and they are not considered critical to the survival of the species in the assessment area if present.

5) Disrupt the breeding cycle of an important population

Whilst the presence of this species remains unknown. It is considered unlikely that a significant proportion of an important population occurs in the construction footprint. Surveys have been carried out in suitable habitats and during rainfall (however not during the stipulated high rainfall amounts (>100mm in three days)). Tadpoles were not observed in any of the waterways of the development site (during March, February and December surveys). The proposed action would not directly impact on known or likely breeding site and such as unlikely to disrupt the breeding cycle of this species. The habitats provided by Trimble Creek (and some other small drainage lines off-site) are likely to be abundant in surrounding unburnt forest areas of the plateau and Kangaroo Valley escarpments.

6) Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would impact up to 29.8 hectares of potential habitat between Fitzroy Falls and Kangaroo Valley. However larger areas of connecting habitat through this area will remain. The impact to potential habitat is considered minor and would not decrease the availability of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Given the nature of the proposed works, weed spread is possible on the widened track edges and laydown areas. Whilst the plateau section of the assessment area contains only low-level weed growth (confined mostly to the intersection of Nowra/Moss Vale Rd), the valley areas are moderately to severely affected by weed infestations. The spread of weeds can be controlled through strict mitigation measures and vehicle/equipment cleaning protocols. Any potential impact would be restricted to areas immediately adjacent to the proposed activity and is not likely to substantially affect the broader sections of forest. The Giant-burrowing Frog is dependent on high-condition native forest and may be susceptible to weed invasion of habitats. Weed control strategies will be detailed in the BDAR and CEMP for the project.

The extent of predation by the feral cat and the European red fox on this species is unknown. The widening of tracks and existing cleared areas could theoretically assist the travel of feral cat and foxes in the area. However, as the vegetation surrounding the site is not considered critical habitat and there is extensive preferred habitat in surrounding areas, the increased risk on predation is considered low.

8) Introduce disease that may cause the species to decline

The presence and spread of the Chytrid Fungus is recognised as a Key Threatening Process in Australia and is widely regarded as playing an important role in the decline of the many frog species. Chytrid Fungus is already widespread in NSW. Specific hygiene protocols to minimise the risk of the spread of Chytrid Fungus are detailed in the Frog Hygiene Protocols (DECC, 2008). Measures include, clothing and equipment wash down procedures and the sourcing of suitable materials that are not likely to be contaminated with the Chytrid Fungus. It is unknown if Chytrid Fungus is present among frog populations around the assessment area. Best practice hygiene protocols will be detailed in the project CEMP to prevent the introduction or spread of pathogens. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interferes substantially with the recovery of the species

A recovery plan does not exist for the Giant Burrowing Frog. However, the following actions have been identified by the OEH for recovery of this species:

- Retain native vegetation and minimise ground disturbance where the species occurs. This is essential within 300 m of known breeding sites.
- Protect breeding sites from disturbance, sedimentation and pollution.
- The proposed action will not interfere with any of the objectives identified for the Giant Burrowing Frog.

Whilst up to 29.8 ha of non-breeding habitat, and some minor areas of potential breeding habitat (mainly a short section of Trimble Creek) will be impacted by the proposed action, the loss of this habitat would not be significant given the abundance of suitable habitats in the surrounding plateau and escarpment areas. The section of Trimble Creek within the development site is already modified by a concrete culvert (passing beneath the existing pipeline corridor) and is not in a natural state. Riparian edges would be considered high quality non-breeding habitat, however the small scale clearing proposed would not interfere sensationally with the recovery of this species. Suitable habitats will remain up and downstream of the development site.

Mitigation measures will be applied to prevent any decreases of water-quality during construction (to be detailed in the BDAR and CEMP).

Conclusion

Potential habitat for the Giant Burrowing Frog would approximate to 29.8 hectares in the development site, however, it is considered unlikely that an important population occurs in the construction footprint. The loss of this habitat is associated with mostly habitats cleared with ground disturbance in the past and have regrown (>45 years ago). The project will remove narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. The Giant Burrowing Frog will experience a small reduction in extent of potential habitat. The construction footprint does not contain a known population and the proposed action is unlikely to reduce the population size of this species or decrease its reproductive success. The proposed action is unlikely to result in a significant impact to the Giant Burrowing Frog.

C.4.4 Pilotbird (*Pycnoptilus floccosus*)

Pilotbirds are endemic to south-east Australia. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the Australian Capital Territory, and in the Snowy Mountains in New South Wales and north-east Victoria (Higgins & Peter 2002; Loyn et al. 2021). Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne (Higgins & Peter 2002; Loyn et al. 2021).

The main factor that made the species eligible for listing in the Vulnerable category was that the species likely underwent a population decline of 30 to 50% in the last three generations (11 years) (Loyn et al. 2021). This major reduction in population was caused by the 2019/2020 NSW bushfires (Loyn et al. 2021). The total population of Pilotbirds is estimated at 88,000 (range 10,000–143,000) mature individuals in the wild with a declining trend (Loyn et al. 2021).

In a separate analysis, 47% of the species' overall distribution was burnt in the 2019/2020 bushfires (Legge et al. 2021). An expert elicitation estimated that Upland Pilotbirds experienced a decline of 30% (potentially as much as 45%, which was the lower 80% confidence bound) one year after fire (Legge et al. 2021).

Lowland Pilotbirds were estimated to experience declines of 26% (potentially as much as 42%) one year after fire (Legge et al. 2021).

This species was not recorded within the assessment area, despite repeated survey throughout suitable habitats in February and March 2019, October and December 2021 and April and May 2022. Targeted birds surveys were undertaken, however this species was also likely to be detectable throughout all other surveys. The call of this species was not heard during extensive flora and fauna surveys, despite common occurrences of Superb Lyrebird (often associated with Pilotbird presence). The development site contains suitable habitats for this species, particularly the wetter sclerophyll vegetation types such as PCT 1254, PCT 1245, PCT 1283 and PCT 1108. This species may also use drier vegetation types such as PCT 1083, PCT 1082 and PCT 1156. Given this, the majority of vegetation within the development site is deemed as potential habitat. Pilotbirds are likely to occur in surrounding unburnt forest areas of Morton national Park, Kangaroo Valley and vast forest areas to the north such as Budderoo National Park. Previous records are frequent in Fitzroy Falls, Budderoo NP, and a 2003 record exists near Bendeela (approximately 100m east of the assessment area).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1) Lead to a long-term decrease in the size of an important population

This species was not recorded, and the presence of an important population within the development site is unlikely. The wider expanses of (unburnt) forests surrounding the development site in Morton National Park, Kangaroo Valley and Budderoo National Park would contain a proportion of the total population and considering the recent decreases in population numbers and area of occupancy due to bushfires, would be an important population.

There were no substantive threats to the Pilotbird until a combination of extended drought and exceptional heat provided impetus for fire that burnt large parts of the habitat with high severity in January 2020 (Loyn et al. 2021).

The proposed action will remove up to 29.8 hectares of vegetation (consisting approximately 22 hectares of regrowth) – a minor amount of potentially suitable habitat given the large expanses of similar unburnt forest surrounding the development site. This reduction would theoretically reduce the (potential) area of occupancy of the total population however is unlikely to lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population

The extent of occurrence (EOO) for the species is stable (212,200 km²), however, the area of occupancy (AOO) for the species has contracted to 26,600 km² (Loyn et al. 2021).

This species was not recorded, and the presence of an important population within the development site is unlikely. The clearing of up to 29.8 hectares of vegetation (consisting approximately 22 hectares of regrowth) would remove a minor amount of potentially suitable habitat, which would theoretically reduce the (potential) area of occupancy of the total population. This species was not recorded, and the presence of an important population within the development site is unlikely.

3) Fragment an existing important population into two or more populations

The pipeline easement will remain the same, with the clearing of occasional laydown areas at various points. Power station areas will be widened, and stockpile emplacement areas will require larger clearing amounts (however have been designed to affect lower-quality regrowth vegetation on disturbed land). It is obvious that small and medium sized birds are able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the forest patches surrounding the existing pipeline and power stations. As such, the works would not fragment the landscape to a degree in which would separate an important population.

4) Adversely affect habitat critical to the survival of the species

This species was not recorded, and so breeding and foraging habitat is unconfirmed. Whilst vegetation on the site could be suitable for this species, it is currently not considered habitat critical to the survival of the Pilotbird. Similar, suitable unburnt habitat is widely available in the areas to the south and north of the assessment area. No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

The removal of potential habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the assessment area. Loss of habitat on the development site is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. The proposed area of disturbance represents a very small fraction of the potential of foraging habitat for the Pilotbird in the wider landscape. The proposed activity is unlikely to impact habitat critical to the survival of the species.

5) Disrupt the breeding cycle of an important population

This species was not recorded, and the presence of an important population within the development site is unlikely. Nonetheless, suitable habitat exists in the peripheries of the development site and there is moderate likelihood of this species utilising the surrounding forest areas and occasionally frequent the development site. Construction activities occurring during the breeding season (August to January) could increase disturbance to locally occurring birds. Given that the proposed action has been designed to largely utilise existing clearings, and previously cleared vegetation, the likelihood of breeding pairs is considered low. No potential Pilotbird nests were observed during the comprehensive Spring 2021 flora surveys, which included one observer searching only the ground layer in 10–20m transect spacing (for threatened orchids or small shrubs). No Pilotbird calls were heard. The proposed action is unlikely disrupt the breeding cycle of this species.

6) Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

This species was not recorded, and the presence of an important population within the development site is unlikely. Nonetheless, the potential loss of habitat for the species is approximately 29.8 hectares comprising all native vegetation communities in the development site. Approximately 22 hectares of this vegetation is already modified from historical clearing for the original hydro scheme. Loss of habitat is associated with the removal of narrow strips of native vegetation (in varying condition) along tracks, pipeline and larger areas of native vegetation for construction of surge tower, cavern, spoil sites, surface infrastructure and temporary laydowns. Many areas will be only temporarily lost, and revegetation of laydown and stockpile areas would bring back some foraging habitat following construction.

The proposed area of disturbance represents a small fraction of the potential habitat for the Pilotbird, and it is considered unlikely the species would decline as a result of the proposed activity.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Predation by cats and foxes is listed as a threat for Pilotbirds. The extent of predation by the feral cat and the European red fox on this species is unknown. The widening of tracks and existing cleared areas could theoretically assist the travel of feral cat and foxes in the area. However, the scale of this would be minimal (given the existing context of the development site).

Given the nature of the proposed works, weed spread is possible on the widened track edges and laydown areas. Whilst the plateau section of the assessment area contains only low-level weed growth (confined mostly to the intersection of Nowra/Moss Vale Rd), the valley areas are moderately to severely affected by weed infestations. The spread of weeds can be controlled through strict mitigation measures and vehicle/equipment cleaning protocols. Any potential impact would be restricted to areas immediately adjacent to the proposed activity and is not likely to substantially affect the broader sections of surrounding forest. Given this species primarily forages in the ground layer of dense forest, any weeds introduced along the existing clearing edges are unlikely to impact significantly on the mature forest areas.

The proposed action is unlikely to result in invasive species becoming established in the landscape. The proposed action affects land which has long been cleared, and vegetation which has regrown or previously existed on the edges of clearings.

8) Introduce disease that may cause the species to decline

There are no known disease issues affecting this species of relevance to the proposed action. The proposed action would be unlikely to increase the potential for significant disease vectors to affect local populations of the species.

9) Interferes substantially with the recovery of the species

There is currently no published recovery plan for the Pilotbird. However, the species Conservation Advice lists numerous high priority actions. The following are relevant to the proposed action:

- After fires, protect unburnt areas within or adjacent to recently burnt ground that may provide ongoing refuge.
- Actively manage the landscape to minimise the risk of large wildfires, ensuring that this also meets the ecological requirements of the species.
- Ensure fire management (fire risk reduction, fire suppression and post-fire management activities) considers impacts on key breeding locations, foraging, roosting and nesting habitat for Pilotbird
- Ensure remaining habitat is protected from disturbance and fragmentation.

This species was not recorded, and the presence of an important population within the development site is unlikely. Nonetheless, suitable habitat exists in the peripheries of the development site and there is moderate likelihood of this species utilising the surrounding forest areas and occasionally frequenting the development site.

Conclusion

This species was not recorded within the assessment area, however, is considered moderately likely to occur at least on an occasional basis. A single important population would not be reliant on the development site. The Pilotbird would experience a relatively small modification of suitable habitat from the proposed action.

The proposed action is unlikely to reduce the population size or decrease the reproductive success of this species. The proposed action would not interfere with the recovery although the removal of up to 29.8 hectares of potentially suitable habitat would cause a minor reduction in its area of occupancy. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to Pilotbird.

C.4.5 Glossy Black-cockatoo (*Calyptorhynchus lathami lathami*)

The subspecies has undergone a substantial reduction (30–50%) in the last three generations (Cameron et al. 2021). This reduction in population was mostly caused by the 2019/2020 bushfires, and a result of historical and ongoing habitat loss. Both EOO and AOO are contracting, they are estimated as 470,000 km² and 40,000 km², respectively (Cameron et al. 2021). Furthermore, the estimated total number of mature individuals is 7,500, and is declining rapidly (Cameron et al. 2021).

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1) lead to a long-term decrease in the size of an important population

The population which resides in the locality of the southern highlands would not be considered an important population. The geographic range of the species occurs over a large area of eastern Australia, and there are large areas of potential habitat in the Sydney Basin bioregion. All PCTs impacted by this project comprise Allocasuarina food resources for this species and as such the potential impact would be around 29.5 ha which includes 12 potential nest trees to be removed from development site. The project would not lead to a long-term decrease in the size of an important population. The individual observed at the site were foraging in habitat directly adjacent to the existing scheme infrastructure.

2) reduce the area of occupancy of an important population

The current area of occupancy is estimated at 470,000km². The project would potentially remove 29.5 ha which is a very small fraction. The population in the study area is not considered important.

3) fragment an existing important population into two or more populations

The population in the study area is not considered important. The project would clear about 29.5 hectares native vegetation, largely along the edges of the existing cleared footprints of the pipeline and power station areas. Access tracks would be widened in some areas and may be about 10 m wide. The pipeline easement will remain the same, with the clearing of occasional laydown areas at various points. Power station areas will be widened, and stockpile emplacement areas will require larger clearing amounts (however have been designed to affect lower-quality regrowth vegetation on disturbed land). It is obvious that Glossy Black-cockatoos are able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the forest patches surrounding the existing pipeline and power stations. As such, the works would not fragment the landscape to a degree in which would separate a population.

4) adversely affect habitat critical to the survival of a species

All PCTs impacted by the project were found to comprise Allocasuarina food resources and hollow-bearing trees both of which are critical to the survival of this species. The impact would be around 29.5 ha however around 1/3 of this is regrowth vegetation with no hollow-bearing trees. A survey of the buffer area of the project out to 200 m found that hollow-bearing potential nest trees are very common in Morton National Park, as was similar quality habitat. Given the extent of likely critical habitat in the total surrounding area of Morton National park, the loss of habitat associated with this project is not considered significant.

5) disrupt the breeding cycle of an important population

The species roosts in the hollows of tree trunks and limbs, or within the dead sprout of large, living eucalypts. A survey of the project corridor and buffer area in the 2022 breeding season identified 344 trees that could potentially be used as nest sites, however no Glossy Black-cockatoo breeding pairs was present. There is potential for the species to breed in the locality and adjacent to the project in the future, and clearing along the edges of the existing scheme is not considered to impact on this occurring.

6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Whilst much of Morton National Park was burnt in the 2019/2020 bushfires, large areas around the development site, and vast areas to the north were not burnt and remain in high condition.

The project would clear about 29.5 hectares native vegetation, largely along the edges of the existing cleared footprints of the pipeline and power station areas. Access tracks would be widened in some areas and may be about 10 m wide. The pipeline easement will remain the same, with the clearing of occasional laydown areas at various points. Power station areas will be widened, and stockpile emplacement areas will require larger clearing amounts (however have been designed to affect lower-quality regrowth vegetation on already modified land). It is obvious that the species is able to cross over the existing cleared footprints and there are no apparent barriers to their movements between the high-quality forest patches surrounding the existing pipeline and power stations. The proposed action will not isolate quality habitats.

The habitats to be affected are already modified to an extent by previous vegetation clearing for the original power scheme. The habitats are already affected by cleared corridors (pipeline, power station, dams, access tracks) and these corridors will not be expanded to any point where they would isolate habitats (for a highly mobile species). There will be a small decrease to availability of habitats (foraging and home-ranges) however this won't be at a scale large enough to cause a decline in the species.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Intra/interspecies competition for hollows is a threat to Glossy Black-cockatoo, which has been exacerbated by the 2019/2020 bushfires along the Great Dividing Range. Feral honeybees, possums, and other bird species such as starlings, Noisy Miners and Common Mynas are likely to dominate such habitat features, particularly in areas with scarce hollows. Given the development site is located within large tracts of unburnt forest, the scarcity of hollows is less of a threat than in a burnt landscape, or a highly fragmented landscape. Competition from Mynas is worse in urban and over cleared settings where Mynas have found an ecosystem niche. Common Mynas and Starlings were absent from the assessment area during all surveys, and Noisy Miners were only recorded in very low numbers and were absent in most surveys. Similarly, no Feral honeybees were observed within the development site. The Common Brushtail Possum was recorded on numerous occasions but isn't considered an invasive species.

The proposed vegetation clearing is largely confined to the edges of existing clearings such as the pipeline, power stations, infrastructure footprints, dams and access tracks. The proposed widening of these areas could theoretically improve the landscape for the Myna birds which prefer fragmented woodland habitats. However, given the existing cleared proportions of the development site and the relative absence of these species, it is unlikely that the proposed action would exacerbate their movement into these habitats.

Given the nature of the proposed works, weed spread is possible on the widened track edges and laydown areas. Whilst the plateau section of the assessment area contains only low-level weed growth (confined mostly to the intersection of Nowra/Moss Vale Rd), the valley areas are moderately to severely affected by weed infestations. The spread of weeds can be controlled through strict mitigation measures and vehicle/equipment cleaning protocols. Any potential impact would be restricted to areas immediately adjacent to the proposed activity and is not likely to substantially affect the broader sections of forest. The Glossy Black-Cockatoo primarily forages in the canopy. Any weeds introduced along the road edge or existing clearing edges are unlikely to impact significantly on the mature Allocasuarina in the area.

The proposed action is unlikely to result in invasive species becoming established in the landscape. The proposed action affects land which has long been cleared, and vegetation which has regrown or previously existed on the edges of clearings.

8) introduce disease that may cause the species to decline, or

The proposed action would not affect the prevalence of disease in the population.

9) interfere substantially with the recovery of the species.

Management actions would aim to address threats to the species such as weeds, invasive species / competition for hollows and loss of habitat. The proposed action will remove an area of suitable foraging

habitat and potential breeding habitat. This species was impacted by the 2019/2020 bushfires that affected large forest areas across its range, although the location of the development site is surrounded by very large areas of unburnt, high-quality habitat. Removal of habitat (largely regrowth) from the edges of an existing cleared corridor is not expected to affect the recovery of this species.

Conclusion

The Glossy Black-cockatoo would experience a relatively small modification of suitable habitat from the proposed action. No known breeding habitat will be impacted, and the loss of up to 12 suitable hollow-bearing trees would only be a minor decrease of what is available in the locality (which contains large areas of unburnt forest). The proposed action is unlikely to reduce the population size of the species or decrease the reproductive success of this species. This species is already using the assessment area despite clearings and disturbance for the existing hydro scheme. The widening of the existing clearings in some areas would not limit the movement or dispersal capability of this highly mobile species in the landscape. The proposed action would not interfere with the recovery of the species. After consideration of the factors above, an overall conclusion has been made that the proposed action is unlikely to result in a significant impact to the Glossy Black-cockatoo.

C.5 Migratory species

The following migratory or marine species were recorded within the assessment area or are considered moderately likely to occur based on suitable habitats;

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

The White-bellied Sea Eagle is a migratory species found in a range of habitat near the sea or further inland near lakes and reservoirs. Can be found in coastal dunes, tidal flats, grassland, heathland, woodland and forest, but require tall eucalypts for breeding and nesting.

A White-bellied Sea Eagle was observed flying above Bendeela Pondage (potentially foraging). No nest has been observed during repeat surveys over multiple years.

Black-faced Monarch (*Monarcha melanopsis*)

Black-faced Monarch individuals were observed on two occasions in January and March 2019. Suitable habitat occurs in wet sclerophyll forest including Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion and Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion.

Rufous Fantail (*Rhipidura rufifrons*)

Individuals were observed on two occasions in January and March 2019. Suitable habitat occurs in intact forests with good cover. Many regrowth vegetation communities in the assessment area also provide good shelter for this species.

Satin Flycatcher (*Myiagra cyanoleuca*)

Widespread in eastern Australia and vagrant to New Zealand, sparsely scattered on western slopes, extending into the Riverina region as far west as Deniliquin. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers are migratory, moving north in autumn to spend winter in northern Australia and New Guinea. They return south in spring to spend summer in south-eastern Australia.

This species was not recorded however is likely to utilise the vegetation within the assessment area (at least on an occasional basis). All plant community types present would provide potential woodland and forest habitats for this species.

Spectacled Monarch (*Monarcha trivirgatus*)

The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. This species prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.

This species was not recorded however is likely to utilise the vegetation within the assessment area (at least on an occasional basis). All plant community types present would provide potential woodland and forest habitats for this species.

No migratory wetland bird species are considered likely or moderately likely to occur based on the absence of suitable habitats. The man-made dams are not suitable for such species as they are surrounded by steep concrete or rock scree edges, with highly fluctuating water levels. No aquatic vegetation or foraging habitat is available in the dams.

The Significant impact guidelines (DoE, 2013) define an area of 'important habitat' for a migratory species as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- habitat that is of critical importance to the species at particular life-cycle stages, and/or
- habitat utilised by a migratory species which is at the limit of the species range, and/or
- habitat within an area where the species is declining.

Whilst habitats in the development site are potentially suitable for the above species, these habitats are unlikely to be important habitat for listed migratory species.

An action is likely to have a significant impact on these migratory species if there is a real chance or possibility that it will:

- 1) **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The proposed action will remove up to 22.2 ha of regrowth and 7.6 hectares of potentially remnant native vegetation from the edges of existing cleared corridors. This amount of vegetation is minor when compared to the large extent of similar (and better) condition forests to the south and north of the assessment area (including large unburnt areas). The proposed action will not substantially modify, destroy or isolate an area of important habitat for the listed migratory species.

- 2) **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or**

The development site is not important habitat for these species and it would not result in an invasive species that is harmful to these species.

Competition from Mynas is worse in urban and over cleared settings where Mynas have found an ecosystem niche. Noisy Miners and Common Mynas and Starlings were absent from the assessment area during all surveys, and Noisy Mynas were only recorded in very low numbers and were absent in most surveys. The proposed action would unlikely increase numbers of these species.

- 3) **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

There is no evidence to suggest that an ecologically significant proportion of the population of any identified migratory species exists within the assessment area.

While the project is likely to impact of some habitat that could potentially be used for breeding purposes by woodland birds, this habitat is not considered to be important habitat for these species. These species are not known to have a restricted breeding habitat. No large stick nests have been recorded and breeding habitat for the White-bellied Sea Eagle is limited. Whilst some large Eucalypts occur near Kangaroo River, or near the man-made dams (and could be used for nest building), these are not considered important for this species and clearing of some areas of eucalypt forest near waterbodies would not seriously disrupt the lifecycle of the White-bellied sea eagle.

The proposed works are not considered likely to seriously disrupt the lifecycle of an ecologically significant proportion of these populations.

Appendix D. Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00034904	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Names	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Nil		
Species		
Chalinolobus dwyeri / Large-eared Pied Bat		
Genoplesium baueri / Bauer's Midge Orchid		

Additional Information for Approval

BAM Biodiversity Credit Report (Like for like)

PCT Outside Ibra Added

None added

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
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Not a TEC	2.2	0	39	39
1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Not a TEC	9.4	147	40	187
1108-River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Not a TEC	3.7	37	25	62

BAM Biodiversity Credit Report (Like for like)

1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_High	Yes	84	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Mod_old_regrowth	Yes	63	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Mod_shrub_regrowth	No	40	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1108-River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Eastern Riverine Forests This includes PCT's: 42, 85, 485, 1106, 1108, 1318, 1714	Eastern Riverine Forests >=50% and <70%	1108_Mod_old_regrowth	Yes	37	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

	Eastern Riverine Forests This includes PCT's: 42, 85, 485, 1106, 1108, 1318, 1714	Eastern Riverine Forests >=50% and <70%	1108_Low_derived_grass	No	25	Ettrema, Bateman, Bungonia, Burraborang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_old _regrowth	No	38	Ettrema, Bateman, Bungonia, Burraborang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_young_regrowth	No	1	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	11.6	301.00
Chalinolobus dwyeri / Large-eared Pied Bat	1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	0.4	16.00
Genoplesium baueri / Bauer's Midge Orchid	1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	9.4	375.00

BAM Biodiversity Credit Report (Like for like)

Heleioporus australiacus / Giant Burrowing Frog	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	11.6	226.00
Hibbertia puberula / Hibbertia puberula	1083_High	0.6	21.00
Myotis macropus / Southern Myotis	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1108_Mod_old_regrowth, 1108_Low_derived_grass	3.9	76.00

Credit Retirement Options

Like-for-like credit retirement options

Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW
Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Genoplesium baueri / Bauer's Midge Orchid	Spp	IBRA subregion
	Genoplesium baueri / Bauer's Midge Orchid	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Heleioporus australiacus / Giant Burrowing Frog	Spp	IBRA subregion
	Heleioporus australiacus / Giant Burrowing Frog	Any in NSW
Hibbertia puberula / Hibbertia puberula	Spp	IBRA subregion
	Hibbertia puberula / Hibbertia puberula	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00034904	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Name(s)	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Nil		
Species		
Chalinolobus dwyeri / Large-eared Pied Bat		
Genoplesium baueri / Bauer's Midge Orchid		

Additional Information for Approval

PCT Outside Ibra Added
None added

BAM Biodiversity Credit Report (Variations)

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
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Not a TEC	2.2	0	39	39.00
1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Not a TEC	9.4	147	40	187.00
1108-River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Not a TEC	3.7	37	25	62.00

1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_High	Yes	84	Ettrema,Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Mod_old_regrowth	Yes	63	Ettrema,Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Mod_shrub_regr owth	No	40	Ettrema,Bateman, Bungonia, Burraborang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Variation options					
Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1083_High	Yes (includi ng artificia l)	84	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1083_Mod_ol d_regr owth	Yes (includi ng artificia l)	63	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1083_Mod_shrub_regr owth	No	40	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

1108-River Peppermint - Rough-barked Apple - River Oak herb/grass riparian forest of coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Eastern Riverine Forests This includes PCT's: 42, 85, 485, 1106, 1108, 1318, 1714	Eastern Riverine Forests >=50% and <70%	1108_Mod_ old_regrow th	Yes	37	Ettrema,Bateman, Bungonia, Burrangorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Eastern Riverine Forests This includes PCT's: 42, 85, 485, 1106, 1108, 1318, 1714	Eastern Riverine Forests >=50% and <70%	1108_Low_ derived_gr ass	No	25	Ettrema,Bateman, Bungonia, Burrangorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 3 or higher threat status	1108_Mod_ old_regrow th	Yes (includi ng artificia l)	37	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Forested Wetlands	Tier 3 or higher threat status	1108_Low_ derived_gr ass	No	25	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_old_regrowth	No	38	Ettrema,Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_young_regrowth	No	1	Ettrema,Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Wet Sclerophyll Forests (Grassy sub-formation)	Tier 4 or higher threat status	1283_Mod_old_regrowth	No	38	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

	Wet Sclerophyll Forests (Grassy sub-formation)	Tier 4 or higher threat status	1283_Mod_ young_regr owth	No	1	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
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Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	11.6	301.00
Chalinolobus dwyeri / Large-eared Pied Bat	1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	0.4	16.00
Genoplesium baueri / Bauer's Midge Orchid	1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	9.4	375.00
Heleioporus australiacus / Giant Burrowing Frog	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1083_High, 1083_Mod_old_regrowth, 1083_Mod_shrub_regrowth	11.6	226.00
Hibbertia puberula / Hibbertia puberula	1083_High	0.6	21.00
Myotis macropus / Southern Myotis	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1108_Mod_old_regrowth, 1108_Low_derived_grass	3.9	76.00

BAM Biodiversity Credit Report (Variations)

Credit Retirement Options

Cercartetus nanus/
Eastern Pygmy-possum

Like-for-like options

Spp	IBRA region
Cercartetus nanus /Eastern Pygmy-possum	Any in NSW

Variation options

Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
Fauna	Vulnerable	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Chalinolobus dwyeri/
Large-eared Pied Bat

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

Variation options

Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Genoplesium baueri/ Bauer's Midge Orchid	Spp		IBRA region
	Genoplesium baueri /Bauer's Midge Orchid		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Endangered	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Heleioporus australiacus/ Giant Burrowing Frog	Spp		IBRA region
	Heleioporus australiacus /Giant Burrowing Frog		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing	IBRA region

BAM Biodiversity Credit Report (Variations)

		under Part 4 of the BC Act shown below	
	Fauna	Vulnerable	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Hibbertia puberula/ Hibbertia puberula	Spp		IBRA region
	Hibbertia puberula /Hibbertia puberula		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Endangered	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp		IBRA region
	Myotis macropus /Southern Myotis		Any in NSW
	Variation options		

BAM Biodiversity Credit Report (Variations)

	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Ettrema, Bateman, Bungonia, Burragorang, Illawarra, Jervis and Moss Vale. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00035327	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Names	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Nil		
Species		
Rhodamnia rubescens / Scrub Turpentine		

Additional Information for Approval

PCT Outside Ibra Added

BAM Biodiversity Credit Report (Like for like)

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Pseudomys novaehollandiae / New Holland Mouse

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
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	1.0	22	1	23
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	0.0	1	0	1
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Not a TEC	0.5	0	8	8
1245-Illawarra Escarpment Blue Gum wet forest	Not a TEC	1.4	0	24	24

BAM Biodiversity Credit Report (Like for like)

1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Mod_old_regrowth	Yes	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
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BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_High	Yes	15	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_old_regrowth	Yes	7	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_shrub_regrowth	No		1 Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1245-Illawarra Escarpment Blue Gum wet forest	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Like for like)

	North Coast Wet Sclerophyll Forests This includes PCT's: 487, 613, 661, 684, 686, 692, 693, 694, 695, 699, 747, 748, 752, 812, 826, 827, 1073, 1208, 1217, 1222, 1237, 1244, 1245, 1257, 1259, 1260, 1261, 1265, 1266, 1282, 1284, 1285, 1504, 1561, 1562, 1563, 1566, 1567, 1568, 1569, 1572, 1573, 1575, 1579, 1841, 1843, 1915	North Coast Wet Sclerophyll Forests <50%	1245_Moderate	No	24	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Like for like)

	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_old_regrowth	No	6	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_young_regrowth	No	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_sheoak_regrowth	No	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Callocephalon fimbriatum / Gang-gang Cockatoo	1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	0.0	2.00
Cercartetus nanus / Eastern Pygmy-possum	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	2.8	74.00
Heleioporus australiacus / Giant Burrowing Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	2.8	55.00
Litoria littlejohni / Littlejohn's Tree Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	1.0	30.00
Myotis macropus / Southern Myotis	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	1.8	41.00

BAM Biodiversity Credit Report (Like for like)

Petauroides volans / Greater Glider	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	1.0	30.00
Rhodamnia rubescens / Scrub Turpentine	1245_Moderate	2.0	6.00

Credit Retirement Options

Like-for-like credit retirement options

Callocephalon fimbriatum / Gang-gang Cockatoo	Spp	IBRA subregion
	Callocephalon fimbriatum / Gang-gang Cockatoo	Any in NSW
Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW
Heleioporus australiacus / Giant Burrowing Frog	Spp	IBRA subregion
	Heleioporus australiacus / Giant Burrowing Frog	Any in NSW
Litoria littlejohni / Littlejohn's Tree Frog	Spp	IBRA subregion
	Litoria littlejohni / Littlejohn's Tree Frog	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Petauroides volans / Greater Glider	Spp	IBRA subregion
	Petauroides volans / Greater Glider	Any in NSW
Rhodamnia rubescens / Scrub Turpentine	Spp	IBRA subregion
	Rhodamnia rubescens / Scrub Turpentine	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00035327	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Name(s)	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Nil		
Species		
Rhodamnia rubescens / Scrub Turpentine		

Additional Information for Approval

PCT Outside Ibra Added
None added

PCTs With Customized Benchmarks

BAM Biodiversity Credit Report (Variations)

PCT

No Changes

Predicted Threatened Species Not On Site

Name

Pseudomys novaehollandiae / New Holland Mouse

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
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	1.0	22	1	23.00
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	0.0	1	0	1.00
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Not a TEC	0.5	0	8	8.00
1245-Illawarra Escarpment Blue Gum wet forest	Not a TEC	1.4	0	24	24.00

1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
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BAM Biodiversity Credit Report (Variations)

	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Mod_old_regrowth	Yes	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Mod_old_regrowth	Yes (including artificial)	1	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_High	Yes	15	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_old_regrowth	Yes	7	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_shrub_regrowth	No	1	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Variation options						
Formation	Trading group	Zone	HBT	Credits	IBRA region	
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_High	Yes (including artificial)	15	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.	

BAM Biodiversity Credit Report (Variations)

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_Mod_old_regrowth	Yes (including artificial)	7	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_Mod_shrub_regrowth	No	1	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1245-Illawarra Escarpment Blue Gum wet forest	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	North Coast Wet Sclerophyll Forests This includes PCT's: 487, 613, 661, 684, 686, 692, 693, 694, 695, 699, 747, 748, 752, 812, 826, 827, 1073, 1208, 1217, 1222, 1237, 1244, 1245, 1257, 1259, 1260, 1261, 1265, 1266, 1282, 1284, 1285, 1504, 1561, 1562, 1563, 1566, 1567, 1568, 1569, 1572, 1573, 1575, 1579, 1841, 1843, 1915	North Coast Wet Sclerophyll Forests <50%	1245_Moderate	No	24	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Wet Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1245_Moderate	No	24	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1283-Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_old_regrowth	No	6	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_young_regrowth	No	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Southern Lowland Wet Sclerophyll Forests This includes PCT's: 777, 1079, 1206, 1212, 1214, 1220, 1283	Southern Lowland Wet Sclerophyll Forests <50%	1283_Mod_sheoak_regrowth	No	1	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Wet Sclerophyll Forests (Grassy sub-formation)	Tier 4 or higher threat status	1283_Mod_old_regrowth	No	6	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Wet Sclerophyll Forests (Grassy sub-formation)	Tier 4 or higher threat status	1283_Mod_young_regrowth	No	1	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Wet Sclerophyll Forests (Grassy sub-formation)	Tier 4 or higher threat status	1283_Mod_sheoak_regrowth	No	1	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Callocephalon fimbriatum / Gang-gang Cockatoo	1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	0.0	2.00
Cercartetus nanus / Eastern Pygmy-possum	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	2.8	74.00

BAM Biodiversity Credit Report (Variations)

Heleioporus australiacus / Giant Burrowing Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	2.8	55.00
Litoria littlejohni / Littlejohn's Tree Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	1.0	30.00
Myotis macropus / Southern Myotis	1283_Mod_old_regrowth, 1283_Mod_young_regrowth, 1283_Mod_sheoak_regrowth, 1245_Moderate	1.8	41.00
Petauroides volans / Greater Glider	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth	1.0	30.00
Rhodamnia rubescens / Scrub Turpentine	1245_Moderate	2.0	6.00

Credit Retirement Options

Like-for-like options

Callocephalon fimbriatum / Gang-gang Cockatoo	Spp		IBRA region
	Callocephalon fimbriatum /Gang-gang Cockatoo		Any in NSW
	Variation options		
Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region	

BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Cercartetus nanus/ Eastern Pygmy-possum	Spp		IBRA region
	Cercartetus nanus /Eastern Pygmy-possum		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Heleioporus australiacus/ Giant Burrowing Frog	Spp		IBRA region
	Heleioporus australiacus /Giant Burrowing Frog		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Litoria littlejohni/ Littlejohn's Tree Frog	Spp		IBRA region
	Litoria littlejohni/Littlejohn's Tree Frog		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp		IBRA region
	Myotis macropus/Southern Myotis		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Petauroides volans/ Greater Glider	Spp		IBRA region
	Petauroides volans/ Greater Glider		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Not Listed	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Rhodamnia rubescens/ Scrub Turpentine	Spp		IBRA region
	Rhodamnia rubescens/ Scrub Turpentine		Any in NSW
	<i>Note: Variation rules do not apply for Critically Endangered species and impacts on Commonwealth listed entities that are a controlled action.</i>		

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00035326	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Names	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Endangered Ecological Community	1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
Species		
Chalinolobus dwyeri / Large-eared Pied Bat		

Additional Information for Approval

BAM Biodiversity Credit Report (Like for like)

PCT Outside Ibra Added

None added

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
1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	0.2	8	0	8
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	4.6	80	16	96
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	6.6	148	0	148

BAM Biodiversity Credit Report (Like for like)

1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Class	Trading group	Zone	HBT	Credits	IBRA region
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_High	Yes	55	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Mod_old_regrowth	Yes	93	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_High	Yes	34	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_old_regrowth	Yes	46	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_shrub_regrowth	No		16 Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Like-for-like credit retirement options					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion This includes PCT's: 944, 1107, 1254	-	1254_High	Yes	8	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

1254-Sydney Peppermint -
White Stringybark moist
shrubby forest on elevated
ridges, Sydney Basin
Bioregion

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Callocephalon fimbriatum / Gang-gang Cockatoo	1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	1.0	32.00
Cercartetus nanus / Eastern Pygmy-possum	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	334.00
Chalinolobus dwyeri / Large-eared Pied Bat	1156_High, 1156_Mod_old_regrowth	0.4	19.00
Heleioporus australiacus / Giant Burrowing Frog	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	250.00

BAM Biodiversity Credit Report (Like for like)

Litoria littlejohni / Littlejohn's Tree Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.1	326.00
Myotis macropus / Southern Myotis	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	4.0	116.00
Petauroides volans / Greater Glider	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	334.00

Credit Retirement Options

Like-for-like credit retirement options

Callocephalon fimbriatum / Gang-gang Cockatoo	Spp	IBRA subregion
	Callocephalon fimbriatum / Gang-gang Cockatoo	Any in NSW
Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Heleioporus australiacus / Giant Burrowing Frog	Spp	IBRA subregion
	Heleioporus australiacus / Giant Burrowing Frog	Any in NSW
Litoria littlejohni / Littlejohn's Tree Frog	Spp	IBRA subregion
	Litoria littlejohni / Littlejohn's Tree Frog	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Petauroides volans / Greater Glider	Spp	IBRA subregion
	Petauroides volans / Greater Glider	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033614/BAAS20027/22/00035326	Shoalhaven Hydro Expansion Project	14/10/2022
Assessor Name	Assessor Number	BAM Data version *
Matthew Consterdine	BAAS20027	55
Proponent Name(s)	Report Created	BAM Case Status
Lauren Barnaby	07/11/2022	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	07/11/2022

* 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
Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Endangered Ecological Community	1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion
Species		
Chalinolobus dwyeri / Large-eared Pied Bat		

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

BAM Biodiversity Credit Report (Variations)

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
1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	0.2	8	0	8.00
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	4.6	80	16	96.00
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	6.6	148	0	148.00

1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_High	Yes	55	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Mod_old_regrowth	Yes	93	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_High	Yes (including artificial)	55	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Mod_old_regrowth	Yes (including artificial)	93	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1156-Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_High	Yes	34	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_old_regrowth	Yes	46	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1156_Mod_shrub_regr owth	No	16	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Variation options					
Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_High	Yes (includi ng artificia l)	34	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_Mod_ol d_regr owth	Yes (includi ng artificia l)	46	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1156_Mod_shrub_regr owth	No	16	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

1254-Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Southern Highlands Shale Woodlands in the Sydney Basin Bioregion This includes PCT's: 944, 1107, 1254	-	1254_High	Yes	8	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Wet Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	1254_High	Yes (including artificial)	8	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Callocephalon fimbriatum / Gang-gang Cockatoo	1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	1.0	32.00
Cercartetus nanus / Eastern Pygmy-possum	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	334.00

BAM Biodiversity Credit Report (Variations)

Chalinolobus dwyeri / Large-eared Pied Bat	1156_High, 1156_Mod_old_regrowth	0.4	19.00
Heleioporus australiacus / Giant Burrowing Frog	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	250.00
Litoria littlejohni / Littlejohn's Tree Frog	1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.1	326.00
Myotis macropus / Southern Myotis	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	4.0	116.00
Petauroides volans / Greater Glider	1254_High, 1156_High, 1156_Mod_old_regrowth, 1156_Mod_shrub_regrowth, 1082_High, 1082_Mod_old_regrowth	11.4	334.00

Credit Retirement Options

Like-for-like options

Callocephalon fimbriatum / Gang-gang Cockatoo	Spp	IBRA region
	Callocephalon fimbriatum /Gang-gang Cockatoo	Any in NSW
	Variation options	

BAM Biodiversity Credit Report (Variations)

	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Cercartetus nanus/ Eastern Pygmy-possum	Spp		IBRA region
	Cercartetus nanus /Eastern Pygmy-possum		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Chalinolobus dwyeri/ Large-eared Pied Bat	Spp		IBRA region
	Chalinolobus dwyeri /Large-eared Pied Bat		Any in NSW
	Variation options		

BAM Biodiversity Credit Report (Variations)

	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Heleioporus australiacus/ Giant Burrowing Frog	Spp		IBRA region
	Heleioporus australiacus/ Giant Burrowing Frog		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Litoria littlejohni/ Littlejohn's Tree Frog	Spp		IBRA region
	Litoria littlejohni/ Littlejohn's Tree Frog		Any in NSW
	Variation options		

BAM Biodiversity Credit Report (Variations)

	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp		IBRA region
	Myotis macropus /Southern Myotis		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Petauroides volans/ Greater Glider	Spp		IBRA region
	Petauroides volans /Greater Glider		Any in NSW
	Variation options		

BAM Biodiversity Credit Report (Variations)

	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Not Listed	Moss Vale, Burragorang, Ettrema, Illawarra and Sydney Cataract. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Appendix E. Protected Matters Search Tool report



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 29-Jun-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	11
Listed Threatened Species:	68
Listed Migratory Species:	17

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	22
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	7
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community may occur	In buffer area only within area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community likely to occur	In feature area within area
Illawarra and south coast lowland forest and woodland ecological community	Critically Endangered	Community likely to occur	In feature area within area
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur	In feature area within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community may occur	In buffer area only within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur	In feature area within area
Robertson Rainforest in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur	In feature area within area
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur	In feature area within area
Temperate Highland Peat Swamps on Sandstone	Endangered	Community may occur	In buffer area only within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community likely to occur	In feature area within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur	In feature area within area

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
CRUSTACEAN			
Euastacus dharawalus Fitzroy Falls Spiny Crayfish [83143]	Critically Endangered	Species or species habitat known to occur within area	In feature area
FISH			
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area	In feature area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
FROG			
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area	In feature area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Endangered	Species or species habitat may occur within area	In buffer area only
Litoria watsoni Watson's Tree Frog [91509]	Endangered	Species or species habitat likely to occur within area	In feature area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
MAMMAL			
Chalinolobus dwyeri			
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area
Isoodon obesulus obesulus			
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In feature area
Petauroides volans			
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area	In feature area
Petaurus australis australis			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In feature area
Petrogale penicillata			
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
Potorous tridactylus trisulcatus			
Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pseudomys novaehollandiae			
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pteropus poliocephalus			
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In feature area
PLANT			
Acacia bynoeana			
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Boronia deanei Deane's Boronia [8397]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat may occur within area	In feature area
Commersonia prostrata Dwarf Kerrawang [87152]	Endangered	Species or species habitat may occur within area	In buffer area only
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat known to occur within area	In feature area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area	In feature area
Eucalyptus aggregata Black Gum [20890]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus macarthurii Camden Woollybutt, Paddys River Box [7827]	Endangered	Species or species habitat known to occur within area	In buffer area only
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat known to occur within area	In feature area
Gentiana wingecarribiensis Wingecarribee Gentian [18033]	Endangered	Species or species habitat known to occur within area	In buffer area only
Grevillea molyneuxii [22052]	Endangered	Species or species habitat known to occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Helichrysum calvertianum [5702]	Vulnerable	Species or species habitat known to occur within area	In feature area
Irenepharsus trypherus Delicate Cress, Illawarra Irene [14664]	Endangered	Species or species habitat known to occur within area	In feature area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat may occur within area	In feature area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Persoonia acerosa Needle Geebung [7232]	Vulnerable	Species or species habitat may occur within area	In feature area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat may occur within area	In buffer area only
Pomaderris brunnea Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat known to occur within area	In feature area
Pomaderris sericea Bent Pomaderris [9597]	Vulnerable	Species or species habitat may occur within area	In feature area
Prasophyllum affine Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Prasophyllum fuscum Tawny Leek-orchid, Slaty Leek-orchid [19455]	Vulnerable	Species or species habitat known to occur within area	In feature area
Prostanthera densa Villous Mintbush [12233]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis pulchella Pretty Greenhood [6448]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area	In feature area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Rhodomyrtus psidioides Native Guava [19162]	Critically Endangered	Species or species habitat may occur within area	In feature area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Triplarina nowraensis Nowra Heath-myrtle [64544]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area	In feature area
Zieria murphyi Velvet Zieria [4634]	Vulnerable	Species or species habitat may occur within area	In feature area

REPTILE			
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat known to occur within area	In feature area

Listed Migratory Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Migratory Terrestrial Species			
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
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Communications, Information Technology and the Arts - Telstra Corporation Limited

Commonwealth Land - Australian Telecommunications Commission [11836]	NSW	In buffer area only
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Commonwealth Land - Australian Telecommunications Commission [12012]	NSW	In buffer area only
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Defence - Defence Housing Authority

Commonwealth Land - Defence Housing Authority [12004]	NSW	In buffer area only
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Commonwealth Land - Defence Housing Authority [12003]	NSW	In buffer area only
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Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
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Bird

[Actitis hypoleucos](#)

Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
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[Apus pacificus](#)

Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
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[Bubulcus ibis as Ardea ibis](#)

Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
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[Calidris acuminata](#)

Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
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[Calidris ferruginea](#)

Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
------------------------	-----------------------	--	-----------------

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Barrengarry	Nature Reserve	NSW	In buffer area only
Budderoo	National Park	NSW	In buffer area only
Bugong	National Park	NSW	In buffer area only
Cambewarra Range	Nature Reserve	NSW	In buffer area only
Kangaroo River	Nature Reserve	NSW	In feature area

Protected Area Name	Reserve Type	State	Buffer Status
Morton	National Park	NSW	In feature area
Tapitallee	Nature Reserve	NSW	In buffer area only

Regional Forest Agreements

[[Resource Information](#)]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
Southern RFA	New South Wales	In feature area

EPBC Act Referrals

[[Resource Information](#)]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Weed Management Program within Wingecarribee Swamp	2004/1762	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
construction & operation of gas-fired power facility, installation of transmission lines & gas pipel	2006/3056	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Bioregional Assessments

SubRegion	BioRegion	Website	Buffer Status
Sydney	Sydney Basin	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Department of Agriculture Water and the Environment

GPO Box 858

Canberra City ACT 2601 Australia

+61 2 6274 1111

Appendix F. BDAR requirements compliance

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Introduction	Chapters 2 and 3	Information	
		Introduction to the biodiversity assessment including:	
		<input type="checkbox"/> brief description of the proposal	Section 2
		<input type="checkbox"/> identification of subject land boundary, including:	Section 2.3
		<input type="checkbox"/> operational footprint	
		<input type="checkbox"/> construction footprint indicating clearing associated with temporary/ancillary construction facilities and infrastructure	
		<input type="checkbox"/> general description of the subject land	Section 2.1
		<input type="checkbox"/> sources of information used in the assessment, including reports and spatial data	Section 5.1
		<input type="checkbox"/> identification and justification for entering the BOS	Section 1.1
Landscape	Sections 3.1 and 3.2, Appendix E	Maps and tables	
		<input type="checkbox"/> Map of the subject land boundary showing the final proposal footprint, including the construction footprint for any clearing associated with temporary/ancillary construction facilities and infrastructure	Figure 2-1
		Information	
		Identification of site context components and landscape features, including:	
		<input type="checkbox"/> general description of subject land topographic and hydrological setting, geology and soils	Section 4
		<input type="checkbox"/> per cent native vegetation cover in the assessment area (as described in BAM Section 3.2)	Section 4.9
		<input type="checkbox"/> IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.))	Section 4.1
		<input type="checkbox"/> rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Appendix E)	Section 4.4
		<input type="checkbox"/> wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.))	Section 4.5
		<input type="checkbox"/> connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.))	Section 4.6
		<input type="checkbox"/> karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.))	Section 4.7
		<input type="checkbox"/> areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.))	Section 4.8
		<input type="checkbox"/> any additional landscape features identified in any SEARs for the proposal	Section 4.3

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BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> NSW (Mitchell) landscape on which the subject land occurs	Section 4.2
		<input type="checkbox"/> details of field reconnaissance undertaken to confirm the extent and condition of landscape features and native vegetation cover (as described in Operational Manual Stage 1 Section 2.4)	Section 5.2
		Maps and tables	
		<input type="checkbox"/> Site Map <ul style="list-style-type: none"> <input type="checkbox"/> Property boundary <input type="checkbox"/> Boundary of subject land <input type="checkbox"/> Cadastre of subject land (including labelling of Lot and DP or section plan if relevant) <input type="checkbox"/> Landscape features identified in BAM Subsection 3.1.3 	Figure 2-1
		<input type="checkbox"/> Location Map <ul style="list-style-type: none"> <input type="checkbox"/> Digital aerial photography at 1:1,000 scale or finer <input type="checkbox"/> Boundary of subject land <input type="checkbox"/> Assessment area (i.e. the subject land and either 1500 m buffer area or 500 m buffer for linear development) <input type="checkbox"/> Landscape features identified in BAM Subsection 3.1.3 <input type="checkbox"/> Additional detail (e.g. local government area boundaries) relevant at this scale 	Figure 2-1
		Landscape features identified in BAM Subsection 3.1.3 and to be shown on the Site Map and/or Location Map include:	Figure 4-1 Figure 4-2
		<input type="checkbox"/> IBRA bioregions and subregions <ul style="list-style-type: none"> <input type="checkbox"/> rivers, streams and estuaries <input type="checkbox"/> wetlands and important wetlands <input type="checkbox"/> connectivity of different areas of habitat <input type="checkbox"/> karst, caves, crevices, cliffs, rocks and other geological features of significance and if required, soil hazard features <input type="checkbox"/> areas of outstanding biodiversity value occurring on the subject land and assessment area <input type="checkbox"/> any additional landscape features identified in any SEARs for the proposal <input type="checkbox"/> NSW (Mitchell) landscape on which the subject land occurs 	
		Data	
		<input type="checkbox"/> All report maps as separate jpeg files	BAM-C
		Individual digital shape files of:	

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BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> subject land boundary	BAM-C
		<input type="checkbox"/> assessment area (i.e. subject land and 1500 m buffer area) boundary	BAM-C
		<input type="checkbox"/> cadastral boundary of subject land	BAM-C
		<input type="checkbox"/> areas of native vegetation cover	BAM-C
		<input type="checkbox"/> landscape features	BAM-C
Native vegetation	Chapter 4, Appendix A and Appendix H	Information	
		<input type="checkbox"/> Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	Section 4.9
		<input type="checkbox"/> Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	Section 5.3.2
		<input type="checkbox"/> Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	Section 5.1
		<input type="checkbox"/> Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	Section 5.2 and Section 5.3
		<input type="checkbox"/> Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	N/A
		For each PCT within the subject land, describe:	
		<input type="checkbox"/> PCT name and ID	Section 5.4
		<input type="checkbox"/> vegetation class	Section 5.4
		<input type="checkbox"/> extent (ha) within subject land	Section 5.4
		<input type="checkbox"/> evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	Section 5.4
		<input type="checkbox"/> plant species relied upon for identification of the PCT and relative abundance of each species	Section 5.4
		<input type="checkbox"/> if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	
		<input type="checkbox"/> estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	Section 5.7
		Describe the vegetation integrity assessment of the subject land, including:	
		<input type="checkbox"/> identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	Section 5.5

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	Section 5.5
		<input type="checkbox"/> area (ha) of each vegetation zone	Section 5.5
		<input type="checkbox"/> assessment of patch size (as described in BAM Subsection 4.3.2)	Section 5.6
		<input type="checkbox"/> survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.)	Section 5.3.2
		<input type="checkbox"/> use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	Section 5.5
		Where use of more appropriate local benchmark data is proposed (as described in BAM Subsection 1.4.2, BAM Subsection 4.3.3(5.) and BAM Appendix A):	N/A
		<input type="checkbox"/> identify the PCT or vegetation class for which local benchmark data will be applied	N/A
		<input type="checkbox"/> identify published sources of local benchmark data (if benchmarks obtained from published sources)	N/A
		<input type="checkbox"/> describe methods of local benchmark data collection (if reference plots used to determine local benchmark data)	N/A
		<input type="checkbox"/> provide justification for use of local data rather than BioNet Vegetation Classification benchmark values	N/A
		<input type="checkbox"/> provide written confirmation from the decision-maker that they support the use of local benchmark data	N/A
		Maps and tables	
		<input type="checkbox"/> Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2)	Figure 4-2
		<input type="checkbox"/> Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	Figure 5-1
		<input type="checkbox"/> Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	Figure 5-1
		<input type="checkbox"/> Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	Figure 5-1
		<input type="checkbox"/> Map of TEC distribution on the subject land and table of TEC listing, status and area (ha)	Figure 5-1
		<input type="checkbox"/> Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	patch size locations are not mapped but described in Section 5.6. the patch size is the max class

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Table of current vegetation integrity scores for each vegetation zone within the site and including:	
		<input type="checkbox"/> composition condition score	Table 9-2 and Appendix B
		<input type="checkbox"/> structure condition score	
		<input type="checkbox"/> function condition score	
		<input type="checkbox"/> presence of hollow bearing trees	
		Data	
		<input type="checkbox"/> All report maps as separate jpeg files	BAM-C
		<input type="checkbox"/> Plot field data (MS Excel format)	BAM-C
		<input type="checkbox"/> Plot field datasheets	Appendix B
		Digital shape files of:	
Threatened species	Chapter 5	<input type="checkbox"/> PCT boundaries within subject land	BAM-C
		<input type="checkbox"/> TEC boundaries within subject land	BAM-C
		<input type="checkbox"/> vegetation zone boundaries within subject land	BAM-C
		<input type="checkbox"/> floristic vegetation survey and vegetation integrity plot locations	BAM-C
		Information	
		Identify ecosystem credit species likely to occur on the subject land, including:	
		<input type="checkbox"/> list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.))	Section 6.2.2
		<input type="checkbox"/> justification and supporting evidence for exclusion of any ecosystem credit species based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	Section 6.2.2
		<input type="checkbox"/> justification for addition of any ecosystem credit species to the list	Section 6.2.2
		Identify species credit species likely to occur on the subject land, including:	
		<input type="checkbox"/> list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1)	Section 6.2.3
		<input type="checkbox"/> justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	Section 6.2.3.1
		<input type="checkbox"/> justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2)	Section 6.2.3.2
		<input type="checkbox"/> justification for addition of any species credit species to the list	Section 6.2.3.3
		From the list of candidate species credit species, identify:	

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.)) <input type="checkbox"/> species present within the subject land on the basis of being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.)) <input type="checkbox"/> species for which targeted surveys are to be completed to determine species presence (BAM Subsection 5.2.4(2.b.)) <input type="checkbox"/> species for which an expert report is to be used to determine species presence (BAM Subsection 5.2.4(2.c.))	Section 6.3 and Section 6.4
		Present the outcomes of species credit species assessments from:	
		<input type="checkbox"/> threatened species survey (as described in BAM Section 5.2.4)	Section 6.3
		<input type="checkbox"/> expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Subsection 5.2.4, Section 5.3, Box 3)	N/A
		Where survey has been undertaken include detailed information on:	
		<input type="checkbox"/> survey method and effort (as described in BAM Section 5.3)	Section 6.3
		<input type="checkbox"/> justification of survey method and effort (e.g. citation of peer-reviewed literature) if approach differs from the department's taxa-specific survey guides or where no relevant guideline has been published	Section 6.3
		<input type="checkbox"/> timing of survey in relation to requirements in the TBDC or the department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys	Section 6.3
		<input type="checkbox"/> survey personnel and relevant experience	Section 1.3
		<input type="checkbox"/> describe any limitations to surveys and how these were addressed/overcome	Section 5.9
		Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include:	
		<input type="checkbox"/> justification of the use of an expert report	N/A
		<input type="checkbox"/> identify the expert, provide evidence of their expert credentials and departmental approval of expert status	
		<input type="checkbox"/> all requirements of Box 3 have been addressed in the expert report	
		Where use of local data is proposed (BAM Subsection 1.4.2):	
		<input type="checkbox"/> identify relevant species	N/A
		<input type="checkbox"/> identify data to be amended	
		<input type="checkbox"/> identify source of information for local data, e.g. published literature, additional survey data, etc.	
		<input type="checkbox"/> justify use of local data in preference to VIS Classification or TBDC data	
		<input type="checkbox"/> provide written confirmation from the decision-maker that they support the use of local data	N/A
		Species polygon completed for species credit species present within the subject land (assumed present or determined on the basis of survey, expert report or important habitat map) ensuring that:	

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BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> the unit of measure for each species is documented	Section 6.4 and Section 9.1
		for species assessed by area:	
		<input type="checkbox"/> the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	Section 9.1
		<input type="checkbox"/> a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to map the species polygon including reference to information in the TBDC for that species and any buffers applied	Section 12.1.2
		for species assessed by counts of individuals:	
		<input type="checkbox"/> the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.))	Section 12.1.2
		<input type="checkbox"/> the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken	Section 6.4 and Section 12.1.2
		<input type="checkbox"/> the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land	Section 12.1.2
		<input type="checkbox"/> Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	Table 12.2
		Maps and tables	
		<input type="checkbox"/> Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	Table 13.1
		<input type="checkbox"/> the ecosystem credit species removed from the list	N/A
		<input type="checkbox"/> the sensitivity to gain class of each species	Table 13-1
		<input type="checkbox"/> Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	Table 13.2
		<input type="checkbox"/> the species credit species removed from the list of species because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present	Section 6.2.3
		<input type="checkbox"/> the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	Section 6.4 and Section 12.1.2
		<input type="checkbox"/> Table detailing species credit species recorded or assumed as present within the subject land, habitat constraints or microhabitats associated with the species, counts of individuals (flora)/extent of suitable habitat (flora and fauna) (as described in BAM Subsection 5.2.6) and biodiversity risk weighting (BAM Section 5.4)	Table 13.2
		<input type="checkbox"/> Map indicating the GPS coordinates of all individuals of each species recorded within the subject land and the species polygon for each species (as described in BAM Subsection 5.2.5)	Section 12.1.2

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Data	
		<input type="checkbox"/> Digital shape files of suitable habitat identified for survey for each candidate species credit species	BAM-C
		<input type="checkbox"/> Survey locations including GPS coordinates of any plots, transects, grids	BAM-C
		<input type="checkbox"/> Digital shape files of each species polygon including GPS coordinates of located individuals	BAM-C
		<input type="checkbox"/> Species polygon map in jpeg format	BAM-C
		<input type="checkbox"/> Expert reports and any supporting data used to support conclusions of the expert report	N/A
		<input type="checkbox"/> Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	This information is described and tabled in Section 6.3
Prescribed impacts	Chapter 6	Information	
		Identify potential prescribed biodiversity impacts on threatened entities, including:	
		<input type="checkbox"/> karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1)	Section 9.3
		<input type="checkbox"/> occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2)	
		<input type="checkbox"/> corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3)	
		<input type="checkbox"/> waterbodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4)	
		<input type="checkbox"/> protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5)	N/A
		<input type="checkbox"/> where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6)	Section 9.3.5
		<input type="checkbox"/> Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	Section 9.1.2
		<input type="checkbox"/> Describe the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns (e.g. Subsection 6.1.3)	Section 12.1.2
		Where the proposed development is for a wind farm:	N/A

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> identify a candidate list of protected animals that may use the development site as a flyway or migration route, including: resident threatened aerial species, resident raptor species and nomadic and migratory species that are likely to fly over the proposal area (as described in BAM Subsection 6.1.5)	N/A
		<input type="checkbox"/> provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.)	N/A
		<input type="checkbox"/> predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.))	N/A

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Avoid and minimise impacts		Where the proposal may result in vehicle strike:	
		<input type="checkbox"/> identify a list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	Section 9.3.5
		Maps and tables	
		<input type="checkbox"/> Map showing location of any prescribed impact features (i.e. karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	Figure 4-1
		<input type="checkbox"/> Map showing location of potential vehicle strike locations	n/a
		<input type="checkbox"/> Maps of habitual flight paths for nomadic and migratory species likely to fly over the site and maps of likely habitat for threatened aerial species resident on the site (for wind farm developments only)	n/a
		Data	
		<input type="checkbox"/> Digital shape files of prescribed impact feature locations	n/a
		<input type="checkbox"/> Prescribed impact features map in jpeg format	n/a
	Chapter 7	Information	
		Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative:	Section 8
		<input type="checkbox"/> modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	n/a
		<input type="checkbox"/> routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	Section 8.1
		<input type="checkbox"/> alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	section 8.1.1 and section 8.1.2
		<input type="checkbox"/> alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site	Section 8.1
		<input type="checkbox"/> Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2)	Section 8.1.1
		<input type="checkbox"/> Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Subsection 7.2.1(3.))	Section 8.1.2
		<input type="checkbox"/> Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g. due to site constraints)	n/a
		Maps and tables	

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	Details in Section 8
		<input type="checkbox"/> Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	n/a
		<input type="checkbox"/> Maps demonstrating indirect impact zones where applicable	n/a
		Data	
		Digital shape files of:	
		<input type="checkbox"/> alternative and final proposal footprint	BAM-C
		<input type="checkbox"/> direct and indirect impact zones	BAM-C
		<input type="checkbox"/> Maps in jpeg format	BAM-C
		Information	
		<input type="checkbox"/> Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1)	Section 9.1
Assessment of impacts	Chapter 8, Sections 8.1 and 8.2	Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2):	Section 9.2
		<input type="checkbox"/> description of the nature, extent, frequency, duration and timing of indirect impacts of the proposal	Table 9-3
		<input type="checkbox"/> documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	Section 9.1- 9,2 and 12.1.2
		<input type="checkbox"/> reporting any limitations or assumptions, etc. made during the assessment	Section 12.1
		<input type="checkbox"/> identification of the threatened entities and their habitat likely to be affected	Section 12.1
		Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including:	Section 9.3
		assessment of the nature, extent frequency, duration and timing of impacts on the habitat of threatened species or ecological communities associated with:	
		<input type="checkbox"/> karst, caves, crevices, cliffs, rocks and other features of geological significance	Section 9.3.1
		<input type="checkbox"/> human-made structures	Section 9.3.2
		<input type="checkbox"/> non-native vegetation	n/a
		<input type="checkbox"/> connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Section 9.3.3

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> movement of threatened species that maintains their life cycle	Section 9.3.3
		<input type="checkbox"/> water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	Section 9.3.4
		<input type="checkbox"/> assessment of the impacts of wind turbine strikes on protected animals	n/a
		<input type="checkbox"/> assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	Section 9.3.5
		<input type="checkbox"/> evaluate the consequences of prescribed impacts	Section 9.3
		<input type="checkbox"/> describe impacts that are uncertain	n/a
		<input type="checkbox"/> document limitations to data, assumptions and predictions	n/a
		Maps and tables	
		<input type="checkbox"/> Table showing change in vegetation integrity score for each vegetation zone as a result of identified impacts	Table 12-1
		Data	
		N/A	
Mitigation and management of impacts	Chapter 8, Sections 8.4 and 8.5	Information	
		Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including:	
		<input type="checkbox"/> techniques, timing, frequency and responsibility	Section 10.1
		<input type="checkbox"/> identify measures for which there is risk of failure	
		<input type="checkbox"/> evaluate the risk and consequence of any residual impacts	
		<input type="checkbox"/> document any adaptive management strategy proposed	Section 10.1
		Identification of measures for mitigating impacts related to:	
		<input type="checkbox"/> displacement of resident fauna (as described in BAM Subsection 8.4.1(2.))	Section 10.1
		<input type="checkbox"/> indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.))	
		<input type="checkbox"/> mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2)	
		<input type="checkbox"/> Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	Section 10.2
		Maps and tables	
		<input type="checkbox"/> Table of measures to be implemented before, during and after construction to mitigate and manage impacts of the proposal, including action, outcome, timing and responsibility	Section 10.2

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Impact summary	Chapter 9	Data	
		N/A	
		Information	
		Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAIL, in accordance with BAM Section 9.1) including:	
		<input type="checkbox"/> addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAIL present on the subject land	Section 11
		<input type="checkbox"/> for each TEC, report the extent of the TEC in NSW	Section 11,2
		<input type="checkbox"/> addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAIL present on the subject land	Section 11.3
		<input type="checkbox"/> for each threatened species, report the population size in NSW	Section 11.3
		<input type="checkbox"/> documenting assumptions made and/or limitations to information <input type="checkbox"/> documenting all sources of data, information, references used or consulted <input type="checkbox"/> clearly justifying why any criteria could not be addressed	Section 11.3
		<input type="checkbox"/> Identification of impacts requiring offset in accordance with BAM Section 9.2	Section 12.1
		<input type="checkbox"/> Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	Section 12.2
		<input type="checkbox"/> Identification of areas not requiring assessment in accordance with BAM Section 9.3	Section 12.2

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Maps and tables	
		<input type="checkbox"/> Map showing the extent of TECs at risk of an SAIL within the subject land	See figures in Section 12
		<input type="checkbox"/> Map showing location of threatened species at risk of an SAIL within the subject land	See figures in Section 12
		Map showing location of:	
		<input type="checkbox"/> impacts requiring offset	See figures in Section 12
		<input type="checkbox"/> impacts not requiring offset	See figures in Section 12
		<input type="checkbox"/> areas not requiring assessment	See figures in Section 12
		Data	
		Digital shape files of:	
		<input type="checkbox"/> extent of TECs at risk of an SAIL within the subject land	BAM-C
		<input type="checkbox"/> location of threatened species at risk of an SAIL within the subject land	BAM-C
		<input type="checkbox"/> boundary of impacts requiring offset	BAM-C
		<input type="checkbox"/> boundary of impacts not requiring offset	BAM-C
		<input type="checkbox"/> boundary of areas not requiring assessment	BAM-C
		<input type="checkbox"/> Maps in jpeg format	BAM-C
Impact summary	Chapter 10	Information	
		Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including:	
		<input type="checkbox"/> future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H)	Section 12 and Section 13
		<input type="checkbox"/> change in vegetation integrity score (BAM Subsection 8.1.1)	
		<input type="checkbox"/> number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 10.1.2)	
		<input type="checkbox"/> biodiversity risk weighting for each	Section 12 and Section 13

Biodiversity development assessment report

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		<input type="checkbox"/> number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	Section 13.2
		Maps and tables	
		<input type="checkbox"/> Table of PCTs requiring offset and the number of ecosystem credits required	Table 13-1
		<input type="checkbox"/> Table of threatened species requiring offset and the number of species credits required	Table 13-2
		Data	
		<input type="checkbox"/> Submitted proposal in the BAM Calculator	BAM-C
Biodiversity credit report	Chapter 10	Information	
		<input type="checkbox"/> Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2)	Table 13-1
		<input type="checkbox"/> BAM credit report in pdf format	Appendix D
		Maps and tables	
		<input type="checkbox"/> Table of credit class and matching credit profile	Table 13-1 and Appendix D
		Data	
		<input type="checkbox"/> BAM credit report in pdf format	Appendix D and BAM-C