Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity Development Assessment Report

Prepared for OMPS Pty Ltd

August 2024

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Biodiversity Development Assessment Report

OMPS Pty Ltd

J210465 Amendment report - Biodiversity Development Assessment Report

August 2024

Version	Date	Prepared by	Reviewed by	Comments
V1	15 December 2022	Jason Brown	Nathan Garvey	Version for client review
V2	15 March 2023	Jason Brown	Nathan Garvey	Addressing client and peer review comments
V3	1 August 2023	Jason Brown	Nathan Garvey	Addressing Client and BCD comments
V4	22 August 2023	Jason Brown	Nathan Garvey	Addressing DPE comments
V5	8 September 2023	Nathan Garvey	–	Updates to V1.2 benchmarks
V6	4 July 2024	Jason Brown	Cecilia Phu Paul Rossington	Draft for review - Addressing RTS comments and Amended Project
V7	2 August 2024	Jason Brown	Cecilia Phu	Final for RTS submission
V8	19 August	Jason Brown	Paul Rossington	Changes to correct vegetation mapping and address BCS early comments on Figures.

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19 August 2024

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Executive Summary

ES1 Project description

OMPS Pty Ltd (OMPS) is proposing to develop the Oven Mountain Pumped Hydro Energy Storage Project (the Project), an off-river pumped hydro energy storage system (referred to as the pumped hydro system) located approximately half-way between Kempsey and Armidale adjacent to the Macleay River in northern NSW. The Project is located within the New England Renewable Energy Zone (REZ) and the Armidale Regional Local Government Area (LGA), proximate to its border with Kempsey Shire LGA.

The Project has been declared by the NSW Government to be critical State significant infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Infrastructure projects are declared to be CSSI if, in the opinion of the NSW Minister for Planning, they are essential to the State for economic, environmental, or social reasons.

This Biodiversity Development Assessment Report (BDAR) documents the terrestrial biodiversity assessment methods and results, the initiatives built into the Project design to avoid and minimise associated impacts to terrestrial biodiversity, and the mitigation, and management measures, including offset requirements, proposed to address any unavoidable residual impacts. It should be read in conjunction with the Project's Environmental Impact Statement (EIS) and Amendment Report, which provides a full detailed description of the Project.

ES2 Landscape feature

The Project occurs within the NSW North Coast interim biogeographic regionalisation of Australia (IBRA) bioregion and Macleay Gorges, Carrai Plateau and Macleay Hastings IBRA subregions on the Macleay Escarpment Foothills BioNet NSW Landscapes (formerly Mitchell Landscapes). The percentage of native vegetation within a 1,500 m buffer of the footprint of the reservoirs construction and operation areas combined and a 500 m buffer on either side of the centreline of the transmission line and access footprints is estimated at approximately 96.7% based on aerial imagery. The patch size is calculated to be greater than 101 hectares (ha) due to the contiguity of vegetation in the construction envelope with nearby vegetation within the region.

ES3 Native vegetation

The vegetation within the Project area reflects past land uses and disturbances, including historical timber felling, current uses such as grazing, the 2019/2020 bushfires and floodplain along the Macleay River, as well as the landscape in which the Project is situated, noting there is an elevation change of approximately 1,000 metres (m) from the Macleay River to the Carrai Plateau.

On the banks of the Macleay River, the vegetation is primarily dominated by River Oak (*Casuarina cunninghamiana*). Dry sclerophyll forests occur along the floodplain of the Macleay River and lower slopes, with much of the vegetation within the construction envelope occurring as open grassy Eucalypt forests with smaller wet sclerophyll areas influenced by surface water flows located on headwater tributaries. Vegetation on upper slopes includes tall grassy forests, with shrubby understorey in wetter and cooler microclimates.

In the floodplains and foothills of the Project area, past disturbance has led to clearing of native vegetation and native and exotic grasslands occur; these grasslands lack a mid-storey and canopy stratum and vary in species density and diversity. These lower elevation areas support a higher density of exotic species, due to both the alluvial influences of the Macleay River as well as past and current disturbance.

The following plant community types (PCTs) are mapped within the construction envelope:

- PCT 762 – Cabbage Gum open forest or woodland on flats of the North Coast
- PCT 842 – Forest Redgum – Broad leaved Apple dry open forest of the gorges of NSW North Coast Bioregion
- PCT 868 – Grey gum – Stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion
- PCT 979 – New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion
- PCT 988 – New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion
- PCT 1106 – River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
- PCT 1142 – Shatterwood Giant Stinging Tree Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
- PCT 1215 – Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
- PCT 1268 – Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion
- PCT 1287 – Upland heath swamps of the New England Tableland Bioregion.

Vegetation zones were delineated by the presence/absence of canopy and condition of derived grasslands, with 20 vegetation zones delineated across the ten PCTs.

The following threatened ecological communities (TECs) occur within the Project area. The disturbance footprint contains:

- 3.9 ha of Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion
- 0.9 ha of Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion
- 5 ha of Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions.

These TECs are listed as endangered ecological communities (EECs) under the BC Act.

ES4 Threatened species

The Project area has an elevation change of nearly 1,000 m. The escarpment of the Carrai Plateau is dominated by a series of scarp slopes, rocky areas with deep gullies. The construction envelope is, in parts, densely vegetated with disturbance limited to areas where there has been historical use for logging and areas of lower elevation along the Macleay River which have been subject to low level clearing associated with grazing activities. The Project area was also impacted by the 2019/2020 bushfires which along with historical land use, reduced habitat values for threatened species.

A habitat assessment within the construction envelope was used to guide the candidate species assessment. This assessment concluded that targeted surveys were required for 30 flora species and 33 fauna species. Safe access to certain areas of the construction envelope were also restricted due to the steep terrain, with survey effort using traditional methodologies either limited or impossible to undertake for forest owls and Glossy Black-Cockatoo. Alternative survey methodology was applied where feasible; however, where survey gaps existed, assumed presence for some species was required.

The following species credit species were recorded within the construction envelope:

- Guthrie's Grevillea (*Grevillea guthrieana*)
- Tall Velvet Sea-berry (*Haloragis exalata* subsp*. velutina*)
- Wandering Pepper Cress (*Lepidium peregrinum*)
- *Pultenaea rubescens*
- Southern Myotis (*Myotis macropus*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*).
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Greater Glider (*Petauroides volans*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Brush-tailed Rock-wallaby (*Petrogale penicillata*)
- Koala (*Phascolarctos cinereus*) (old scat found in one location indicating species presence)
- Long-nosed Potoroo (*Potorous tridactylus*)

One species were assumed to be present as identification could not be confirmed.

- Cryptic Forest Twiner (*Tylophora woollsii*)[1]

[1] Unconfirmed by the herbarium and genetic analysis.

ES5 Groundwater dependent ecosystems

The updates as part of the project design in the response to submissions stage predict that water table drawdown is predicted to occur during the construction period only to the two obligate GDEs (PCT 1287). Drawdown is not predicted (within the minimum drawdown threshold) during operation. No ongoing drawdown is predicted within 40 m of facultative/opportunistic GDEs between the lower reservoir and Macleay River. A separate report covering GDE assessment can be found in Appendix I of the EIS.

ES6 Impact avoidance and minimisation

A key focus of the Project has been to avoid and minimise impacts to biodiversity values identified during the field surveys. The Project has undergone significant steps to avoid and minimise impacts to ensure impacts are avoided and minimised to the greatest extent possible, within the design and other limitations of the Project.

Avoidance consideration of options and development of the Project was informed by iterative environmental constraint assessment comprising both desktop and field survey. The Project was designed to avoid, where practical direct impacts to threatened flora species and critical habitat known to support threatened fauna species.

Minimisation and mitigation of impacts was also incorporated into the final design where components were moved away from more sensitive areas such as the Macleay River flood plain that was associated with EECs and habitat to support threatened species. All works will be undertaken in accordance with general mitigation measures to be identified in the construction environment management plan (CEMP).

A summary of measures undertaken to avoid and minimise impacts is provided in Section 8.3.

ES7 Impact assessment

The Project will result in the following direct impacts:

- loss of 362.7 ha of native vegetation and threatened species habitat of varying condition
- loss of 9.8 ha of threatened ecological communities.

Six serious and irreversible impacts (SAII) candidate species were recorded within the Project area. Of these, the Project is considered likely to have impacts on approximately 0.0059 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat, impacting one colony containing a minimum of two individuals. Two individuals of Wandering Pepper Cress will also be impacted, impacting 0.1% of the percentage of the NSW population and 2.51 ha of habitat for this species. *Pultenaea rubescens,* Scrub Turpentine, Little Bent-winged Bat and Large Bent-winged Bat will not be directly impacted by the Project.

Four prescribed impacts are expected to occur as a result of the Project. These are:

- impacts on cliffs and rocks
- movement corridors
- water quality, water bodies and hydrological processes
- vehicle strikes.

These prescribed impacts may impact threatened species. Mitigation measures to minimise these impacts have been included in this assessment.

ES8 Biodiversity offsets

The Project requires a total of 9,056 ecosystem credits to compensate for impact on native vegetation and species habitat. An additional 52,377 species credit are required to offset the residual impacts of the Project on threatened species that were recorded or assumed present within the disturbance footprint.

Offsets are not required for five vegetation zones (762_DNG Moderate, 762_Exotic Grassland, 842_DNG Moderate and 842_Exotic Grassland) as the vegetation integrity score of these zones falls below the offset threshold under the BAM. Additional areas which do not require offsetting include existing cleared access tracks and watercourses, both of which occur within the disturbance footprint.

ES9 Assessment of impacts under other relevant biodiversity legislation

ES9.1 Environment Protection and Biodiversity Conservation Act 1999

This BDAR has also been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued by the former Department of Planning and Environment (DPE) (now the Department of Planning, Housing and Infrastructure (DPHI)) on 10 June 2022. To inform preparation of the SEARs, the Department invited relevant government agencies to advise on matters to be addressed in the EIS. These matters were taken into account by the Secretary for the Department when preparing the SEARs.

One EEC listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions, occurs within the disturbance footprint associated with PCT 762. Impacts will occur to 0.3 ha of this community. The EEC within the disturbance footprint is Class C2, moderate condition and as such the Project is unlikely to have a significant impact to the EEC.

Seven flora species and nine fauna species listed under the EPBC Act were recorded within the Project area. Of these, the Project will have an adverse impact on critical habitat for Brush-tailed Rock-wallaby; however, it is unlikely to significantly impact the local population of the species. The remaining species are unlikely to be significantly impact by the Project.

Four migratory species were also recorded within the construction envelope. The Project is unlikely to significantly impact these species.

ES9.2 Biosecurity Act 2015

Seven priority weeds of the North Coast region were recorded in the construction envelope. One species, Tropical Soda Apple (*Solanum viarum*), is listed as having a control order, where landowners are required to notify the local control authority.

TABLE OF CONTENTS

Annexures

Tables

Figures

Plates

1 Introduction

1.1 The Project

OMPS Pty Ltd (OMPS) is proposing to develop the Oven Mountain Pumped Hydro Energy Storage Project (the Project), an off-river pumped hydro energy storage system (referred to as the 'pumped hydro system') located approximately half-way between Kempsey and Armidale, adjacent to the Macleay River in northern NSW. The Project is located within the New England Renewable Energy Zone (REZ) and the Armidale Regional Local Government Area (LGA), proximate to its border with Kempsey Shire LGA.

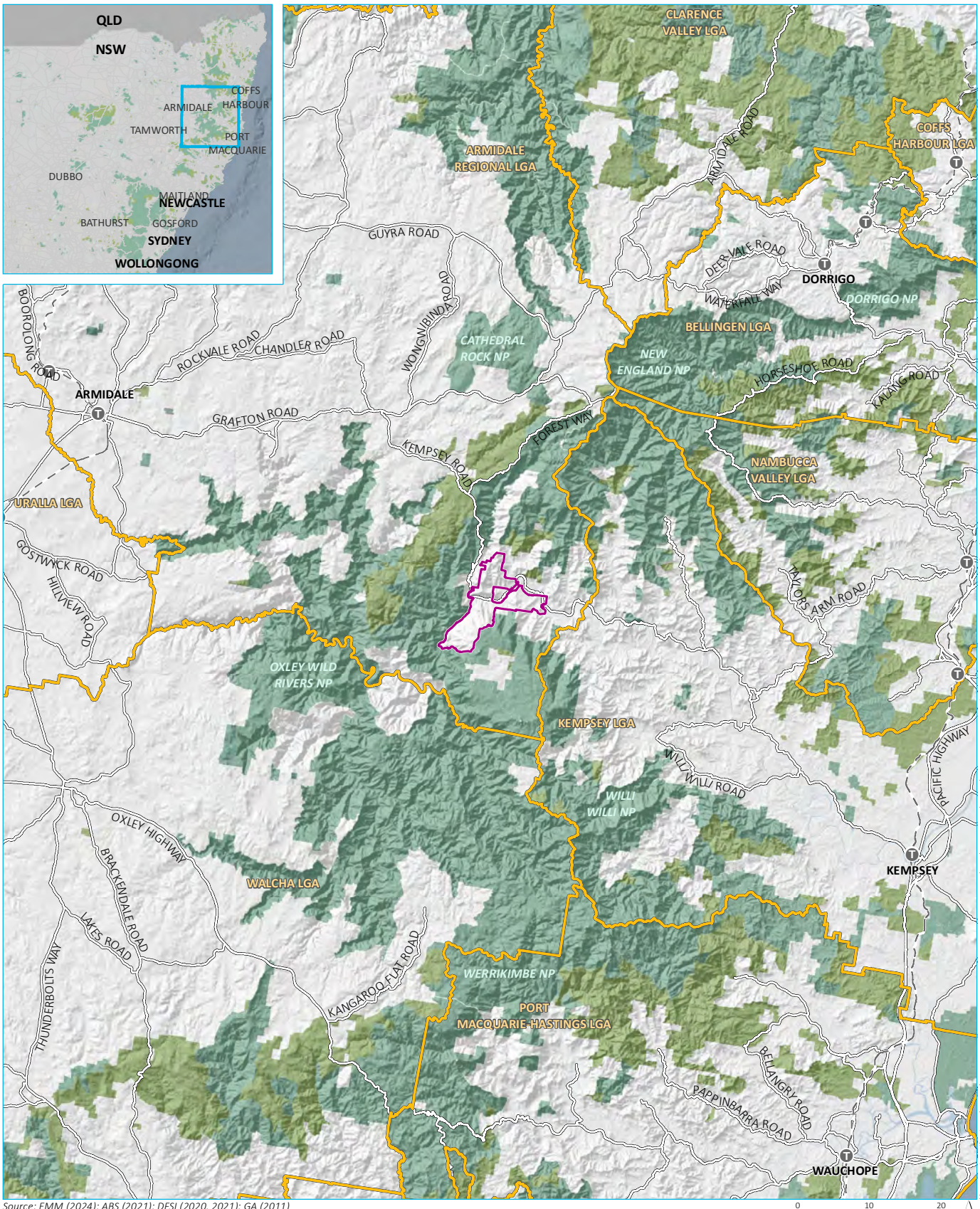
Figure 1.1 and Figure 1.2 provide the regional and local context of the Project respectively.

At a basic level, the Project will consist of upper and lower water reservoirs and an underground waterway connecting them via a hydro-electric power station. The Project will utilise the highly favourable natural terrain of the site to allow electrical energy from the main grid to be stored by pumping water from the lower reservoir to the upper reservoir. Energy can then be generated when needed by allowing water to flow back down to the lower dam and reservoir via the hydro-electric power station, effectively enabling the Project to act as a large battery.

The Project has been declared by the New South Wales (NSW) Government to be critical State significant infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Infrastructure projects are declared to be CSSI if, in the opinion of the NSW Minister for Planning, they are essential to the State for economic, environmental, or social reasons. By providing up to 900 megawatts (MW) of electricity generating capacity, the Project will aid in the transition of the National Electricity Market (NEM) towards cleaner, more reliable and affordable electricity. It will also provide between 8 and 12 hours of dispatchable energy at full generation to be stored and made available to the NEM through the New England REZ. The expected operational lifespan of the Project is in excess of 100 years.

1.2 Proponent

OMPS Pty Ltd (ABN 22 160 259 174) is developing the Project and is located at 2/28 Clyde Street, Kempsey NSW 2440.



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Train station
- Rail line
- Major road
- Named waterbody
- Local government area
- NPWS reserve
- State forest

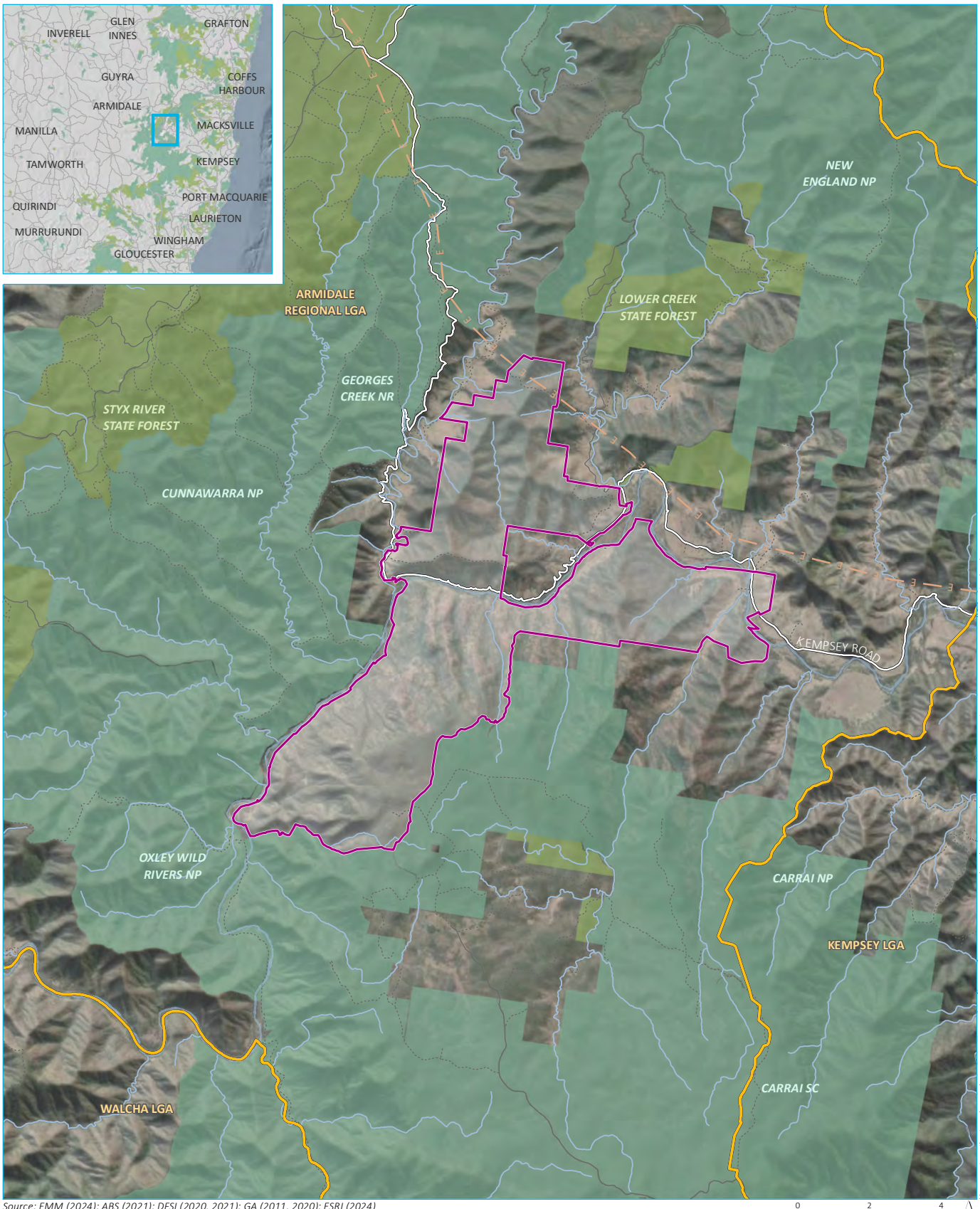
INSET KEY

- Major road
- NPWS reserve
- State forest

Regional setting

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 1.1

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); ESRI (2024)

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KEY

- Project area
- Existing transmission line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Named waterbody
- Local government area
- NPWS reserve
- State forest

INSET KEY

- Major road
- NPWS reserve
- State forest

The Project area - local context

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 1.2

EMM creating opportunities

1.3 Purpose of this report

This Biodiversity Development Assessment Report (BDAR) documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise associated impacts to terrestrial biodiversity, and the mitigation, and management measures, including offset requirements, proposed to address any unavoidable residual impacts. The BDAR is an appendix to the Project's environmental impact statement (EIS) and should be read in conjunction with it. The EIS was publicly exhibited between September and October 2023. Following exhibition, amendments to the Project have been made to respond to submissions raised during exhibition as well as incorporating a more detailed design and construction review of project elements. This BDAR therefore assesses the amended Project.

The specific objectives of this assessment are to:

- describe biodiversity values of the Project area
- assess the likelihood that threatened species and communities (threatened biodiversity) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) could occur in the disturbance footprint
- document the strategies implemented to avoid and/or minimise impacts of the Project on threatened biodiversity
- assess residual threatened biodiversity impacts, after avoidance and minimisation strategies have been implemented
- provide environmental safeguards to mitigate threatened biodiversity impacts during construction and operation
- describe the offsets and other compensatory measures that are appropriate for the Project.

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM) (DPIE, 2020a).

1.4 Assessment guidelines and requirements

This BDAR has also been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued by the former Department of Planning and Environment (DPE) (now the Department of Planning, Housing and Infrastructure (DPHI)) on 10 June 2022. To inform preparation of the SEARs, the Department invited relevant government agencies to advise on matters to be addressed in the EIS. These matters were taken into account by the Secretary for the Department when preparing the SEARs. Table 1.1 lists the matters relevant to this assessment and where they are addressed in the report.

Table 1.1 Relevant matters raised in SEARs

Terrestrial Biodiversity and Ecology Requirements	Sections where addressed
Key Matter – Biodiversity: • An assessment of the biodiversity impacts of the Project on terrestrial, aquatic and groundwater-dependent ecosystems, including listed Commonwealth and State threatened species and communities and listed Commonwealth migratory species, and impacts on National Parks and Reserves and World Heritage Areas), and Appendix A of the SEARs. • A strategy to offset the residual impacts of the Project on these ecosystems.	Assessment of biodiversity impacts is addressed in Chapter 8 with residual impacts outlined in Chapter 11. Assessment of aquatic biodiversity impacts is addressed in Appendix J in the EIS. Assessment of ground water dependent ecosystems is addressed in Appendix I in the EIS and summarised in Chapter 7. Assessment of impacts on National Parks and Reserves and World Heritage Areas is addressed in Appendix V of the EIS. A strategy to offset the residual impacts of the project is outlined in Chapter 12.
Impacts 10. The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including: i. a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts ii. a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible iii. analysis of the significance of the relevant impacts iv. any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Assessment of biodiversity impacts is addressed in Sections 8.1 and 8.2.
Avoidance, mitigation and offsetting 11. For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: i. a description, and an assessment of the expected or predicted effectiveness of the mitigation measures ii. any statutory policy basis for the mitigation measures iii. the cost of the mitigation measures iv. an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing v. the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	General avoidance and mitigation is detailed in Section 8.3. A strategy to offset the residual impacts of the project is outlined in Chapter 12.
12. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	Residual impacts are outlined in Chapter 11. The significance of these impacts are assessed in Section 13.1. A strategy to offset the residual impacts of the project, including significant residual adverse impacts to Matters of National Environmental Significance (MNES) listed under the EPBC Act, is outlined in Chapter 12.

Terrestrial Biodiversity and Ecology Requirements	Sections where addressed
13. For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: i. conservation advice or recovery plan for the species or community ii. relevant threat abatement plan for the species or community iii. wildlife conservation plan for the species iv. any strategic assessment.	Addressed in Section 13.1
Assessment Requirements 14. The EIS must identify each EPBC Act listed threatened species and community and migratory species likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the Project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	Addressed in Section 13.1
15. Further analysis of the impacts of the 2019–2020 bushfires on EPBC Act listed threatened species and communities should be undertaken during the assessment. Further assessment will determine whether the remaining habitat within the proposed action area is of substantially greater importance to the survival of the listed threatened species following the fires and/or whether the population of the species in the area is considered an important population. This information, once obtained, can be considered when determining avoidance, mitigation and offset measures for these species.	Addressed in Section 6.3.4 and Section 13.2.2
16. For each of the EPBC Act listed threatened species and ecological communities and migratory species likely to be impacted by the proposed action the EIS must provide a separate: i. Description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans. ii. Details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements. iii. Description of the relevant impacts of the action having regard to the full national extent of the species or community's range. iv. Description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action. v. Identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account. vi. A description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established. vii. Details of how the current published NSW Biodiversity Assessment Method (BAM) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts. viii. Details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the BAM and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	i Is addressed in Section 13.1. ii Is addressed in Section 6.3.3. iii Is addressed in Chapter 8. iv Is addressed in Section 8.3. v Is addressed in Chapter 12. vi Is addressed in Chapter 12. vii Is addressed in Chapter 12. viii Is addressed in Chapter 12.
17. Any significant residual impacts not addressed by the BAM may need to be addressed in accordance with the EPBC Act 1999 Environmental Offset Policy. http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy	Addressed in Section 13.1

This assessment also considers relevant governmental assessment requirements, guidelines and policies, and was prepared in consultation with the relevant government agencies.

1.4.2 Response to submission summary

This BDAR also addresses the submission made on 22 November 2023 by Biodiversity, Conservation and Science (BCS) of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW), formerly the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment (DPE). The key changes made to this BDAR as a response to the comments and recommendations put forward by BCS are summarised in Table 1.2, which also lists where they have been addressed in the report.

Table 1.2 Key changes made to this BDAR since exhibition

Identifier	Recommendation	Response summary	Section addressed
2.1	The BDAR be revised to remove the incorrect terminology which reports 'occupied' and 'potential' brush-tailed rock-wallaby denning habitat and these habitat categories be combined and correctly referred to as 'actual brush-tailed rock-wallaby denning and refuge (critical) habitat.'	Report has updated the terminology and reassessed the impacts to the Brush-tailed Rock-wallaby, taking into consideration the updates to avoidance measures associated with the project design changes.	Section 8.3.1, Section 9.4 and Section 13.1.2.
2.4	The proponent consults with BCS to identify additional and appropriate measures to avoid and minimise the likely SAII on the brush-tailed rock-wallaby and P*ultenaea rubescens* and document these in the RTS report.	Report has been updated post consultation.	Section 8.3.1, Section 9.2, Section 9.4 and Section 13.1.2.
3.1	The BDAR be revised to include further information to determine whether the proposal will result in a SAII for wandering pepper cress.	Additional information provided.	Section 9.1
4.1	The construction envelope be reduced to align with the disturbance footprint in locations containing threatened flora species, SAII entities, and critical habitat for SAII entities.	Construction envelope has been reduced to avoid critical SAII habitat where possible.	Section 2.3
5.1	The BDAR be revised to map the species polygon for *Pultenaea rubescens* in line with the requirements of the BAM and remove all reference to 'occupied' and 'potential' habitat within that species polygon.	Species polygon has been updated, including habitat terminology.	Figure 6.7
5.2	The revised BDAR clarify how the species polygon for wandering pepper cress (*Lepidium peregrinum*) was mapped in accordance with the BAM, with consideration of the vegetation zone mapping in Figure 5.1 of the BDAR.	Species polygon has been updated, including PCT association.	Figure 6.6

Identifier	Recommendation	Response summary	Section addressed
5.3	The BDAR be revised to map species polygons for brush-tailed phascogale (*Phascogale tapoatafa*) in accordance with section 5.2.5 of the BAM and the requirements of the TBDC	Species polygon has been updated to include all associated PCTs vegetation zones where this species was recorded.	Figure 6.16
6.3	Additional information be provided in a revised BDAR on prescribed impacts on downstream aquatic and riparian biota, including threatened species and ecological communities, or their habitats, arising from reducing the streamflow of the Macleay River and from operational discharges to the river associated with the project.	Additional information included.	Section 8.2.3
6.4	Information be provided in a revised BDAR and RTS report on how the proponent proposes operating the pumped hydro system during extended periods of drought without the required water top ups of the reservoirs from the Macleay River, to ensure the biodiversity impacts during operations are fully assessed.	Additional information included.	Section 8.2.3
6.5	The BDAR be amended to include an assessment of the potential impacts of *Phytophthora cinnamomi* on *Pultenaea rubescens* from the various disturbances associated with the project.	Included as an indirect impact.	Section 8.1.3 and 8.3.2
7.1	The BDAR be revised to determine the presence of candidate threatened flora species in all areas of unsurveyed 100 metre (m) grid intersection locations by surveying, by assuming presence or by obtaining an expert report.	All threatened flora survey area have been completed within the construction envelope.	Section 6.3.3. and Figure 6.1.
8.1	The BDAR be revised to include the Eastern cave bat as a candidate species for all IBRA subregions on the project site within the subject land.	This species was added as a candidate species.	Table 6.2
8.2	The BDAR be revised to include a SAII assessment for the Eastern cave bat for any impacts to its breeding habitat (caves, cliffs, scarps, and rock overhangs including a 100m buffer).	This species is not considered to be present within the project area.	Section 6.3.6
9.1	A revised BDAR demonstrate that a minimum of one BAM plot has been completed in the mapped northern-most extent of the area mapped as PCT 868 to determine if this is the correct PCT and to provide data to determine the vegetation integrity score.	No BAM Plot was undertaken at this location, a plot using benchmarks for this PCT will be applied in the BAM-C.	Figure 5.1

Identifier	Recommendation	Response summary	Section addressed
10.1	The BDAR be revised to include assessments of impacts from stormwater and surface water discharge points on threatened flora, threatened flora habitat, and EECs known to occur on the project site.	Impacts updated in report.	Section 8.1.3 & 8.2.3
11.1	Positive identification of the Cryptic Forest Twiner (*Tylophora woollsii* or *Tylophora* sp.*) be determined and the BDAR revised as required.	Further surveys and genetic analysis couldn't confirm positive identification of this species.	Section 6.3.3 and 6.3.5
12.1	The data and information inconsistencies in the BDAR identified in this response be reviewed and corrected.	Updated in report.	Table 6.1, Table 6.10. and Section 8.3.
13.1	Additional information is required to enable BCS to assess the project under the bilateral agreement with the Australian Government.	Reference to sections where this has occurred has been updated.	Section 13.1
14.1	The BDAR be revised to correct the information used in assessments of significance for MNES and rectify the issues described in Attachment 2 of this response.	Updated in report.	Table 13.10, Table 13.12, and Table 13.20
15.1	Further information be provided in a revised BDAR to demonstrate how species richness was determined in accordance with the EPBC Act listing advice for Lowland Rainforest of Subtropical Australia (DSEWPaC, 2011a).	Data updated.	Table 5.10

1.5 Other relevant reports

This BDAR has been prepared with reference to other technical reports that were compiled as part of the EIS. The other relevant reports referenced in this BDAR are listed below:

- Aquatic Ecology Assessment (EMM, 2022a) – appended to the EIS
- Groundwater Assessment (EMM, 2022b) – appended to the EIS
- Noise and Vibration Impact Assessment (EMM, 2022c) – appended to the EIS
- Soils and Land Capability Assessment (EMM, 2022d) – appended to the EIS
- Traffic Impact Assessment (EMM, 2022e) – appended to the EIS
- Surface Water Assessment (EMM, 2022f) – appended to the EIS
- Groundwater Dependent Ecosystems (EMM, 2023) – appended to the EIS.

1.5.1 Other information sources

The main sources of pre-existing data used to inform this assessment, including databases, spatial datasets and previous reports are listed below.

i Publications and databases

In order to provide context for the Project, data about flora and fauna species, populations, communities and habitats from the locality were obtained from the following databases:

- NSW BioNet (Department of Planning, and Environment; DPE):
  - BioNet Atlas – threatened species records
  - BioNet Threatened Biodiversity Data Collection
  - BioNet Vegetation Classification database – Plant Community Types (PCTs)
- NSW Threatened biodiversity profile search (DPE)
- Protected Matters Search Tool (PMST) (Department of Climate Change, Energy, the Environment and Water; DCCEEW)
- Commonwealth Species Profile and Threats Database (DCCEEW)
- Directory of Important Wetlands: Nationally Important Wetlands (DCCEEW, 2005)
- NSW Wetlands (DPIE, 2018)
- Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology (BoM))
- PlantNET (The NSW Plant Information Network System) (Royal Botanic Gardens and Domain Trust)
- Atlas of Living Australia (National Collaborative Research Infrastructure Strategy (NCRIS) and CSIRO)
- Google Earth aerial images for the Project area and locality.

ii Spatial data

Spatial data defining the disturbance footprint was obtained from OMPS. Base map data was obtained from the Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI.

The following spatial datasets were utilised during the development of this report:

- NSW State Vegetation Type Map (DPE, 2022a)
- Vegetation Map for the Northern Rivers CMA VIS_ID 524 (NRCMA, 2010)
- Mitchell Landscapes Version V3.1 (OEH, 2016a)
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DCCEEW, 2017).

Mapping was undertaken using a hand-held GPS unit, Collector for ArcGIS™ and Survey123 for ArcGIS™ installed on mobile tablet computers and mobile phones, and aerial photo interpretation. Accuracy of GPS devices is generally ±5 m. Mapping has been produced using a Geographic Information System (ArcGIS 10.5).

1.6 Declarations

1.6.1 BAM contributors

The following key people contributed to this BDAR and the associated biodiversity assessment.

Table 1.3 Key personnel involved in preparing this BDAR

Name	Qualifications	Experience	Role
Nathan Garvey	BSc, GradDip (BioSci) BAM Accredited Assessor (BAAS17037)	22 years	Technical guidance and review
Jason Brown	BSc, (Env mgn/GeoSci) BAM Accredited Assessor (BAAS21017)	18 years	Lead author Field surveys
Ross Davey	BSc.	3 years	Field surveys Report preparation
Paul Rossington	BSc, (Biology) BAM Accredited Assessor (BAAS18065)	18 years	Field surveys Technical guidance Review
Amy Rowles	BSc, (Honours)(Ecology)	26 years	Ultrasonic bat call analysis
Nicole McVicar	BSc, Bush Regeneration Certificate II BAM Accredited Assessor (BAAS18077)	15 years	BAM Plot surveys Targeted flora surveys
Brendan Ryan	BSc, (Ecology) Master of Science (Ecology) BAM Accredited Assessor	25 years	Bird surveys Mammal surveys Targeted flora surveys
Simone Popp	BSc. 12 years handling dogs and caring for koalas 5 years Koala feed tree collection	12 years	Koala detection dog handler
Claire Chiotti	BASd 18 years animal training and handling experience 5 years training and handling Koala detection dogs	18 years	Koala detection dog handler
Mark Phillips	Licence: ARN/REPL/AROC-835759	Flight hours: 800+ hours 200+ night hours for thermal Koala and fauna survey	Drone pilot for Koala, forest owls and Glossy Black-Cockatoos

Name	Qualifications	Experience	Role
Cecilia Phu	Bsc (Hons) Biology BAM Accredited Assessor (BAAS17058)	17 years	Review
Bianca Morton	BSc, GradDip (GIS) BAM Accredited Assessor (BAAS23008)	5 years	BDAR updates

1.6.2 Certification under clause 6.15 Biodiversity Conservation Act 2016

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method (DPIE, 2020a) and Clause 6.15 of the BC Act.

Name: Jason Brown

Date: 19 August 2024

BAM Assessor Accreditation no: BAAS21017

1.6.3 Conflict of interest

As per the Accredited BAM Assessor Code of Conduct, BAM Accredited Assessors must not act in circumstances where there is actual, perceived, or potential conflict of interest. I declare that I have considered the circumstances and there is no actual, perceived, or potential conflict of interest. This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

2 The Project description

2.1 Project overview

The Project involves building two 'off river' water containment structures to create an upper and a lower reservoir (referred to as 'the upper dam and reservoir' and 'the lower dam and reservoir'), on an ephemeral tributary of the Macleay River. An underground hydro-electric power station complex will be connected to the reservoirs by infrastructure including a power waterway and tunnels. During operation, the water will enable the generation of electricity as it passes through the underground power station while moving from the upper to the lower reservoir, from where it is pumped back up via the same waterway in a 'closed-loop circuit'. The pumped hydro system will be connected to the existing transmission network via new overhead high voltage transmission lines.

A detailed description of the Project and its strategic context is provided in the Project's EIS which should be read in conjunction with this report.

An overview of the key components and elements are provided below.

2.2 Key Project design elements

The Project will result in the creation of permanent infrastructure, both above and below the ground, which is required to operate the Project. The design of the infrastructure elements has taken into account the existing environment with careful consideration of its values, as well as maintaining public access during construction and operation to valued areas such as the National Trail along the Macleay River and Georges Junction campground.

Broadly, the Project has been categorised into three key components, which are further broken down into the Project's key elements in Table 2.1 and shown in Figure 2.1:

- pumped hydro-electric and generation works (PHGW) – including
  - new upper and lower water storage dams, reservoirs and spillways
  - a new underground pumped hydro-electric power station and transformer hall
  - pressure shaft, water tunnels, access tunnels, portals and adits
  - tailrace surge shaft
  - intake and outlet structures
  - associated gates, shafts and screens
- transmission connection works – including:
  - new electricity transmission lines to connect the generation works to the existing electricity transmission network (Line 965)
  - a switchyard and substation
- ancillary development – including but not limited to:
  - access roads, two temporary bridges and two permanent bridges
  - on-site quarries, spoil emplacement areas, rock processing/crushing facilities and related infrastructure

- utilities and communications infrastructure
- construction pads containing assets such as workshops, concrete batching plants (CBPs), and offices
- laydown and storage areas
- construction accommodation (including temporary fly camps)
- pumping infrastructure
- operational facilities such as offices, and camps for staff
- construction and operational power and water supplies.

Table 2.1 Key Project elements

Project element	Description
Pumped hydro-electric and generation works	
Underground power station complex	An underground pumped hydro-electric power station located below the upstream end of the pumped hydro system to optimise the hydraulic arrangement of the Project. The power station complex consists of: • two main caverns, comprising: – the machine hall – the transformer hall • interconnecting tunnels and isolated phase busbar (IPB) galleries.
Dams and reservoirs	Two concrete faced rockfill dams (CFRD) and reservoirs, referred to as the upper dam and reservoir and lower dam and reservoir, with the following specifications:
	Upper dam and reservoir: • CFRD approximately 70 m high and 780 m long. A polymer or asphalt based liner may be added to the upstream face and/or base of the reservoir to prevent water losses. • reservoir covering a total area of approximately 20 hectares (ha) and an inundation extent of approximately 16.7 ha • reservoir height of approximately 881 m Australian Height Datum (AHD) at full supply level (FSL) and approximately 830 m AHD at minimum operating level (MOL) • total reservoir storage capacity of around 5.1 gigalitres (GL) at FSL.
	Lower dam and reservoir: • CFRD approximately 70 m high and 280 m long • reservoir covering a total area of approximately 24.7 ha and an inundation extent of approximately 21.6 ha • reservoir height of 250 m AHD at FSL, 215 m at MOL and 205 m AHD at lowest operating level (LOL) • total reservoir storage capacity of around 6.5 GL at FSL.
Water intake structures	Two intake structures, one at each reservoir, including: • a morning glory, vertical-type intake structure provided of a hood to prevent vorticity, situated at the upper dam and reservoir • a lateral intake structure, with head gates and stoplog slots, and an intake channel, at the lower dam and reservoir.
Spillways	Two concrete lined spillway chutes, one for each of the upper and lower dams and reservoirs. Both spillway crests will comprise of ungated ogee-shaped overflow weirs on the upstream ends of the spillway chutes.

Project element	Description
Macleay River pump facility	A pump facility on the edge of the Macleay River, which will include an access road, duty and standby pumps for the initial fill and for ongoing reservoir top-ups as required.
Tunnels	Three main tunnels comprising of: • main access tunnel (MAT) • emergency, cable, ventilation tunnel (ECVT). • tailrace surge shaft ventilation tunnel (TSSVT) connected to the ECVT. The MAT will provide loop access to the power station complex from the MAT portal. The ECVT will provide services access and egress between the switchyard portal and the transformer hall. The ECVT portal will contain the station switchyard, control rooms, ventilation and firefighting equipment, with blast walls separating important equipment. The TSSVT will provide service access to the tailrace surge shaft, as well as ventilation service to the surge shaft.
Power waterway	The power waterway will consist of: • an approximately 660 m deep, 6.4 m hydraulic diameter concrete lined vertical pressure shaft • an approximately 130 m long concrete lined high-pressure headrace tunnel, varying from 6.4 to 4.5 m diameter after the bifurcation • four 130 m long steel penstock tunnels, varying from 2.9 to 2.3 m diameter • four 60 m long steel draft tube tunnel at the exit of the draft tube cone an approximate 130 m long steel tailrace up to the tailrace surge shaft • an approximate 155 m deep and 18 m inner diameter surge shaft • an approximately 1,600 m long concrete lined tailrace tunnel.
Transmission connection works	
Connection works	The connection works will consist of: • an approximately 15 km long transmission alignment comprising, at a maximum, double circuit single tower 330 kV overhead infrastructure and single circuit single tower 132 kV overhead infrastructure connecting to Transgrid Line 965 • up to 25 transmission tower sites (approximately 50 m x 50 m) containing the 132 kV and 330 kV infrastructure • a transmission easement width of a maximum of approximately 105 m. Note: The upgrade of existing Line 965 will be the subject of a separate application.
Sub-station	Construction of a substation and associated connection infrastructure of up to 330 kV rating.
Switchyard	• A high voltage connection linking the connection transmission lines to the cables exiting the underground power station complex. The outdoor air insulated switchyard will likely include: – switchgear and control room – cable potheads – disconnector/earth switches – capacitive voltage transformer (VT) – lightning protection – security fencing, lighting and surveillance • surge arrestor.

Project element	Description
Ancillary development (construction and operation)	
Access roads, access tracks and bridge	A variety of road works to improve existing access, and construction of new permanent roads to enable construction access, temporary establishment and use of construction sites, and general access to the Project area including transmission line infrastructure.
	The proposed main access will be via the construction of a new unsealed two-lane access road located to the east of the site (the Eastern Access Road (EAR)). The Main Access Road (MAR) will interface with the existing Kempsey-Armidale Road and will require the construction of two new single- or two-lane low--level bridge crossings over the Macleay River (referred to as Smiths Bluff Bridge and Carrolls Creek Bridge). A temporary bridge will be utilised prior to the construction of the Smiths Bluff permanent bridge (referred to as Eastern Access Temporary Bridge).
	A secondary, temporary access is proposed via the construction of a new, temporary bridge crossing of the Macleay River about 600 m upstream and north-west of Georges Junction (referred to as Western Access Temporary Bridge).
Surface works pads and facilities	There are four main construction pads in addition to surface portals which will be used temporarily during construction for different services (accommodation camp, construction site offices, workshop area, and laydown storage).
	Construction works will require the establishment of the following ancillary support infrastructure and areas: • main accommodation camp, which will temporarily accommodate the majority of workers as required throughout the construction period • temporary or fly camps that may be required prior to the main accommodation camp being constructed • works areas, which will contain ancillary facilities such as CBPs, mechanical and electrical workshops, a laboratory and various water treatment and wash areas • temporary stockpiling areas • permanent spoil emplacement areas, which prior to spoil placement may also be used as temporary works areas • staging areas • temporary site offices to be used during construction.
Communications	• Construction water will be supplied to water storage systems either via groundwater bores, or via pumping of water from the Macleay River to support camp operations, the CBP, dust suppressions and other activities across the site. Construction power will be supplied primarily by use of portable diesel generators and supported where possible by leveraging off existing electricity distribution infrastructure running through the generation site.
Utilities during construction	• Alignment and length of utilities (electricity, water, etc.) will be combined into a single corridor (total length of about 5.4 km).
Utilities for operation	• Site drainage will include a combination of cross drainage culverts, drainage pits and pipe, open channels/open drains (vegetated, rock-lined or concrete), levees/bunds, and detention basins. • Various water treatment plants will be used for construction drainage and water treatment facilities – for the main accommodation camp, temporary or fly camps, CBP, tunnel, etc. Specific discharge locations are planned for stormwater and surface water runoff and will be determined during detailed design or construction planning.
Water diversion and water treatment facilities	• Temporary laydown/stockpile areas will be utilised across the Project area, with a total allocated stockpile area of around 119,600 m^2.
Laydown/stockpile areas	Temporary laydown/stockpile areas will be utilised across the Project area, with a total allocated stockpile area of around 119,600 m^2

Project element	Description
Spoil emplacement areas	Primary operation of the Project can be undertaken remotely and will require minimal onsite operational staff, other than for maintenance activities. Operational facilities include maintenance housing, work area, car parking, workshop and storage, control room and switchgear, water treatment plant, office area, heating, ventilation and air conditioning (HVAC), backup generators and Macleay River pump facility.
Ancillary operational facilities	• Construction water will be supplied to water storage systems either via groundwater bores, or via pumping of water from the Macleay River to support camp operations, the CBP, dust suppressions and other activities across the site. Construction power will be supplied primarily by use of portable diesel generators and supported where possible by leveraging off existing electricity distribution infrastructure running through the generation site.
Other	
Construction	• Construction duration of around four to five years. • Construction workforce of over 600 workers at construction peak.
Rehabilitation	Rehabilitation of areas disturbed during pre-construction and construction will be undertaken progressively where practical during all stages and phases of the Project. Progressive rehabilitation will occur over about 62.7 ha including spoil emplacement areas and areas used for construction ancillary facilities no longer needed during operation. At the end of the Project's life, 194.7 ha in total will be rehabilitated to native ecosystem (including native vegetation and rock landscape). Approximately 152.1 ha will be retained permanently for the water storages and access roads, subject to agreement with relevant landowners/land managers.
Operation	• The Project will provide 900 MW of electricity generating capacity and up to eight hours of energy storage at full generating capacity. • Maintenance and operational activities will include power station operations, infrastructure inspections, maintenance to assets, vegetation management, auditing and compliance and other activities. • It is expected that the operation of the new power station will require around 20 full-time workers, and up to 30 additional contractors for regular and ad hoc maintenance and repairs.
Hours of operation	• Construction of the Project will be 24/7 and 365 days per year. • Operation of the Project will be 24/7 and 365 days per year.
Project timeline	• Construction duration of around four to five years. Construction workforce of over 600 workers at construction peak.
CIV	Rehabilitation of areas disturbed during pre-construction and construction will be undertaken progressively where practical during all stages and phases of the Project. Progressive rehabilitation will occur over about 62.7 ha including spoil emplacement areas and areas used for construction ancillary facilities no longer needed during operation. At the end of the Project's life, 194.7 ha in total will be rehabilitated to native ecosystem (including native vegetation and rock landscape). Approximately 152.1 ha will be retained permanently for the water storages and access roads, subject to agreement with relevant landowners/land managers.

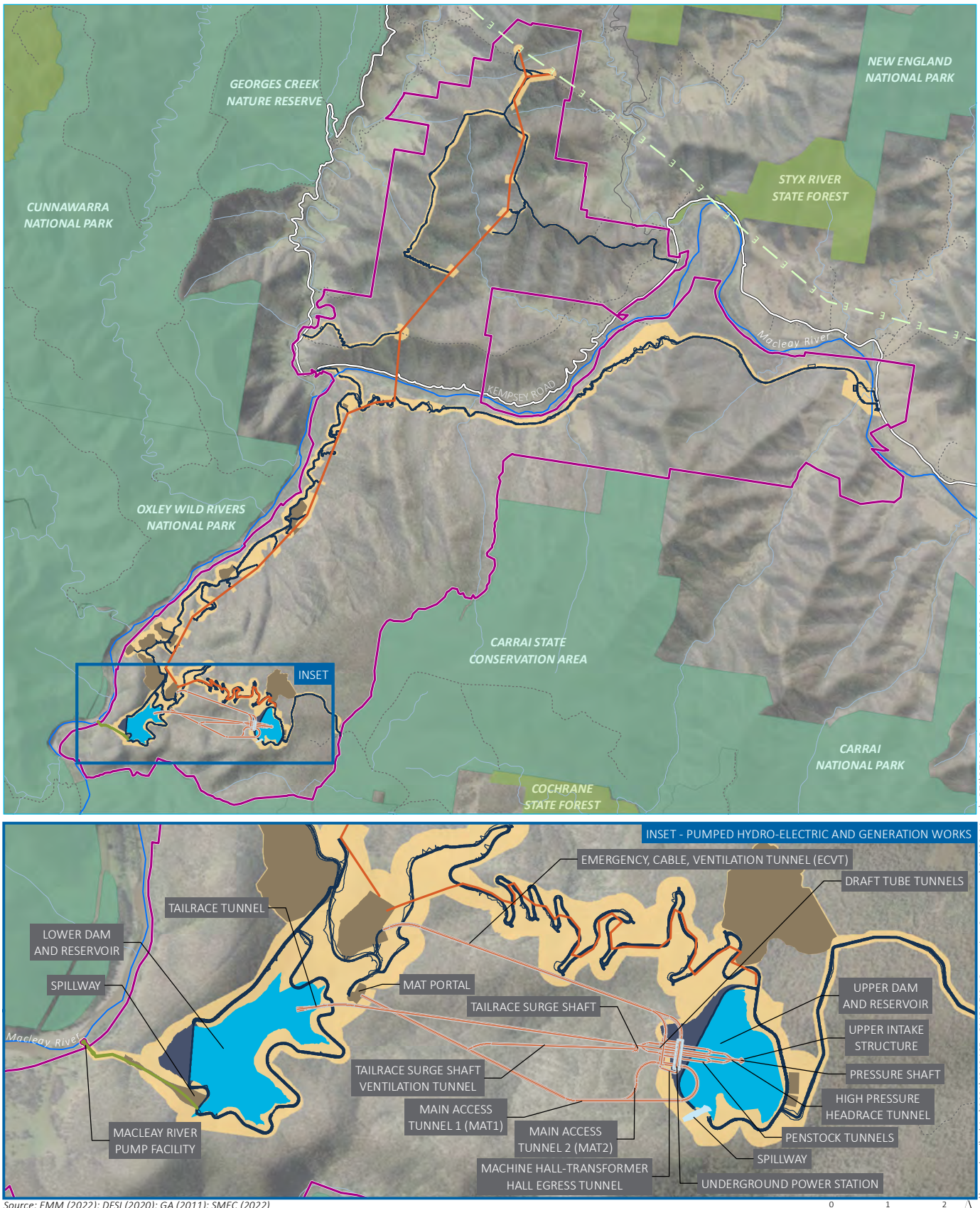
2.3 Project design changes as part of the response to submission stage

An overview of the project amendments in comparison to the Project EIS submission is summarised in Table 2.2.

Table 2.2 Overview of the project amendments in comparison to the Project

Project element	Description of change	Summary of the Project as exhibited in EIS	Summary of the amended Project
Internal roads			
Eastern Access Road (EAR) refinement	Realignment of the EAR to reduce need for earthworks, improve road safety and address drainage issues. This includes extending into areas outside of the proposed EIS construction envelope.	Approximately 11.4 km	Approximately 12.1 km
Temporary bridges	A temporary bridge will be utilised prior to the construction of the two permanent bridges (referred to as Eastern Access Temporary Bridge). A secondary, temporary access is proposed via the construction of a new, temporary bridge crossing of the Macleay River about 600 m upstream and north-west of Georges Junction (referred to as Western Access Temporary Bridge).	One temporary bridge: Eastern Access Temporary Bridge. One permanent bridge.	Two temporary bridges: Eastern Access Temporary Bridge (EATB) and Western Access Temporary Bridge (WATB). One permanent bridge.
Upper Dam Access Road (UDAR) refinement	Realignment of the UDAR to allow more feasible heavy vehicle access and to address drainage issues. This includes extending into areas outside of the proposed EIS construction envelope.	Approximately 7.1 km	Approximately 6.4 km
Construction			
Temporary or fly camps	It is anticipated up to three fly camps may be required and located near Smith's Bluff, the intersection of the Main Access Road and the EAR and the upper reservoir (within spoil emplacement area). The camps will accommodate up to 20 workers and be established within the first year of construction and decommissioned following completion of the main accommodation camp. All services will be trucked in and out of the sites, with no permanent facilities or services proposed.	Temporary or fly camps may be required. The location and size will be documented during the detailed design phase.	Three temporary or fly camps will provide small scale temporary work accommodation for workers completing initial road works until the main accommodation camp is completed. Proposed locations in proximity of EATB, WATB, and Upper reservoir.
Blasting	Allowing blasting as a construction method for road works and other above-ground works.	Blasting required for tunnels and portals.	Blasting required for tunnels and portals, reservoirs and road works.
Construction water requirements	Increasing the estimated water requirements for use in construction (e.g. dust suppression, concrete batching, etc).	Approximately 1 ML/day	Approximately 3 ML/day
Drainage/erosion and sediment control	Allowing sufficient area for retention basins within the construction envelope, in particular for early works. This may include extending into areas outside of the proposed EIS construction envelope.	See 'disturbance footprint'.	See 'disturbance footprint'.
Rock crushing/processing	Rock processing/crushing facilities will be required in the lower reservoir (LR) and upper reservoir (UR) areas to process rock for use in dams.		

Project element	Description of change	Summary of the Project as exhibited in EIS	Summary of the amended Project
Construction envelope	Updates to the construction envelope to accommodate stakeholder feedback, design changes and refined construction requirements.	Approximately 780 ha	Approximately 772 ha
Disturbance footprint	Updates to the disturbance footprint to accommodate stakeholder feedback, design changes and refined construction requirements.	Approximately 330 ha	Approximately 367 ha
Spoil and materials			
Laydown/stockpile areas	There will be four areas used for stockpiling and material laydown. One area is located along the main access road (between transmission towers 14–16), one area is located in proximity to the batching plant, one area is located near Georges Junction, and one is located near the Eastern Access Temporary Bridge on the eastern side of the Macleay River. The largest of the four areas has also been flagged as available for other ancillary uses, to provide further flexibility as the detailed design progresses.	There will be two areas used for stockpiling and material laydown, covering a total area of 114,000 m^2	There will be four areas used for stockpiling and material laydown, covering a total area of 119,600 m^2
Spoil emplacement	TBC	TBC	TBC
Operational footprint	Updates to the operational footprint to accommodate design changes (including permanent spoil emplacement).	Approximately 270 ha	Approximately 276 ha
Operation / generation			
Underground arrangement and sizing for improved generation capacity	The Project will provide up to 900 MW of electricity generating capacity and up to twelve hours of energy storage at full generating capacity.	Up to 900 MW and between 8 and 12 hours of energy storage. Underground arrangement and tunnel sizes reflect lower energy storage capacity.	Up to 900 MW and up to 12 hours of energy storage. Underground arrangement and tunnel sizes reflect greater energy storage capacity. Re-location of MAT portal to align with amended arrangement.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Construction envelope
- Surface works

Project operational elements

- Power station
- Pump station
- Tunnels, portals, intakes, shafts
- Transmission overhead lines
- Permanent road
- Dam wall
- Reservoir
- Spillway

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

Key project elements

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 2.1

EMM creating opportunities

2.4 Project area terminology

Approval for the Project is being sought based on feasibility and concept designs, as is common for projects of this size and scale. To accommodate minor changes and amendments to the design as it progresses, a 'Project area', 'construction envelope', 'disturbance footprint' and 'operational footprint' approach is being adopted for the Project. This approach is aimed at ensuring environmental impacts are assessed as accurately as possible, whilst accounting for the current level of design and the likelihood of design refinements occurring as the Project progresses towards construction. The terms are explained below with the BDAR equivalent terms outlined in Table 2.3.

The *Project area* is the broader area within which the Project will be built and operated, and the extent within which direct impacts from the Project are anticipated. Importantly the Project area does not represent a footprint for the construction works, but rather indicates an area that was investigated during environmental assessments. The Project area has been further divided into different areas to facilitate the assessment of direct impacts from the Project.

The *construction envelope* represents the maximum extent of where disturbance may occur during the construction of the Project. To derive the construction envelope, buffers have been applied to the key Project elements and infrastructure. The buffers used to derive the final construction envelope area reflect the confidence around the current siting of the asset or infrastructure and the likelihood that some minor amendments may be required prior to commencing the construction works as a result of the detailed design. Design updates have removed areas of the construction envelope that occur within rocky cliff areas and floodplains where development wouldn't occur regardless of location within the construction envelope. This removes large areas associated with SAII species and habitat associated with Guthrie's Grevillea. The construction envelope for the Project covers an area of around 772 ha.

Located entirely within the bounds of the construction envelope sits the *disturbance footprint* (subject land), a smaller area that has been derived directly from the current level of design. The disturbance footprint represents the physical disturbance that is expected as part of the construction works. As the design is refined, the final siting of the disturbance footprint can move within the construction envelope, subject to the recommended environmental management measures, and provided it does not exceed any limits in this BDAR or any conditions of approval. The clearance area and associated credit liability is representative of the upper limits of clearance required for the disturbance footprint. No increased credit liability or impacts to threatened species, ecological communities and SAII entities will occur as part of the final design. The disturbance footprint for the Project covers an area of around 367 ha.

Progressively and at the end of construction, temporary components that are required to support the construction of the Project will be rehabilitated and returned to a state representing their previous use. The exceptions to this are the areas required for the permanent operation of the Project, which would be retained (referred to as the *operational footprint*). The operational footprint of the Project covers an area of around 280 ha. Approximately 87 ha would be progressively rehabilitated during and following the completion of construction.

The Project area, construction envelope and disturbance footprint are shown in Figure 2.2. How these elements were used to inform this BDAR are summarised in Table 2.3.

Table 2.3 Project elements referred in this BDAR

Project elements	Definition
Buffer area (equivalent to the assessment area in the BAM)	1,500 m buffer from the footprint of the reservoirs construction and operation areas (area based development) combined with a 500 m buffer on either side of the centreline of the transmission line and access footprints (linear development). Used to assess identify landscape features in accordance with Section 3 of the BAM (DPIE, 2020a).

Project elements	Definition
Project area	The broader area within which the Project will be built and operated. It also includes a larger area of investigation that was required for certain species outside of that described for the construction envelope, such as habitat supporting serious and irreversible impacts (SAII) candidate species.
Construction envelope	The maximum extent of where disturbance may occur during the construction of the Project. It is also the area that was surveyed for ecological values. This included the disturbance footprint and additional adjacent lands to provide context for impacts. Investigations increased to up 100 m from the disturbance footprint if features were observed to contain important habitat such as the nests for birds of prey and roosting features for microbats. All flora species which are candidates for serious and irreversible impacts (SAII) which fall within the construction envelope, and, where practical, threatened flora credit species, have exclusion areas within the construction envelope that ensure no additional direct impacts above what is assessed within the disturbance footprint.
Disturbance footprint (equivalent to subject land in the BAM)	Equivalent to the Project footprint described in the EIS, consisting of a combination of the construction and operational footprints. This is the area which will be directly impacted and which vegetation clearing will occur. The area (ha) of the disturbance footprint will not increase on final design. This is the area that was used to determine direct impacts to biodiversity values.
Generation site	The generation site is in the southern section of the Project area and is comprised of the two reservoirs, the associated construction and operational footprint, not including the access road and transmission line, see top inset in Figure 2.2
Access road	The main access road runs from the Kempsey Road, in the eastern section of the Project area, roughly parallel to the Macleay River, and joins the generation area to the south. Labelled as Eastern Access Road (EAR) in the bottom left inset in Figure 2.2
Transmission Line	The transmission line is located to the north of the generation site. Labelled as Northern Transmission Alignment in the bottom right inset in Figure 2.2

2.5 Project design changes as part of the response to submission stage

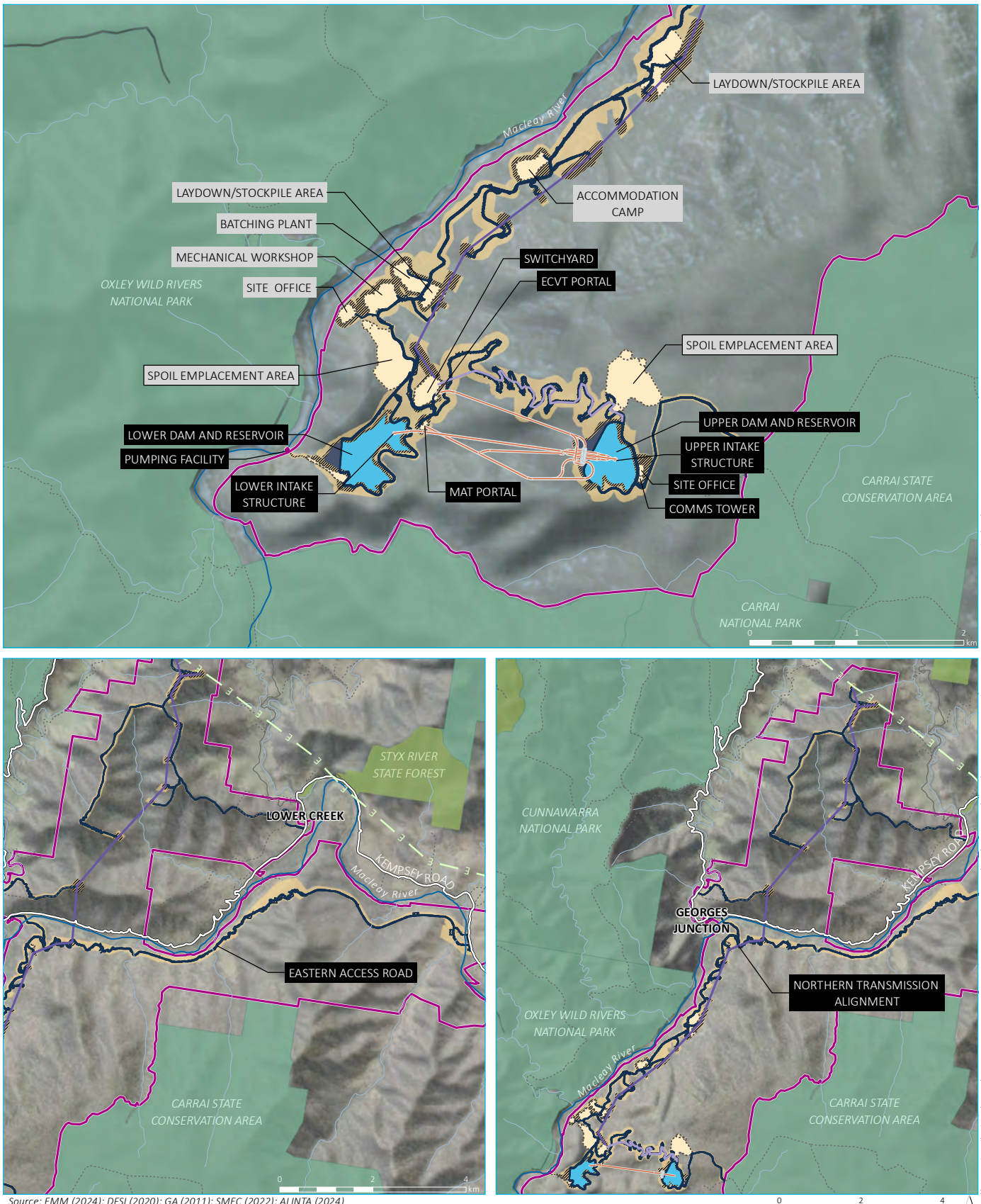
An overview of the project amendments in comparison to the Project EIS submission is summarised in Table 2.4.

Table 2.4 Overview of the project amendments in comparison to the Project

Project element	Description of change	Summary of the Project as exhibited in EIS	Summary of the amended Project
Internal roads			
Eastern Access Road (EAR) refinement	Realignment of the EAR to reduce need for earthworks, improve road safety and address drainage issues. This includes extending into areas outside of the proposed EIS construction envelope.	Approximately 11.4 km	Approximately 12.1 km
Temporary bridges	A temporary bridge will be utilised prior to the construction of the two permanent bridges (referred to as Eastern Access Temporary Bridge). A secondary, temporary access is proposed via the construction of a new, temporary bridge crossing of the Macleay River about 600 m upstream and north-west of Georges Junction (referred to as Western Access Temporary Bridge).	One temporary bridge: Eastern Access Temporary Bridge. One permanent bridge.	Two temporary bridges: Eastern Access Temporary Bridge (EATB) and Western Access Temporary Bridge (WATB). One permanent bridge.
Upper Dam Access Road (UDAR) refinement	Realignment of the UDAR to allow more feasible heavy vehicle access and to address drainage issues. This includes extending into areas outside of the proposed EIS construction envelope.	Approximately 7.1 km	Approximately 6.4 km

Project element	Description of change	Summary of the Project as exhibited in EIS	Summary of the amended Project
Construction			
Temporary or fly camps	It is anticipated up to three fly camps may be required and located near Smith's Bluff, the intersection of the Main Access Road and the EAR and the upper reservoir (within spoil emplacement area). The camps will accommodate up to 20 workers and be established within the first year of construction and decommissioned following completion of the main accommodation camp. All services will be trucked in and out of the sites, with no permanent facilities or services proposed.	Temporary or fly camps may be required. The location and size will be documented during the detailed design phase.	Three temporary or fly camps will provide small scale temporary work accommodation for workers completing initial road works until the main accommodation camp is completed. Proposed locations in proximity of EATB, WATB, and Upper reservoir.
Blasting	Allowing blasting as a construction method for road works and other above-ground works.	Blasting required for tunnels and portals.	Blasting required for tunnels and portals, reservoirs and road works.
Construction water requirements	Increasing the estimated water requirements for use in construction (e.g. dust suppression, concrete batching, etc).	Approximately 1 ML/day	Approximately 3 ML/day
Drainage/erosion and sediment control	Allowing sufficient area for retention basins within the construction envelope, in particular for early works. This may include extending into areas outside of the proposed EIS construction envelope.	See 'disturbance footprint'.	See 'disturbance footprint'.
Rock crushing/processing	Rock processing/crushing facilities will be required in the lower reservoir (LR) and upper reservoir (UR) areas to process rock for use in dams.		
Construction envelope	Updates to the construction envelope to accommodate stakeholder feedback, design changes and refined construction requirements.	Approximately 780 ha	Approximately 7722 ha
Disturbance footprint	Updates to the disturbance footprint to accommodate stakeholder feedback, design changes and refined construction requirements.	Approximately 330 ha	Approximately 367 ha
Spoil and materials			
Laydown/stockpile areas	There will be four areas used for stockpiling and material laydown. One area is located along the main access road (between transmission towers 14–16), one area is located in proximity to the batching plant, one area is located near Georges Junction, and one is located near the Eastern Access Temporary Bridge on the eastern side of the Macleay River. The largest of the four areas has also been flagged as available for other ancillary uses, to provide further flexibility as the detailed design progresses.	There will be two areas used for stockpiling and material laydown, covering a total area of 114,000 m2	There will be four areas used for stockpiling and material laydown, covering a total area of 119,600 m2
Spoil emplacement	TBC	TBC	TBC
Operational footprint	Updates to the operational footprint to accommodate design changes (including permanent spoil emplacement).	Approximately 270 ha	Approximately 276 ha

Project element	Description of change	Summary of the Project as exhibited in EIS	Summary of the amended Project
Operation / generation			
Underground arrangement and sizing for improved generation capacity	The Project will provide up to 900 MW of electricity generating capacity and up to twelve hours of energy storage at full generating capacity.	Up to 900 MW and between 8 and 12 hours of energy storage. Underground arrangement and tunnel sizes reflect lower energy storage capacity.	Up to 900 MW and up to 12 hours of energy storage. Underground arrangement and tunnel sizes reflect greater energy storage capacity. Re-location of MAT portal to align with amended arrangement.



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Source: EMM (2024); DFSI (2020); GA (2011); SMEC (2022); ALINTA (2024)

KEY

- Project area
- Disturbance footprint
- Construction envelope
- Surface works

Project operational elements

- Underground power station complex
- Power and communications lines
- Transmission overhead lines
- Tunnels, portals, intakes, shafts
- Permanent road
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Vehicular track
- Existing transmission line
- NPWS reserve

Label format

- SURFACE PERMANENT INFRASTRUCTURE
- UNDERGROUND PERMANENT INFRASTRUCTURE
- TEMPORARY INFRASTRUCTURE
- PERMANENT SPOIL EMPLACEMENT

Project areas overview

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 2.2

EMM creating opportunities

3 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

3.1 Commonwealth

3.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES under the EPBC Act. These are:

- world heritage properties
- places listed on the National Heritage Register
- Ramsar wetlands of international significance
- threatened flora and fauna species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is referred to DCCEEW for determination as to whether or not it is a controlled action. If deemed a controlled action, the Project is assessed under the EPBC Act and a decision made as to whether or not to grant approval. A 'controlled action' can only proceed with the approval of the Commonwealth Minister for the Environment.

On 1 February 2021, the delegate for the Minister determined that OMPS was a controlled action under Section 75 of the EPBC Act (EPBC 2020/8850). The EPBC Act controlling provisions for the proposed actions are:

- listed threatened species and communities (Section 18 and Section 18A)
- World Heritage properties (Section 12 and Section 15A)
- National Heritage places (Sections 15B and 15C).

On 23 December 2022, the application to vary the proposal was agreed by the delegate for the Minister. This variation included the access road and transmission line into the Project.

The Project will be assessed in accordance with the bilateral assessment agreement between the Commonwealth and NSW.

3.2 State

3.2.1 Environmental Planning and Assessment Act 1979

The NSW EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by DPE.

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs) and local environmental plans (LEPs).

The Project is declared to be CSSI under the EP&A Act. The Minister is the determining authority for this Project.

i State Environmental Planning Policy (State and Regional Development) 2011

The Project has been recognised to be critical to the state for economic, environmental and social reasons. For this reason, it was declared to be critical State significant infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 4 September 2021.

ii State Environmental Planning Policy (Biodiversity and Conservation) 2021

The State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP) was ratified on 1 March 2022 and consolidates, transfers and repeals provisions of numerous SEPPs, which includes the former State Environmental Planning Policy (Koala Habitat Protection) 2020 (Koala SEPP 2020) and State Environmental Planning Policy (Koala Habitat Protection) 2021 (Koala SEPP 2021). No policy changes have been made to the Koala SEPPs.

The former Koala SEPP 2020 (now Chapter 3 of the Biodiversity and Conservation SEPP) and 2021 (now Chapter 4 of the Biodiversity and Conservation SEPP) together aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

The two Chapters apply as follows:

1. In nine metropolitan Sydney local government areas (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA Chapter 4 of the Biodiversity and Conservation SEPP applies to all land use zones.

2. Outside of the areas identified above, Chapter 3 applies to all land zoned RU1, RU2, and RU3 (in 74 local government areas).

3. In the regional LGA's (in 74 local government areas) where land is zoned other than RU1, RU2, and RU3, Chapter 4 applies to all other landuse zones.

The Project is not a development application and does not require approval from Council, and thus consideration of Chapter 3 of the Biodiversity and Conservation SEPP is not triggered. Nonetheless, consideration has been given to the potential occurrence and impacts upon the Koala within this report.

3.2.2 Biodiversity Conservation Act 2016

The BC Act is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the BAM, (DPIE, 2020a) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and determine offset requirements. For major projects, use of the BAM is mandatory, unless a BDAR waiver is granted.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- identify the biodiversity values on land subject to proposed development area
- determine the impacts of a proposed development, following all measures to avoid and minimise impacts
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM.

3.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in Section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitat (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in Section 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI, 2013).

The impact of the Project on threatened aquatic species, populations, communities, habitats and KFH has been assessed separately and is presented in the aquatic ecology assessment (Stantec, 2022).

3.2.4 Biosecurity Act 2015

The primary objective of the NSW *Biosecurity Act 2015* is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matters, dealing with biosecurity matters, carriers and potential carriers, and other activities that involve biosecurity matters, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about
- applies to all land within NSW and all waters within the limits of the State
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Northern Tablelands Regional Strategic Weed Management Plan 2017–2022 (NTLLS, 2017) outlines how government, industry, and the community will share responsibility and work together to identify, minimise, respond to and manage weeds within the Northern Tablelands Region, which includes the Project area. The plan also supports regional implementation of the Biosecurity Act.

The provisions of the Biosecurity Act are discussed further in Section 13.3.

Stage 1 – Biodiversity assessment

4 Landscape features

The identification of landscape features was undertaken in accordance with Chapter 3 of the BAM (DPIE, 2020a) and results are summarised within this chapter. The landscape features described in the following sections are summarised in Table 4.1 and shown on Figure 4.1 and Figure 4.2.

Table 4.1 Landscape feature

Landscape feature	Subject site
Method applied for site context components	1,500 m buffer of footprint of the reservoirs and construction & operation areas (area assessment), combined with a 500 m buffer on either side of the centreline of the transmission line and access footprints (linear assessment).
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	NSW North Coast
IBRA subregion	Macleay Gorges, Carrai Plateau and Macleay Hastings.
BioNet NSW landscapes (formerly Mitchell landscapes)	Macleay Escarpment Foothills, Macleay Channels and Floodplains and Tinebank Granites.
Rivers, streams and estuaries	Within the 1,500 m buffer of the reservoirs and construction and operation areas the following mapped segments of Strahler streams include: • 289 (1st order streams) • 145 (2nd order streams including Fingerboard Crossing Creek) • 17 (3rd order streams including Fingerboard Crossing Creek) • 5 (4th order streams) • 5 (6th order streams) • 1 (9th order – Macleay River). Within the 500 m buffer of the transmission line and access footprints the following mapped segments of Strahler streams include: • 331 (1st order streams) • 181 (2nd order streams) • 29 (3rd order streams) • 7 (4th order streams) • 4 (5th order streams including Carrolls Creek) • 4 (6th order streams) • 1 (9th order including Macleay River).
Wetlands	There are no nationally important wetlands within the Project area or buffer area.
Connectivity of different areas of habitat	The subject site is entirely surrounded by extensive areas of native forest; however, in some areas, canopy cover is discontinuous due to a history of clearing for agriculture and forestry operations.
Areas of geological significance and soil hazard	The Project area is part of the Macleay Gorges. The Project area and adjacent areas contain large outcrops with vertical surfaces and deep crevices.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value within the Project area.
Percent native vegetation cover	96.7%

4.1 Landscape features

4.1.1 Bioregions and landscape

The Project occurs within the NSW North Coast IBRA region. The generation site occurs within the Macleay Gorges and Carrai Plateau IBRA sub-regions and the access road and transmission line occur in the Macleay Gorges and Macleay Hastings IBRA sub-regions (Figure 4.2).

The buffer area occurs across four BioNet NSW Landscapes (formerly Mitchell Landscapes) (Figure 4.2):

- Apsley Meta-sediments
- Macleay Escarpment Foothills
- Manning – Macleay Channels and Floodplains
- Tinebank Granites.

The Project area occurs within the Macleay Escarpment Foothills BioNet NSW Landscape; this was the landscape used in this assessment.

4.1.2 Rivers, streams, estuaries and wetlands

The Project area is located within the catchment of the Macleay River. This catchment covers 11,452 square kilometres (km^2) and is bounded to the west by the Great Dividing Range and the inland catchments of the Gwydir and Namoi Rivers. To the south lie the coastal Hastings and Manning River catchments and to the north, the coastal Clarence, Bellinger and Nambucca River catchments.

The buffer area contains the following Strahler stream sections (Figure 4.2):

- Within the 1,500 m buffer the following mapped segments of Strahler streams include:
  - 289 (1st order streams)
  - 145 (2nd order streams including Fingerboard Crossing Creek)
  - 17 (3rd order streams including Fingerboard Crossing Creek)
  - 5 (4th order streams)
  - 5 (6th order streams)
  - 1 (9th order – Macleay River).
- Within the 500 m buffer the following mapped segments of Strahler streams include:
  - 331 (1st order streams)
  - 181 (2nd order streams)
  - 29 (3rd order streams)
  - 7 (4th order streams)
  - 4 (5th order streams including Carroll's Creek)

- 4 (6th order streams)
- 1 (9th order including Macleay River).

The Macleay River is the key waterway within the Project area, occurring along the western boundary of the generation site (Figure 4.2). This permanent waterway has a substratum containing a mixture of rocky, cobble, pebble and sandy sections, with some in-stream vegetation. The riparian zone of the Macleay is largely vegetated along the riverbanks and surrounding foot-slopes, with minor clearing in some areas for agriculture and forestry.

The smaller creeks (5th–3rd order) are largely situated on bedrock with some pooling areas. Riparian vegetation is extensive and intact along the creek banks. The second and first order creeks and drainage lines are minor and comprise vegetated banks with rocky sections.

The buffer area or locality does not contain any nationally important wetlands, local wetlands, or Ramsar wetlands.

4.1.3 Connectivity

The subject site is surrounded by extensive areas of intact native forest (Figure 4.2); however, in some small areas, canopy cover is discontinuous due to a history of minor clearing for agriculture and forestry operations. The generation site is bounded by National Parks Estate to the east, west and south and considered largely intact native vegetation. The access road and transmission line are largely surrounded by intact native vegetation within private landholdings, with some small areas of historical clearing for grazing cattle and forestry operations, particularly on valley floors and lower slopes.

4.1.4 Areas of geological significance

The Project area spans the area from the Carrai Plateau, with maximum elevation of approximately 1,000 metres Australian Height Datum (mAHD) to the Macleay River floodplain.

The escarpment of the Carrai Plateau is dominated by a series of steep scarp slopes ranging between 20 and 30 degrees. It is across this focus area where the majority of the power generation will occur, aided by an average grade of 25%. Incised valleys (generally orientated east-west) separate spurs, extending along the escarpment to the plain. Similar topography is mirrored by the Macleay River in the western catchment focus area, rising to approximately 760 mAHD, undulating over a series of north-south orientated ridgelines.

The Project area and adjacent areas contain large outcrops with vertical surfaces and deep crevices. Substantial cliff lines run to the north and south out of the Project area. No significant cave systems were found in or near the Project area; however, the terrain is difficult to access, and inaccessible in some areas, and may have large crevices and small caves along the cliff lines. There are no karst areas (i.e. limestone cave systems) or sandstone cliff areas known from the locality that would be likely to contain substantial caves.

4.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value, as declared by the NSW Minister for Environment and Heritage, within the Project area.

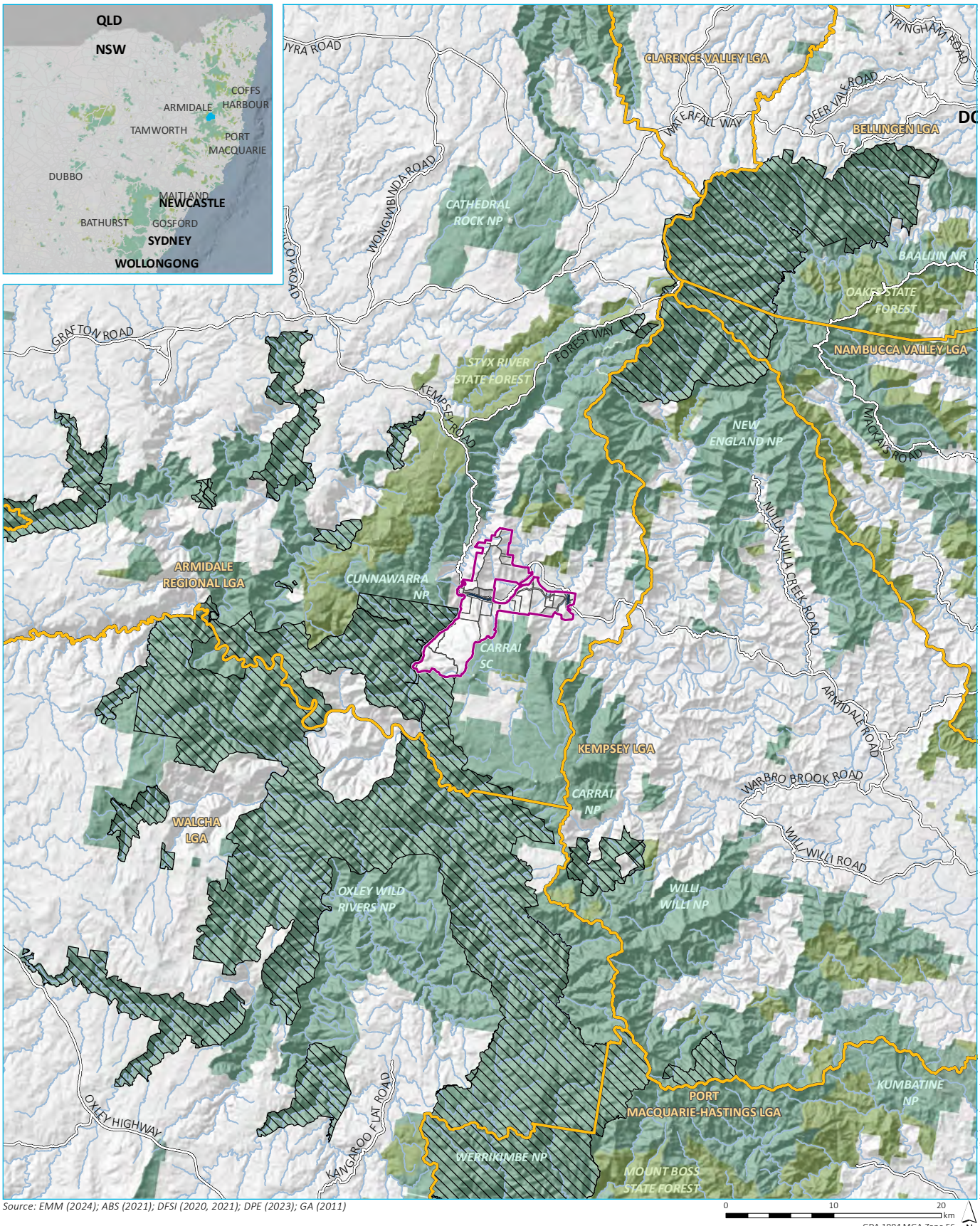
4.2 Assessment of site context

The Project area context has been assessed in accordance with the BAM (DPIE, 2020a).

Mapping of native vegetation within buffer area was undertaken using vegetation mapping collected as a part of surveys, aerial photo interpretation and spatial data from State Vegetation Type Map: nth_rivers_CMA_VISmap_524. Mapping of native vegetation within the buffer areas is shown in Figure 4.2. The area of native vegetation by IBRA sub-regions is shown in Table 4.2.

Table 4.2 Percentage of native vegetation cover

IBRA subregion	Native vegetation in landscape assessment area (ha)	Landscape assessment area (ha)	Percentage of native vegetation in landscape assessment area
Macleay Gorges	4,176.26	4,176.26	100%
Carrai Plateau	961.78	964.65	99.7%
Macleay Hastings	2,403.38	2,654.19	90.6%
Total	7,541.42	7,795.10	96.7%



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); DPE (2023); GA (2011)

0 10 20 km

GDA 1994 MGA Zone 56

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KEY

- Project area
- Named watercourse
- Major road
- Cadastral boundary
- Wetland
- Named waterbody
- Local government area
- Gondwana Rainforest area
- NPWS reserve

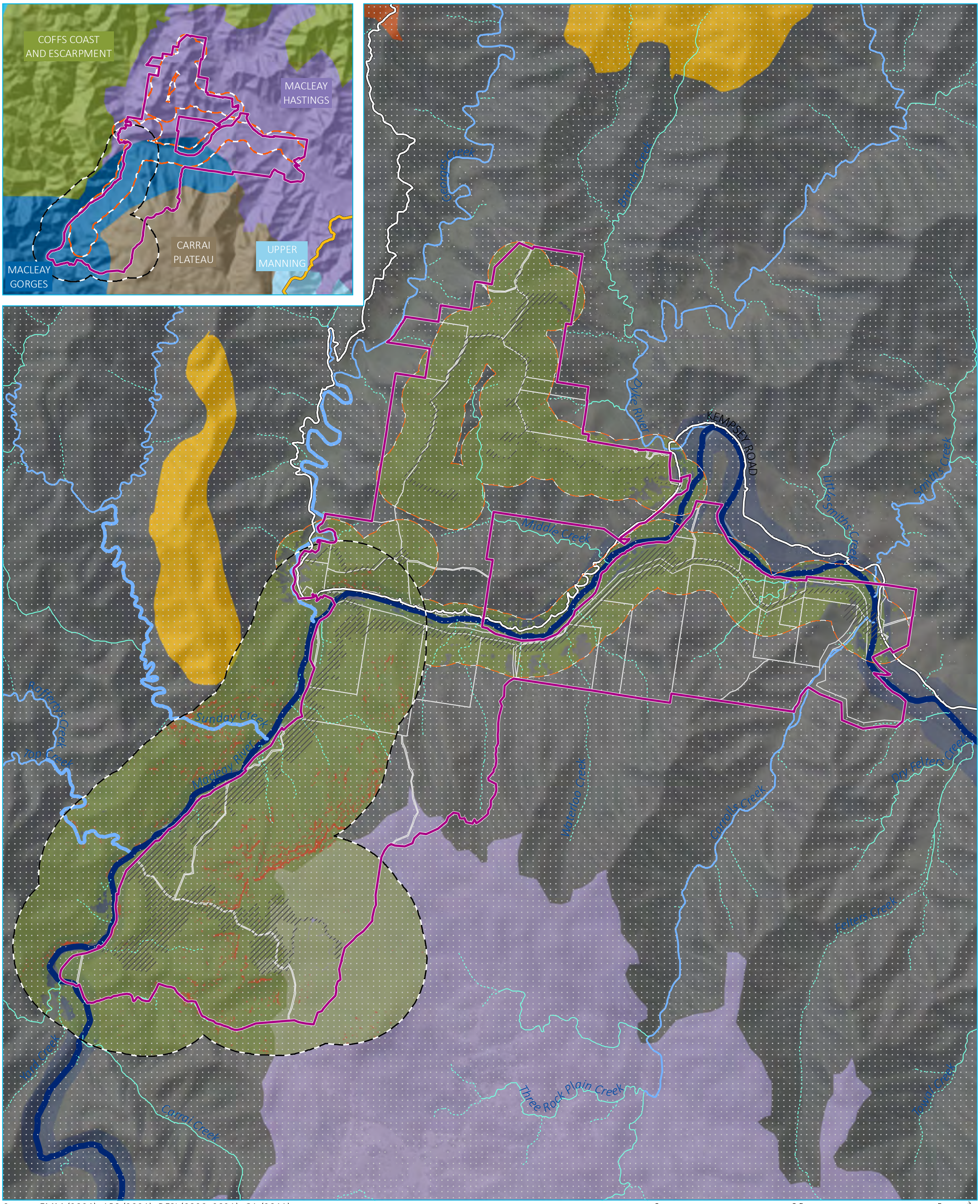
INSET KEY

- Major road
- NPWS reserve
- State forest

Site map

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 4.1

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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KEY

- Project area
- Construction envelope
- Major road
- Habitat connectivity
- Cliffs (slope > 60 degrees)
- Cadastral boundary
- Native vegetation

Assessment area

- Reservoir construction and operation (1500 m buffer)
- Transmission and access (500 m buffer)

Mitchell landscapes

- Apsley Meta-sediments
- Dingo Spur Meta-sediments
- Macleay Escarpment Foothills
- Manning - Macleay Channels and Floodplains
- Tinebank Granites

Strahler stream order

- 3rd order
- 4th order
- 5th order
- 6th order
- 9th order

INSET KEY

- Local government area

IBRA subregion

- Carrai Plateau
- Coffs Coast and Escarpment
- Macleay Gorges
- Macleay Hastings
- Upper Manning

Location map

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 4.2

EMM creating opportunities

5 Native vegetation

5.1 Background review

A search was undertaken of the BioNet Vegetation Classification database and NSW SEED Data Sharing Portal to access existing vegetation mapping information within the Project area. Nine PCTs were mapped within the Project area by NRCMA (NRCMA, 2010); these are listed in Table 5.1.

Table 5.1 Preliminary plant community types in the Project area

PCT ID	PCT name
761	Cabbage Gum – Broad-leaved Apple open forest of the eastern escarpment, NSW North Coast Bioregion and South Eastern Queensland Bioregion
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion
983	New England Blackbutt – stringybark grassy forest in the eastern New England Tableland Bioregion and NSW North Coast Bioregion
988	New England Blackbutt – Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion
993	New England Blackbutt grassy open forest of the eastern New England Tableland Bioregion
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion
1287	Upland heath swamps of the New England Tableland Bioregion

5.2 Detailed vegetation mapping and habitat assessment

An assessment of the generation site was undertaken on 25 and 26 of February 2020 by NGH. Survey methods included a site walkover supported by drone and helicopter surveys. Rapid vegetation assessments (RVAs) were collected, identifying the dominant plant species at each site. The site inspection focused on dominant canopy species and mid-storey, where present; however, as the broader region had been subjected to impacts relating to bushfire of varying intensities, mid-storey and groundcover species were not readily identifiable.

Review of vegetation within the generation site was undertaken by EMM during the extensive surveys undertaken for the Project, including vegetation integrity surveys (see below). Assessment of the access road and transmission line was undertaken between 8 and 10 March and 6 and 9 April 2022 by EMM. Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of RVAs were undertaken, with the three dominant species in the overstorey, mid-storey and groundcover recorded. Extrapolations were made based on the distribution of vegetation communities observed within accessible areas and from desktop assessment. Plant community distribution and condition data was collected in the field using GPS-enabled tablet computers using Collector for ArcGIS™.

PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 5.2. Vegetation zones are distinguished largely by presence or absence of woody native vegetation, tree canopy maturity and by native versus exotic species abundance and diversity.

Table 5.2 Definitions used in delineation of vegetation zones

Condition class	Description
High	Largely intact with all stratum present and minimal disturbance.
Moderate	Some elements or stratum missing, immature, or affected by the intrusion of exotic species.
Derived native grassland (DNG)	Tree stratum missing. Native vegetation restricted to groundcover. Some areas may have a sparse shrub layer.
Poor	Tree stratum present, but understorey vegetation is absent or degraded due to exotics species becoming established, vegetation being cleared, discarded building materials, rubbish and/or vehicles.
Dry	Drier species composition in PCTs associated with sclerophyll forests.
Rainforest (RF)	Rainforest remnants within the associated PCTs.
Exotic grassland (EG)	Dominated by non-native vegetation and/or pasture improvement. These areas were not assessed for ecosystem credits.
Unvegetated	Access tracks, stockpile areas, infrastructure. These areas were not assessed for ecosystem credits.

5.2.1 Vegetation integrity assessment

Following the stratification of vegetation zones within the Project area, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 4.2.1, 4.3.3 and 4.3.4 of the BAM (DPIE, 2020a). Plot data was collected from the construction envelope between 26–31 October and 16–20 November 2020 for the generation site by NGH. Additional plot data for the generation site was collected by EMM between 7–9 June 2022. Plot data for the access road and transmission line was collected between the 7–10 June, 21–25 June 2022, 12-14 December 2023 and 16 March 2024. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure
- one 20 x 50 m plot for assessment of function, including a series of five 1 x 1 m subplots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1–5%) or estimated to the nearest 5% (5–100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM (DPIE, 2020a). Compiled plot data and plot datasheets are in Appendix A.

The plot surveys were conducted prior to the final design of the Project. This was to inform the design and avoid and minimise impacts where possible (see Section 8.3). For this reason, some plots are located outside of, but within proximity to, the construction envelope. Despite falling outside of the final design of the construction envelope, these plots are representative and have been used to inform the stratification of management zones within the Project area and have been used to determine vegetation condition and offset requirements.

Surveys for flora and vegetation communities were completed under the authority of Scientific License (SL100409). A list of flora species was compiled for each plot and PCT. Records of all flora species will be submitted to BCS for incorporation into the Atlas of NSW Wildlife.

5.2.2 Application of Version 1.2 Benchmarks

On 6 September 2023, the BAM-C was updated to version 1.2 benchmarks. Prior to this, version 1.1. benchmarks were used. Version 1.1 benchmarks were used under a transitional arrangement for six months.

To be eligible to apply transitional arrangements to a BAM-C case, the case must:

- be commenced prior to the date the BAM-C is updated with Version 1.2 benchmarks
- modify all benchmarks in the entire proposal to Version 1.1 benchmarks
- finalise the BAM-C assessment prior to 2 August 2023
- submit the certified BDAR prior to 16 August 2023
- document the application of Version 1.1 benchmarks in the Biodiversity Assessment Report.

As the certified BDAR was not submitted prior to 16 August 2023, the BDAR was required to use version 1.2 benchmarks. This BDAR has been updated from Revision 3 to include updates to Version 1.2 benchmarks.

5.3 Results

5.3.1 Vegetation descriptions and environmental weeds

The vegetation within the Project area reflects past land uses and disturbances such as grazing, historical logging, the 2019/2020 bushfires and floodplain inundation in areas adjacent to the Macleay River. Much of the vegetation within the construction envelope occurs as open, grassy Eucalypt forests with smaller wet sclerophyll forest areas influenced by surface water flows located on headwater tributaries. These are located throughout the Project area from higher to lower elevations and vegetation type varies according to landscape position. Some small rainforest remnants occur in protected areas such as gullies.

The vegetation in higher elevations consists of grassy open forests primarily dominated by New England Blackbutt (*Eucalyptus campanulata*), Diehard Stringybark (*Eucalyptus cameronii*), and Tallowwood (*Eucalyptus microcorys*) in the south and Spotted Gum (*Corymbia maculata*) and Thick-leaved Mahogany (*Eucalyptus carnea*) in the north. The understory vegetation structure changes from open grassy to shrubby in wetter and cooler microclimates within the higher forests. On the mid-slopes, the vegetation is comprised of grassy open forests where Small-fruited Grey Gum (*Eucalyptus propinqua*) and Broad-leaved Stringybark (*Eucalyptus caliginosa*) extend below the higher forests. Moving to the lower slopes and foothills, the Broad-leaved Stringybark (*Eucalyptus caliginosa*) continues to occur with the canopy species Forest Red Gum (*Eucalyptus tereticornis*), which is associated with the lower slopes of the Macleay River. The vegetation in the lower slopes and foothills is best described as dry open forest.

In the floodplains and foothills of the Project area, native and exotic grasslands also occur, and many are subject to current grazing practices. These grasslands primarily lack a mid- and canopy stratum and vary in species density and diversity. On the banks of the Macleay River, the vegetation is primarily dominated by River Oak (*Casuarina cunninghamiana*) and has been observed to be inundated by high river levels after rainfall events.

Much of the Project area remains intact with minimal weed disturbance; however, due to the alluvial influences of the Macleay River introducing exotic species from upstream and current disturbance practices, exotic species do occur, primarily in the lower elevations of the Project area. Exotic species occurrence is also associated with the existing access tracks for private and transmission line access. Of the exotic species recorded during surveys, 22 are high threat weeds and primarily include herbaceous groundcover and grasses.

5.3.2 Plant community types and vegetation zones

PCTs were identified through analysis of data collected during vegetation mapping surveys and were verified using floristic data collected during plot surveys. Ten PCTs were identified within the disturbance footprint. These PCTs are summarised in Table 5.3, shown in Figure 5.1.

Table 5.3 PCTs identified within the disturbance footprint

Plant community types	Vegetation formation	Vegetation Class	Percentage cleared (NSW)	Direct impacts (ha)
762 – Cabbage Gum open forest or woodland on flats of the North Coast	Grassy Woodlands	Coastal Valley Grassy Woodlands	70	2.6
842 – Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Northern Gorge Dry Sclerophyll Forests	40	211.3
868 – Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Northern Gorge Dry Sclerophyll Forests	5	68.0
PCT 979 – New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Northern Escarpment Dry Sclerophyll Forests	20	7.2
PCT 988 – New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	Wet Sclerophyll Forests (Shrubby sub-formation)	Northern Escarpment Wet Sclerophyll Forests	30	10.5
1106 – River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Forested Wetlands	Eastern Riverine Forests	90	3.7
1142 – Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Rainforests	Dry Rainforests	30	5.0

Plant community types	Vegetation formation	Vegetation Class	Percentage cleared (NSW)	Direct impacts (ha)
1215 – Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests	35	53.3
1268 – Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	Wet Sclerophyll Forests (grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	15	1.1
1287 – Upland heath swamps of the New England Tableland Bioregion	Freshwater Wetlands	Montane Bogs and Fens	30	0
Total				**362.7 ha**

Vegetation zones were delineated by the presence/absence of canopy and the condition of derived grasslands as discussed in Table 5.2. Most PCTs recorded within the disturbance footprint are represented by multiple vegetation zones. Details for each vegetation zone are summarised and shown in Table 5.4. Descriptions of the PCTs are presented in Table 5.5 to Table 5.14.

Table 5.4 Vegetation zones within the disturbance footprint

PCT ID	PCT name	Condition	Extent in direct impact area (ha)	Vegetation integrity score
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate	0.5	55.5
762	Cabbage Gum open forest or woodland on flats of the North Coast	DNG Moderate	0.2	0.8
762	Cabbage Gum open forest or woodland on flats of the North Coast	Poor	0.3	47.8
762	Cabbage Gum open forest or woodland on flats of the North Coast	EG	1.6	3.9
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	169.0	73
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	DNG Moderate	37.1	15
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Poor	1.6	42.8
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	EG	3.7	1.9
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	61.4	72.5

PCT ID	PCT name	Condition	Extent in direct impact area (ha)	Vegetation integrity score
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry	6.6	66.9
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	High	7.3	73.1
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	10.5	71.4
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High	0.5	54.5
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	2.3	64.8
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate RF	0.9	62.4
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5.0	40.4
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	High	52.1	64.9
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	DNG Moderate	1.2	41
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	High	1.1	77
1287	Upland heath swamps of the New England Tableland Bioregion	High	0	55.9

Updates in design removed all impacts to PCT 780 which was originally impacted on prior to RTS stage.

Table 5.5 PCT 762 – Cabbage Gum open forest or woodland on flats of the North Coast

Attribute	Description
PCT ID	762
Common name	Cabbage Gum open forest or woodland on flats of the North Coast
Vegetation class	Coastal Valley Grassy Woodlands

Attribute	Description
Extent within the disturbance footprint	2.6 hectares (ha), comprising: • Moderate: 0.5 ha • DNG Moderate: 0.2 ha • Poor: 0.3 ha • Exotic Grassland: 1.6 ha.
Survey effort	Plots: • Moderate: LR01 • DNG Moderate: 2023-EAR01 • Poor: 2023-EAR02 • Exotic Grassland: EAR05, EAR21, EAR37
Description and condition	This PCT was identified within the lower elevations of the Project area associated with the floodplains and alluvial terraces of the Macleay River before a steeper break in slope to higher elevation areas. It occurs as intact forests and derived grasslands of varying condition. The majority of the PCT occurs in the north-east portion of the Project area along the eastern access road; however, small pockets also occur to the west and very southern tip of the Project area. Within the forested conditions of the PCT, mature Forest Red Gum (*Eucalyptus* tereticornis) is dominant with Grey Box (*Eucalyptus moluccana*) occurring at lower densities. Other canopy species which occur less often include Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*), Broad-leaved Apple (*Angophora subvelutina*) and Pink Bloodwood (*Corymbia intermedia*). A number of shrub species occur within this PCT and primarily include *Acacia* spp. in addition to Golden Rod (*Sida hackettiana*), Native Peach (*Trema tomentosa*), Cheese Tree (*Glochidion ferdinandi*) and Native Blackthorn (*Bursaria spinosa*). The groundcover shows low to high signs of disturbance due to current grazing and a moderate level of exotic species cover. Despite the weed encroachment in all vegetation zones, a number of native grasses persist. These include Purple Wiregrass (*Aristida ramosa*), Weeping Grass (*Microlaena stipoides*), Small-flowered Finger Grass (*Digitaria parviflora),* Kangaroo Grass (*Themeda triandra*), Lobed Bluegrass (*Bothriochloa biloba*), and Slender Rat's Tail Grass (*Sporobolus creber*). Native forbs and vines also occur within the PCT and include Spiny-headed Mat-rush (*Lomandra longifolia*), Kidney Weed (*Dichondra repens*), Bluebells (*Wahlenbergia* spp.), Dusky Coral Pea (*Kennedia rubicunda*), Scrambling Lily (*Geitonoplesium cymosum*) and Slender Tick-trefoil (*Desmodium varians*). Exotic species vary with condition, with the exotic grasses dominating the exotic grassland condition of the PCT and bordering the edges of the forested conditions. Bahia Grass (*Paspalum notatum*) dominates much of the groundcover whilst Lantana (*Lantana camara*) occurs within the mid-stratum. Other common exotic species include Fireweed (*Senecio madagascariensis*), White Passionflower (*Passiflora subpeltata*), Cat's Claw Creeper (*Dolichandra unguis-cati*) and Blackberry complex (*Rubus fruticosus* sp. agg).
Condition description	The community has a moderate cover of exotic species throughout the PCT due to past and current disturbance associated with agricultural activities. **Moderate:** This vegetation zone has an intact canopy. However, the shrub and ground layer, while dominated by native species overall, contains substantial localised infestations of exotic shrubs and forbs interspersed with native species. **DNG Moderate:** This vegetation zone has had the canopy and mid layer removed, so that only a groundcover of predominantly native species remains. **Poor:** This vegetation zone has a sparse canopy, largely absent native shrub layer, and a ground cover dominated by exotics forbs and grasses. **Exotic Grassland:** This vegetation zone is dominated by exotic grasses and forbs. Native groundcover species may still be present albeit in small numbers.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 762 which also occur within the vegetation community in the construction envelope include: • Grey Box (*Eucalyptus moluccana*) • Forest Red Gum (*Eucalyptus tereticornis*) • Purple Wiregrass (*Aristida ramosa*) • Lobed Bluegrass (*Bothriochloa biloba*). The PCT description in the BioNet Vegetation Classification database has only six species associated with it.

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered in to the PCT filter tool. The following PCTs were considered. • PCT 3427 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on hills fringing hinterland valleys. • PCT 3254 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on coastal, hinterland and escarpment ranges. These the vegetation on site was also found not to support species consistent with the PCT data. • PCT 3329 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on undulating hills in the hinterland valleys. • PCT 3240 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on escarpments. • PCT 3461 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on steep slopes. The vegetation on site was also found not to support species consistent with the PCT data. • PCT 3249 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on low hills. • PCT 3251 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on steep slopes and dissected valleys. The vegetation on site was also found not to support species consistent with the PCT data. • PCT 3170 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on escarpment ranges. The vegetation on site was also found not to support species consistent with the PCT data. • PCT 3241 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on slopes of the hinterland ranges. The vegetation on site was also found not to support species consistent with the PCT data. • PCT 3252 was found to be inconsistent with the landscape position of the vegetation on site. The vegetation on site is located on a floodplain, while this PCT is located on coastal hills and escarpment foothills and ranges. The vegetation on site was also found not to support species consistent with the PCT data. • PCT 4042 was found to support some species consistent with the vegetation on site. In particular, the vegetation description notes that *Eucalyptus amplifolia* and *Eucalyptus tereticornis* may be present in the tree canopy, which are two dominant species in the vegetation on site. The sub-canopy of the PCT (Melaleuca trees) is however, inconsistent with the plot the vegetation on site. The elevation of this PCT (typically below 50 metres ASL) is also inconsistent with the vegetation on site (~130 m ASL). This PCT is an offspring of PCT 762. • PCT 4046 was found not to support species consistent with the vegetation on site, in particular *Eucalyptus robusta* which is almost always present in this PCT. This PCT was also found not to occur within the relevant IBRA subregions. The landscape position is however suitable, occurring on floodplains and low rises. This PCT is an offspring of PCT 762. • PCT 761 was found to be mostly consistent with the species recorded in the vegetation on site, in particular Forest Red Gum (*Eucalyptus tereticornis)* and Grey Box (*Eucalyptus moluccana*). The mid-layer is however, inconsistent with the vegetation on site, with the only species detailed in the PCT being Broad-leaved Paperbark (Melaleuca quinquenervia). The PCT understory description comprised of Purple Wiregrass (*Aristida ramosa*) and Lobed Bluegrass (*Bothriochloa biloba*) is consistent with the vegetation on site. The landscape position of this PCT is also consistent with the vegetation on site, which is identified as poorly drained lower slopes, valley flats and creek banks. • PCT 762 was considered the best fit for the PCT recorded within the Project area. While no PCT from the new state vegetation type maps (DPE, 2022a) were exact matches for the PCT recorded within the Project area, PCT 4042 was the closest match and contained the best match for the species composition as described for PCT 762.

Attribute	Description
Status	**BC Act** PCT 762 is associated with Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion Endangered Ecological Community (EEC) listed under the BC Act. Vegetation zones Moderate, Poor, and DNG Moderate are considered to be part of this EEC as: • the site is located north of Port Stephens • the PCT occurs on inundated alluvial flats, drainage lines and river terraces associated with a coastal floodplain of NSW • the tree layer is made up of mixed Eucalypts and includes Forest Red Gum (*Eucalyptus tereticornis*) and Pink Bloodwood (*Corymbia intermedia*). • rainforest shrubs are scattered throughout areas of the PCT • there are low to no *Casuarina* spp, *Melaleuca* spp. or Swamp Mahogany (*Eucalyptus robusta*) (DECC, 2007). The Exotic Grassland zone is not considered to represent this EEC as there is little to no native vegetation in the exotic grassland. This vegetation zone is highly degraded, and the canopy and shrub layer is absent. **EPBC Act** Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions threatened ecological community (TEC) was listed under the EPBC Act during the preparation this BDAR (5 October 2022). While this listing roughly aligns with the BC Act listed community, the Conservation Listing Advice (DCCEEW, 2022) specifies additional criteria for listing under the EPBC Act. Part of vegetation zones Moderate and Poor, with a patch ≥0.5 ha, are considered to represent this EEC as they meet the key diagnostic characteristics in Section 2.1 and the minimum condition thresholds in Table 2 (DCCEEW, 2022). See Section 13.2.2i for detailed assessment. The Exotic Grassland and DNG Moderate zones are not considered to represent this EEC as they do not meet the required canopy cover of at least 20% (DCCEEW, 2022).
Estimate of percent cleared value of PCT across its distribution	70%
Patch size	Moderate: >100 ha DNG Moderate: >100 ha Poor: >100 ha

Attribute	Description
Example photo	

Plate 5.1 **PCT 762 BAM plot photo**

Table 5.6 PCT 842 – Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion

Attribute	Description
PCT ID	842
Common name	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion
Vegetation class	Northern Gorge Dry Sclerophyll Forests
Extent within the disturbance footprint	221.3 ha, comprising: • High: 168.9 ha • DNG Moderate: 37.1 ha • Poor: 1.6 ha • Exotic Grassland: 3.7 ha.
Survey effort	**Plots:** • High: EAR03, EAR11, EAR14 EAR18, EAR19, EAR23, EAR31, EAR32, EAR36, EAR39, EAR40, EAR46, EE_OMPS_10, EE_OMPS_11, EE_OMPS_9, LW_OMPS_1, LW_OMPS_11, LW_OMPS_16, LW_OMPS_21, LW_OMPS_3, LW_OMPS_37, LW_OMPS_38, LW_OMPS_39, LW_OMPS_7, LW_OMPS_8, MP_OMPS_100, MP_OMPS_12, • DNG Moderate: EAR08, EAR10, EAR17, EAR20, EAR24, EAR42, EAR45, EAR47, LW_OMPS_19, LW_OMPS_5, LW_OMPS_6, LW_OMPS_9. • Poor: EAR02, EAR35, NTL02,NTL12. • Exotic Grassland: EAR01, EAR12, EAR13, EAR33, NTL01.
Description and condition	This PCT is one of the dominant PCTs within the construction envelope. This PCT occurs within the generation site and the eastern access road areas mid to lower slopes. The PCT is dominated by Forest Red Gum (*Eucalyptus tereticornis*) and Broad-leaved Stringybark (*Eucalyptus caliginosa*) within the forested vegetation condition. Grey Box (*Eucalyptus moluccana*) is also present, albeit in less abundance. There is a prevalent mid-stratum within this PCT, with a diverse range of Acacia species such as Coastal Wattle (*Acacia longifolia*), Long-leaf Wattle (*Acacia longifolia*) and Fringed Wattle (*Acacia fimbriata*). Other shrub species which occur include Dogwood (*Jacksonia scoparia*), Dwarf Cherry (*Exocarpos strictus*), Forest Oak (*Allocasuarina torulosa*), Coffee Bush (*Breynia oblongifolia*), *Phyllanthus* spp. And Cockspur Flower (*Plectranthus parviflorus*). The density and diversity of native groundcovers varies between vegetation zones, with an increasingly greater cover and abundance of native grasses and forbs within the High or DNG_moderate condition of the PCT. Exotic grasses dominate the remaining vegetation zones. Native grasses which occur in the High and DNG_moderate condition vegetation zones include Pitted Bluegrass (*Bothriochloa decipiens* var. *decipiens*), Bunch Speargrass (*Heteropogon contortus*), Wiry Panic (*Entolasia stricta*), Paddock Lovegrass (*Eragrostis leptostachya*), Barbed Wire Grass (*Cymbopogon refractus*), and Weeping Grass (*Microlaena stipoides*). Native herbaceous and forb species also occur in smaller densities and include Pink Tongues (*Rostellularia adscendens*), Kidney Weed (*Dichondra repens*), Wattle Matt-rush (*Lomandra filiformis*), Native Wandering Jew (*Commelina cyanea*); False Sarsaparilla (*Hardenbergia violacea*) and Rock Fern (*Cheilanthes sieberi*). Exotic species which occur within the ground stratum of Poor and EG condition classes include Bahia Grass (*Paspalum notatum*) and Kikuyu Grass (*Cenchrus clandestinus*), primarily in high densities within the Exotic grassland vegetation zone. Additional exotic species which occur in low densities within the PCT comprise Tropical Soda Apple (*Solanum viarum*), Parramatta Grass (*Sporobolus africanus*), Fireweed (*Senecio madagascariensis*), Lantana (*Lantana camara*) and Climbing Nightshade (*Solanum seaforthianum*).

Attribute	Description
Condition description	This community is mostly in High or DNG condition with a low diversity and abundance of exotic forbs and grasses. A powerline easement runs through almost the entirety of this PCT. **High:** This vegetation zone has a canopy, shrub and ground-layer that are largely intact and contain minimal exotic species, typically limited to the ground-layer. **DNG Moderate:** This vegetation zone is in moderate condition with a high diversity of native species dominant but exotic species quite abundant. However, overstorey species are lacking. **Poor:** This vegetation zone has a sparse canopy, and a shrub and ground layer containing substantial exotic shrubs and forbs interspersed with native species. **Exotic Grassland:** This vegetation zone has a high cover and abundance of exotic grass and forb species with minimal native species diversity.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 842 which also occur within the vegetation community in the construction envelope include: • Grey Box (*Eucalyptus moluccana*) • Forest Red Gum (*Eucalyptus* tereticornis) • Broad-leaved Stringybark (*Eucalyptus caliginosa*) • Dogwood (*Jacksonia scoparia*) • Rock Fern (*Cheilanthes sieberi*) • Barbed Wire Grass (*Cymbopogon refractus*) • Native Wandering Jew (*Commelina cyanea*) • Kidney Weed (*Dichondra repens*) • Pink Tongues (*Rostellularia adscendens*) • False Sarsaparilla (*Hardenbergia violacea*).

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCT 3427 was found to be consistent with some species recorded in the plot data. The description for PCT 3427 notes that the canopy very frequently includes Ironbarks (*Eucalyptus crebra, Eucalyptus siderophloia*) with Pink Bloodwood (*Corymbia intermedia*), Forest Red Gum (*Eucalyptus tereticornis*) and Thick-leaved Mahogany (*Eucalyptus carnea*) commonly present. While the presence of Pink Bloodwood (*Corymbia intermedia*), Forest Red Gum (*Eucalyptus tereticornis*) and Thick-leaved Mahogany (*Eucalyptus carnea*) are consistent with the plot data, the presence of Ironbarks are not. • PCT 3329 was found to be consistent with species recorded in the plot data. In particular, the PCT description identifies Forest Red Gum (*Eucalyptus tereticornis*) as a dominant species and Thin-leaved Stringybark (*Eucalyptus eugenioides*) and Grey Box (*Eucalyptus moluccana*) as occasionally present in localised areas. The PCT occurs on undulating hills in hinterland valleys, one of which is the Macleay Valley, and is therefore consistent with the location of the plots. The geology associated with this PCT is typically fine-grained sediments, however it is known from acid volcanics or granite, which is consistent with the plot data (mostly granite substrate, with sedimentary substrate also present). • PCT 3240 was found to be inconsistent with the landscape position of the plots. This PCT is located on the escarpment of the Lower North Coast on mid to upper slopes, while the plots are located on foothills and mid to lower slopes. • PCT 3254 was found not to support species consistent with the plot data and was rapidly discounted. • PCT 3463 is located between the Mann and Maryland rivers which is not consistent with the location of the site. This PCT is also not within the relevant IBRA sub regions within the Project area. As this is outside of the Project area or vicinity it was rapidly discounted. This PCT is an offspring of PCT 842. • PCT 842 was found to be consistent with the species recorded in the plot data, in particular Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*), and Broad-leaved Stringybark (*Eucalyptus caliginosa*). The typical landscape position of the PCT is however, not consistent with the plot data. This PCT typically occurs on steep slopes in gorges while the plots are located on foothills and mid to lower slopes. • PCT 1227 was considered as it is a parent PCT of 3329. This PCT was found not to support species consistent with the plot data and was discounted. The canopy species and vegetation class of this PCT are not consistent with the plot data. This PCT is categorised as Coastal Swamp Forests vegetation class, while the plot data is representative of dry sclerophyll forest. • PCT 761 was considered as it is a parent PCT of 3329. This PCT was found to be consistent with some species recorded in the plot data, in particular Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*) and Pink Bloodwood (*Corymbia intermedia*). However, the geology detailed in the PCT description, sedimentary rocks, was found to be inconsistent with that of the plots. The geology of the area in which the plots where undertaken is mostly granite with some minor sedimentary influence. • PCT 842 was considered the best fit for the PCT recorded within the Project area. While PCT 3329 was also a good match from the new state vegetation type maps (DPE, 2022a), its parent PCTs were not. As such, PCT 842 was used in this assessment.
Status	Not listed
Estimate of percent cleared value of PCT across its distribution	40%
Patch size	• High: >100 ha • DNG Moderate: >100 ha • Poor: >100 ha.

Attribute	Description
Example photo	

Plate 5.2 PCT 842 BAM plot photo

Table 5.7 PCT 868 – Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion

Attribute	Description
PCT ID	868
Common name	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion
Vegetation class	Northern Gorge Dry Sclerophyll Forests

Attribute	Description
Extent within the disturbance footprint	68.0 ha, comprising: • High: 61.4 ha • Dry: 6.6 ha.
Survey effort	**Plots:** • High: NTL03, NTL04, NTL05, NTL06, EE_OMPS_12, EE_OMPS_3, EE_OMPS_5, EE_OMPS_6, EE_OMPS_7, LW_OMPS_20, MP_OMPS_17, MP_OMPS_25, NTL868 (Benchmark). • Dry: EE_OMPS_15, EE_OMPS_4, and EE_OMPS_8.
Description and condition	This PCT is located along the high ridges and steep slopes within the construction envelope, primarily associated with the main generation area with some mapped along the transmission line. This PCT occurs as an open forest in two conditions (High and Dry) throughout the construction envelope. The canopy species which dominate this vegetation comprise Grey Gum (*Eucalyptus biturbinata*), Broad-leaved Stringybark (*Eucalyptus caliginosa*), Thick-leaved Mahogany (*Eucalyptus carnea*) and Tallowwood (*Eucalyptus microcorys*). Pink Bloodwood (*Corymbia intermedia*), Grey Box (*Eucalyptus moluccana*) and Forest Oak (*Allocasuarina torulosa*) also occur in lower densities. The shrub stratum can vary from dense to open and includes Fern-leaved Wattle (*Acacia filicifolia*), Hickory Wattle (*Acacia falcata*), *Cassinia compacta* and Australian Indigo (*Indigofera australis*). Within the understorey, a dense layer of natives generally occurs including species such as False Sarsaparilla (*Hardenbergia violacea*) and Blady Grass (*Imperata cylindrica*) that dominate, possibly as successional species following fire. Smaller occurrences of *Macrozamia montana*, Wattle Matt-rush (*Lomandra filiformis*), Blue Flax-lily (*Dianella caerulea*) and Ivy Goodenia (*Goodenia hederacea*) also occur within the understorey, whilst the native vine Wonga Wonga Vine (*Pandorea pandorana*) persists into the canopy. Common native grasses include Yadbila Grass (*Panicum queenslandicum*), Barbed Wire Grass (*Cymbopogon refractus*), Slender Rat's Tail Grass (*Sporobolus creber*) and Jericho Wiregrass (*Aristida jerichoensis*). These species co-occur with occasional high densities of the exotic *Digitaria ischaemum.* Other exotic species which occur within this PCT at low densities include White Passionflower (*Passiflora subpeltata*), Black-berry Nightshade (*Solanum nigrum*), Cobbler's Pegs (*Bidens pilosa*) and Fireweed (*Senecio madagascariensis*).
Condition description	This community is largely in High condition with all layers intact. **High**: This vegetation zone has a high native species diversity in all vegetation layers. Low number of exotic species are present, mostly as grasses and forbs. **Dry:** This vegetation zone has a high diversity of native species with all layers intact. The species are representative of a dry vegetation community, with a sparser vegetation cover than the High condition, and a north facing aspect. No exotic species were recorded in plots undertaken in this condition.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 868 which also occur within the vegetation community in the construction envelope include: • Grey Gum (*Eucalyptus biturbinata*) • Broad-leaved Stringybark (*Eucalyptus caliginosa*) • Tallowwood (*Eucalyptus microcorys*) • Pink Bloodwood (*Corymbia intermedia*) • Forest Oak (*Allocasuarina torulosa*) • Blue Flax-lily (*Dianella caerulea*) • Blady Grass (*Imperata cylindrica*).

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCTs 3427, 3170, 3277, 3461 and 3240 were found not to support species consistent with the plot data and were rapidly discounted. • PCT 3254 showed a strong match with the plot data, with the overstorey comprised of Tallowwood (*Eucalyptus microcorys*) and Thick-leaved Mahogany (*Eucalyptus carnea*) with midstratum containing Forest Oak (*Allocasuarina torulosa*) and Coffee Bush (*Breynia oblongifolia*). Ground cover was represented by Blady Grass (*Imperata cylindrica*) with high occurrences of Blue Flax-lily (*Dianella caerulea*) and *Poa* spp. This PCT aligns with conditions recorded within the Project area with the PCT occurring in mild, wet locations receiving 1,040–1,540 mm mean annual rainfall, at mid to high elevations of 250–830 m ASL. It occurs on clay-rich sedimentary or meta-sedimentary substrates, on ridges to lower slopes, and exposed to moderately sheltered sites. This PCT however, is not consistent with the dry sclerophyll vegetation on site, as it is within the wet sclerophyll forests (grassy sub-formation) formation. • PCT 3251 showed a strong match with the plot data, with a similar composition as PCT 3254 with midstratum also aligning by containing Hickory Wattle (*Acacia falcata*). PCT 3251 is widespread in the steep hinterland hills in the Macleay Valley in hot, wet environments with mean annual rainfall typically between 1,000–1,370 mm. This PCT commonly occurs on metasediments however is also known from volcanic or granitic substrates. Due to the altitude within the Project area, temperatures are considered milder which makes PCT 3254 a closer fit. • PCT 3464 showed a strong match with the vegetation on site, with the canopy very frequently including Grey Gum (*Eucalyptus biturbinata*), and commonly Tallowwood (*Eucalyptus microcorys*) and stringybarks. This is consistent with the vegetation on site especially the high cover of Grey Gum (*Eucalyptus biturbinata*). The mid-story vegetation on site is also consistent with this PCT, where Forest Oak (Allocasuarina torulosa) is almost always present. The ground layer of PCT 3464 very frequently includes Blady Grass (*Imperata cylindrica*), Slender Tick-trefoil (*Desmodium varians*), Large Tick-trefoil (*Oxytes brachypoda*), Spiny-headed Mat-rush (*Lomandra longifolia*), False Sarsaparilla (*Hardenbergia violacea*) and Blue Flax-lily (*Dianella caerulea*). All of these species except Large Tick-trefoil (*Oxytes brachypoda*) and Spiny-headed Mat-rush (*Lomandra longifolia*) were present in the site vegetation. The landscape position and location of this PCT is a suitable fit, with the PCT occurring within the Macleay catchment and typically above 520m ASL (vegetation on site occurs between approximately 150-950 metres ASL). PCT 3465 was discounted as no red gums were recorded within the site vegetation (noted as being very frequent in the PCT description), and it is not within the relevant IBRA sub regions within the Project area. • PCT 3502 was discounted as its location is not suitable (dry northern Stanthorpe Plateau on the NSW-Qld border, known from Maryland National Park and surrounding areas), and it is not within the relevant IBRA sub regions within the Project area. Based on the above, we believe PCT 3464 is the best fit for the vegetation within the project area. As legacy PCTs were used, PCT 1262 (legacy of PCT 3464) was considered. PCT 1262 was not considered a suitable match as it is within the wet sclerophyll forests (grassy sub-formation) formation while the vegetation on site is dry sclerophyll. The next best fit PCT was PCT 3254. The legacy PCT for PCT 3254 is PCT 868. PCT 868 was determined to be a good fit for the vegetation on site due to floristics and landscape position.
Status	Not listed
Estimate of percent cleared value of PCT across its distribution	5%
Patch size	High: >100 ha Dry: >100 ha.

Attribute	Description
Example photo	

Plate 5.3 PCT 868 BAM plot photo

Table 5.8 PCT 979 – New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion

Attribute	Description
PCT ID	979
Common name	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion
Vegetation class	Northern Escarpment Dry Sclerophyll Forests
Extent within the disturbance footprint	7.2 ha of High condition vegetation zone
Survey effort	Plots: • High: EE_OMPS_1, EE_OMPS_13, EE_OMPS_16,

Attribute	Description
Description and condition	PCT 979 is found in the south-eastern corner of the construction envelope, interspersed with PCT 988. This PCT is associated with the Upper Reservoir, steep terrain adjoining the plateau, and exposed rocky terrain on the plateau. This PCT occurs as a dry sclerophyll forest with one vegetation condition (High) throughout the construction envelope. The dominant canopy species are Diehard Stringybark (*Eucalyptus cameronii*), New England Blackbutt (*Eucalyptus campanulata*). Several shrub species occur within this PCT primarily including *Leucopogon lanceolatus,* Crinkle Bush (*Lomatia silaifolia*), *Leucopogon trichostylus*, and Variable Bossiaea (*Bossiaea heterophylla*). The groundcover is largely free of exotics with native grasses and sedges dominating. Native grasses with high cover within this PCT include Bordered Panic (*Entolasia marginata*), Blady Grass (*Imperata cylindrica*). Weeping Grass (*Microlaena stipoides*), and Kangaroo Grass (*Themeda triandra*). Dominant sedges include Spiny-headed Mat-rush (*Lomandra longifolia*) and Wattle Matt-rush (*Lomandra filiformis*). Native vines also occur in high cover and abundance within this PCT. The two dominant vines are Dusky Coral Pea (*Kennedia rubicunda*) and False Sarsaparilla (*Hardenbergia violacea*).
Condition description	**High**: This community is in high condition with all layers intact. This vegetation zone has a high native species diversity in all vegetation layers. There is a low abundance and diversity of exotic forbs.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 979 which also occur within the vegetation community in the construction envelope include: • New England Blackbutt (*Eucalyptus campanulata*) • *Leucopogon lanceolatus* • Narrow-leaved Geebung (*Persoonia linearis*) • Blue Flax-lily (*Dianella caerulea*) • Spiny-headed Mat-rush (*Lomandra longifolia*) • Snowgrass (*Poa sieberiana*) • Bracken (*Pteridium esculentum*)

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification. PCTs were filtered by IBRA region and the dominant plot species. The following PCTs were considered. • PCT 738 has some floristics consistent with the vegetation on site, however, it is not as consistent as PCT 979 (the chosen PCT) and does not occur within either of the two relevant IBRA sub-regions. • PCT 983 was consistent with the floristic composition of the vegetation on site, however it is within the Nandewar IBRA region, which is a different IBRA region to the vegetation on site. • PCT 992 has floristics consistent with the vegetation on site, however it is not consistent with the landscape position. This PCT is found on the northeastern edge of the New England Tablelands, which is not in or near the vicinity of the vegetation on site. • PCT 993 is largely consistent with the landscape description of the vegetation on site, occurring on upper slopes and ridges. The canopy species of this PCT are however, largely inconsistent with the vegetation on site, with four of the six canopy species not consistent with the vegetation on site. • PCT 995 has some floristics consistency with the vegetation on site, however it is not consistent with the landscape position. This PCT is found mainly in the Mann River to Gibraltar Range area, which is not in or near the vicinity of the vegetation on site. • PCT 979 is consistent with the vegetation on site floristically and landscape wise. PCT 979 has a canopy dominated by Diehard Stringybark (*Eucalyptus cameronii*) and New England Blackbutt (*Eucalyptus campanulata*). This is consistent with the vegetation on site which has New England Blackbutt (*Eucalyptus campanulata*) recorded in the plot data and Diehard Stringybark (*Eucalyptus cameronii*) recorded during vegetation mapping surveys. The understory vegetation from this PCT is also largely consistent. It reflects a dry sclerophyll forest which is a good match for the vegetation on site. Landscape wise this PCT is a tall to very tall open forest, located on the eastern edge and fall of the New England Tablelands from Doyles River to Styx River. This PCT is also located within the Macleay Gorges and Carrai Plateau IBRA sub-regions. These attributes are consistent with the vegetation on site. • PCT 1167 is consistent with the landscape description of the vegetation on site, occurring along the rugged eastern fall of the New England Tablelands. The canopy species are however, inconsistent with the vegetation on site with only one species of six consistent. • PCT 1192 occurs at high altitudes on the eastern edge of the New England Tablelands, which is consistent with the vegetation on site. Floristically, however, this PCT is not a good match for the vegetation on site with only one out of the four species present. Based on the above, we believe PCT 979 is the best fit for the vegetation on site.
Status	Not listed
Estimate of percent cleared value of PCT across its distribution	20%
Patch size	High: >100 ha

Attribute	Description
Example photo	

Plate 5.4 PCT 979 BAM plot photo

Table 5.9 PCT 988 – New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion

Attribute	Description
PCT ID	988
Common name	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion
Vegetation class	Northern Escarpment Wet Sclerophyll Forests
Extent within the disturbance footprint	10.5 ha of High condition vegetation zone
Survey effort	Plots: • High: URAT 01, URAT 03, URAT 05, URAT 07, URAT02, URAT06, EE_OMPS_14, EE_OMPS_2.
Description and condition	PCT 988 is found in the south-eastern corner of the construction envelope, interspersed with PCT 979. This PCT is associated with the Upper Reservoir, specifically, moist relatively flat areas on the plateau. This PCT occurs as a wet sclerophyll forest with one vegetation condition (High) throughout the construction envelope. The dominant canopy species are New England Blackbutt (*Eucalyptus campanulata*), Diehard Stringybark (*Eucalyptus cameronii*), Sydney blue gum (*Eucalyptus saligna*), and Tallowwood (*Eucalyptus microcorys*). The relative abundance of these species changes throughout this PCT with some areas dominated notably by Tallowwood (*Eucalyptus microcorys*). Black She-Oak (*Allocasuarina littoralis*) and Forest Oak (*Allocasuarina torulosa*) are present as a sub canopy layer throughout this PCT. Several shrub species occur within this PCT, primarily Bracken (*Pteridium esculentum*), Prickly Shaggy Pea (*Podolobium ilicifolium*), Narrow-leaved Geebung (*Persoonia linearis*), and *Leucopogon lanceolatus.* The groundcover is largely free of exotics with native grasses and sedges dominating. Native grasses in high abundance within this PCT include Blady Grass (*Imperata cylindrica*), Snowgrass (*Poa sieberiana*), and Kangaroo Grass (*Themeda triandra*). Dominant sedges include Spiny-headed Mat-rush (*Lomandra longifolia*), and Blue Flax-lily (*Dianella caerulea*). Native vines also occur in high cover and abundance within this PCT. The two dominant vines are Dusky Coral Pea (*Kennedia rubicunda*) and False Sarsaparilla (*Hardenbergia violacea*).
Condition description	**High**: This community is in high condition with all layers intact. This vegetation zone has a high native species diversity in all vegetation layers. There is a low abundance and diversity of exotic forbs.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 988 which also occur within the vegetation community in the construction envelope include: • New England Blackbutt (*Eucalyptus campanulata*) • Diehard Stringybark (*Eucalyptus cameronii*) • *Leucopogon lanceolatus* • Narrow-leaved Geebung (*Persoonia linearis*) • Native Raspberry (*Rubus parvifolius*) • Elderberry Panax (*Polyscias sambucifolia*) • Blue Flax-lily (*Dianella caerulea*) • Twining Guinea Flower (*Hibbertia dentata*) • Spiny-headed Mat-rush (*Lomandra longifolia*) • Bracken (*Pteridium esculentum*) • Native Violet (*Viola betonicifolia*)

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification. PCTs were filtered by IBRA region and the dominant plot species. The following PCTs were considered. • PCT 980 is not floristically consistent with the vegetation on site and is not found within the correct area. This PCT is located between the Timbarra and the Dorrigo Plateaux which is not consistent with the vegetation on site. • PCT 981 is consistent with the landscape description of the vegetation on site, occurring along the eastern edge of the New England Tablelands. The canopy species are however, inconsistent with the vegetation on site. • PCT 986 has floristics consistent with the vegetation on site, however, does not occur within either of the two relevant IBRA sub-regions. • PCT 988 is consistent with the vegetation on site floristically and landscape wise. PCT 988 has a canopy composed of New England Blackbutt (*Eucalyptus campanulata*), Diehard Stringybark (*Eucalyptus cameronii*), Sydney blue gum (*Eucalyptus saligna*), Tallowwood (*Eucalyptus microcorys*), and Messmate (*Eucalyptus obliqua*). All these species except Messmate (*Eucalyptus obliqua*) and Tallowwood (*Eucalyptus microcorys*) have been recorded within the vegetation on site. While Tallowwood was not recorded within the construction envelope it has been recorded within the vicinity, within the same PCT, outside the construction envelope. The understory vegetation is also largely consistent, reflecting the wet sclerophyll species composition that is present with the vegetation on site. Landscape wise this PCT is a tall to very tall moist open forest, located along the eastern fall of the escarpment and in places on the eastern edge of the tablelands. This PCT is also located within the Macleay Gorges and Carrai Plateau IBRA sub-regions. These attributes are consistent with the vegetation on site. • PCT 992 has floristics consistent with the vegetation on site, however it is not consistent with the landscape position. This PCT is found on the northeastern edge of the New England Tablelands, which is not in or near the vicinity of the vegetation on site. • PCT 995 has some floristics consistency with the vegetation on site, however it is not consistent with the landscape position. This PCT is found mainly in the Mann River to Gibraltar Range area, which is not in or near the vicinity of the vegetation on site. • PCT 1323 is located on the ranges and escarpment which is consistent with vegetation on site. The suite of canopy species in this PCT is however, inconsistent with the vegetation on site. Based on the above, we believe PCT 988 is the best fit for the vegetation on site.
Status	Not listed
Estimate of percent cleared value of PCT across its distribution	30%
Patch size	High: >100 ha

Attribute	Description
Example photo	

Plate 5.5 **PCT 988 BAM plot photo**

Table 5.10 PCT 1106 – River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion

Attribute	Description
PCT ID	1106
Common name	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
Vegetation class	Eastern Riverine Forests
Extent within the disturbance footprint	3.7 ha comprising: • High: 0.5 ha • Moderate: 2.3 ha • Moderate RF: 0.9 ha.
Survey effort	**Plots:** • High: LW_OMPS_10, MP_OMPS_38, EAR26 • Moderate: EAR04, EAR06, EAR07, EAR25, EAR43, EAR54, EAR55, LW_OMPS_2 • Moderate RF:, EAR38, EAR52, EAR53 • Poor RF: EAR22, EAR44. This vegetation zone is no longer within the disturbance footprint.
Description and condition	This PCT was identified on the banks of the Macleay River and occurs as intact forests with some conditions observed to have a rainforest microclimate which supports rainforest flora species. There is some level of weed infestation, largely due to upstream impacts and a history of grazing. Within this PCT, River Oak (*Casuarina cunninghamiana*) is the dominant canopy species, whilst Weeping Bottlebrush (*Callistemon viminalis*) occurs as the dominant tall shrub layer. Within the rainforest influenced conditions of the PCT, a number of other canopy species occur including Weeping Lilly Pilly (*Waterhousea floribunda),* Red Kamala (*Mallotus philippensis*), Creek Sandpaper Fig (*Ficus coronata*) and Ribbonwood (*Euroschinus falcatus* var. *falcatus*). Species which occur in wetter soils and are also present within the PCT include White Cedar (*Melia azedarach*), Silky Oak (*Grevillea robusta*) and Black Tea-tree (*Melaleuca bracteata*). The groundcover shows signs of frequent inundation from the adjacent river; however, in areas of High condition, has a high native species diversity and density. Weeping Grass (*Microlaena stipoides*) is a common and dense species in this PCT, in addition to Common Couch (*Cynodon dactylon*), Australian Basket Grass (*Oplismenus aemulus*) and Native Wandering Jew (*Commelina cyanea*). Within the rainforest vegetation condition classes, a number of native vines also occur and include Scrambling Lily (*Geitonoplesium cymosum*), Twining glycine (*Glycine clandestina*), Wombat Berry (*Eustrephus latifolius*) and Round-leaf Vine (*Legnephora moorei*). Due to frequent inundation of this PCT, exotic species are common within the vegetation within the construction envelope and include Cat's Claw Creeper (*Dolichandra unguis-cati*), Climbing Nightshade (*Solanum seaforthianum*) and Moth Vine (*Araujia sericifera*). Lantana (*Lantana camara*) also occurs within the mid stratum, varying from very low to very high densities.
Condition description	The condition of this community ranges from High condition with all layers intact, to Poor condition with some straum absent. **High:** This vegetation zone has a canopy, shrub and ground-layer that are intact and contain minimal exotic species. **Moderate:** This vegetation zone has an intact canopy, but a shrub and ground layer, while dominated by native species overall, that contains substantial localised infestations of exotic shrubs, forbs, and grasses interspersed with native species. **Moderate RF:** This vegetation zone has an intact canopy, but a shrub and ground layer, while dominated by native species overall, that contains substantial localised infestations of exotic shrubs and forbs interspersed with native species. This vegetation zone differs from the Moderate condition in that it contains rainforest species. **Poor RF:** This vegetation zone contains a sparse canopy, and native shrub and ground layer that has been highly modified, with some areas missing the shrub or ground-layer. Substantial infestations of exotic species are present in the mid and ground-layer. This vegetation zone differs from the Poor condition in that it contains rainforest species.

Attribute	Description
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 1106 which also occur within the vegetation community in the construction envelope include: • River Oak (*Casuarina cunninghamiana*) • Weeping Bottlebrush (*Callistemon viminalis*) • Weeping Lilly Pilly (*Waterhousea floribunda)*.
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCTs 3329, 3427, 3254 and 3089 were found not to support species consistent with the plot data and were rapidly discounted. • PCT 3020 is considered a strong fit for the Moderate RF and Poor RF zones of PCT 1106 due to the species description which has a diversity of mesic species. The canopy species occasionally include River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) which is dominant, and Broad-leaved Apple (*Angophora subvelutina*) sometimes with a high cover, or rarely other eucalypts, also sometimes with high cover. This PCT also notes a sparse to mid-dense sub-canopy of mesophyll small trees and shrubs, very frequently including Creek Sandpaper Fig (*Ficus coronata*). This is consistent with the vegetation on site. In terms of landscape positioning, this PCT occurs on alluvial substrates and at elevations between 50-800m ASL, which consistent with the site. • PCT 4066 was discounted due to the lack of Silky Oak (*Grevillea robusta*) which is a characteristic species, the rarity of Eucalypts which is not consistent with the site vegetation, and due to the fact that it is not located within the relevant IBRA sub regions within the Project area. • PCT 4073 was discounted as it is located outside the vicinity of the project area (Gloucester and Hunter valleys to the north and west of Newcastle), is not a good match floristically (Tree Violet (*Melicytus dentatus*) is the only common shrub in this PCT, whereas this has not been recorded on site) and is not within the relevant IBRA sub regions within the Project area. • PCT 4077 is not a good floristic fit due to the limited number of *Eucalyptus* spp. in the description. Only Flooded Gum (*Eucalyptus grandis*) is listed and this is not consistent with the vegetation on site which has Forest Red Gum (*Eucalyptus tereticornis*) as the most common *Eucalyptus* species. • PCT 4078 is a good floristic fit with the canopy, mid, and ground stratum vegetation on site. It also occurs below 390 m ASL in a warm, moist climate on moist gravelly loam soils that are derived from a variety of substrates, which matches conditions within the Project area. This PCT was, however, discounted as it is not within the relevant IBRA sub regions within the Project area. • PCT 4079 was considered best fit for zones Moderate and High of PCT 1106 due to floristics, lithology, and location. PCT 4079 notes River Oak (*Casuarina cunninghamiana subsp. cunninghamiana*) as the main canopy species, with trees such as *Angophoras* and Eucalypts present rarely and with low cover. This is consistent with the vegetation on site. In terms of landscape position this PCT occurs on creek flats and river beds, on a range of lithologies (sediments, metasediments and granite), and mostly between 200-700m ASL. This is mostly consistent with the site, with the minor exception of the elevation which is around 150m ASL on site. • PCT 4087 was discounted due to the inconsistency of the PCT floristics with the vegetation on site. According to the PCT description, where a Eucalypt canopy is present, Flooded Gum (*Eucalyptus grandis*) is the most frequent species. This *Eucalyptus* species has not been recorded within the vegetation on site. This PCT is also not within the relevant IBRA sub regions within the Project area. • PCT 4139 is a good floristic fit with the canopy, mid, and ground stratum vegetation on site. This PCT was, however, discounted as it is not within the relevant IBRA sub regions within the Project area. PCT 3020 was selected as best fit for the Moderate RF and Poor RF zones of PCT 1106, while PCT 4079 was selected as best fit for the remaining zones of PCT 1106 (Moderate and High). This split from PCT 1106 to PCTs 3020 and 4079 is based on floristics, specifically the diversity of mesic species, which as noted in VIS, is more diverse in PCT 3020. The choice of these two PCTs was based on based on floristics, lithology and location. As legacy PCTs were used and PCTs 3020 and 4079 align with PCT 1106, PCT 1106 was used in this assessment.

Attribute	Description
Status	**BC Act** PCT 1106 is associated with Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the BC Act. This PCT within the construction envelope was determined to be inconsistent with the EEC definitions under the BC Act due to its known and predicted distribution which is situated around the Hunter area, south of the Project area (OEH, 2022a). PCT 1106 is associated with Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion EEC listed under the BC Act. Vegetation zones High and Moderate within the construction envelope are considered to be part of this EEC as: • the Project is located north of Port Stephens • the PCT occurs on inundated alluvial flats, drainage lines and river terraces associated with a coastal floodplain of NSW • the PCT includes species from the species assemblage such as Forest Red Gum, Cabbage Gum, River Oak, and Weeping Bottlebrush • rainforest shrubs and trees are scattered throughout areas of the PCT (DECC, 2007). PCT 1106 is also associated with Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion EEC listed under the BC Act. Vegetation zones Moderate RF and Poor RF within the construction envelope are considered to be part of this EEC as they: • lie within or within the vicinity of the known distribution of this EEC • are consistent with the distribution description which identifies 'riverine corridor and alluvial flats' (OEH, 2022b) • are consistent with several species from the NSW Scientific Committee – final determination including Whalebone Tree (*Streblus brunonianus*), Brush Cherry (*Syzygium australe*), and Creek Sandpaper Fig (NSW TSSC, 2011a) As per the NSW Scientific Committee – final determination (NSW TSSC, 2011a), all remaining native vegetation on the coastal floodplains of NSW is covered by an EEC. While there are several EECs that cover the coastal floodplains of NSW, the best fit for PCT 1106 in Moderate_RF condition is Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion due to the presence of rainforest species which differentiate it from the same PCT in other condition states. **EPBC Act** PCT 1106 could be associated with Lowland Rainforest of Subtropical Australia Critically Endangered Ecological Community (CEEC) listed under the EPBC Act. All occurrences of this PCT within the construction envelope were determined to be inconsistent with the CEEC definitions under the EPBC Act as it does not meet the species richness required as per the key diagnostic characteristics of the listing advice (DSEWPaC, 2011a). The species richness required is at least 30 woody species from the listing advice in patches of this CEEC (DSEWPaC, 2011a). Only 16 species were recorded within BAM plots undertaken in PCT 1106. Sites ≤2ha must be evaluated for canopy cover and species richness across the entire site, 10 rapid data points were undertaken within PCT 1106. A further two species from the listing advice were recorded within these rapid data points, which totals 18 species across PCT 1106. This is still a shortfall of 12 species from the required 30 woody species from the listing advice.
Estimate of percent cleared value of PCT across its distribution	90%
Patch size	• High: >100 ha • Moderate: >100 ha • Moderate RF: >100 ha • Poor RF: >100 ha

Attribute	Description
Example photo	

Plate 5.6 **PCT 1106 BAM plot photo**

Table 5.11 PCT 1142 – Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion

Attribute	Description
PCT ID	1142
Common name	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
Vegetation class	Dry Rainforests
Extent within the disturbance footprint	5.0 hectares of Moderate condition vegetation zone
Survey effort	Plots: • Moderate: MP_OMPS_35 and LW_OMPS_23.
Description and condition	This PCT was identified in the southern part of the Project area within a creek that flows into the Macleay River. The PCT occurs as a dry rainforest with one vegetation condition within the construction envelope. The canopy species which dominate this vegetation comprise Port Jackson Fig (*Ficus rubiginosa*), Snow Wood (*Pararchidendron pruinosum* var. *pruinosum*), and Silver Croton (*Croton insularis*). Hard Quandong (*Elaeocarpus obovatus*) and Red Kamala (*Mallotus philippensis*) are also present in lower densities. The canopy is mostly open, however, dense and closed patches of this PCT are also present. Several shrub species occur with this PCT, primarily Tree Violet (*Melicytus dentatus*), Brush Cherry (*Syzygium australe*), and Black Tea-tree (*Melaleuca bracteata*). Black Plum (*Diospyros australis*) and Grey Myrtle (*Backhousia myrtifolia*) are also present albeit in much smaller densities. This PCT has a high diversity of species in the groundlayer, with ferns and grasses dominant. Prevalent species of ferns include Common Maidenhair (*Adiantum aethiopicum*) and Rough Maidenhair (*Adiantum hispidulum*). The two dominant grass species in this PCT are Weeping Grass (*Microlaena stipoides*) and Australian Basket Grass (*Oplismenus aemulus*). The understory also contains climber species and a diversity of orchids. Climber species include *Tetrastigma nitens*, *Jasminum simplicifolium*, and Native Grape (*Cayratia clematidea*). Orchid species include Tongue Orchid (*Dendrobium linguiforme*), Rat's Tail Orchid (*Dendrobium teretifolium*), and Tangle Orchid (*Plectorrhiza tridentata*). Exotic species are present in all layers of this PCT, albeit in low numbers. Lantana (*Lantana camara*), Large-leaved Privet (*Ligustrum lucidum*), and Common Centaury (*Centaurium erythraea*) are examples of this.
Condition description	**Moderate**: This community is in Moderate condition with all layers intact. This vegetation zone has a canopy, shrub and ground layer that are dominated by native species overall, however, contain substantial localised infestations of exotic species.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 1142 which also occur within the vegetation community in the construction envelope include: • Barbwire Weed (*Nyssanthes diffusa*) • Black Plum (*Diospyros australis*) • Grey Myrtle (*Backhousia myrtifolia*) • Red Kamala (*Mallotus philippensis*) • Rough Maidenhair (*Adiantum hispidulum*).
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered in to the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCT 972 was found to be somewhat consistent with the landscape position of the plots, with the PCT located in steep rocky sites in the gorges. The PCT is, however, largely inconsistent with the species from the plot data. PCT 972 includes the following species: *Alectryon forsythii*, *Alectryon subdentatus,* Whalebone Tree (*Streblus brunonianus*), Yellow Tulipwood (*Drypetes australasica*), *Notelaea microcarpa* var. *velutina, Brachychiton populneus* subsp. *Populneus*, and Red Ash (*Alphitonia excelsa*). Only Whalebone Tree (*Streblus brunonianus*) is consistent with the plot data. The vegetation class of the PCT is also not consistent with the vegetation class of the plot data. The vegetation class of PCT 972 is Western Vine Thickets while the plot data better reflects a dry rainforest vegetation class.

Attribute	Description
	• PCT 2079 was found to be inconsistent with the landscape position of the plots. PCT 2079 is located in gorges of the Macleay Valley on sedimentary rocks, while the plots are located in the gorges on the Carrai Plateau's western slopes on rock which formed as a result of volcanic activity. The PCT was also found to be mostly inconsistent with the species identified in the plots, matching with 3 out of 67 species (4%). • PCT 3057 was discounted as the dominant tree species was not consistent with the vegetation on site Grey Myrtle (*Backhousia myrtifolia*) and it is not within the relevant IBRA sub region within the Project area. • PCT 3084 was discounted due to its occurrence in the coastal ranges in the Coffs Harbour, Myall Lakes and Newcastle-Gosford areas (inconsistent with the site), it's presence of Brown Myrtle (*Backhousia leptopetala*) which is noted as distinctive (this species was not recorded in the vegetation on site), and as it is not within the relevant IBRA sub region within the Project area. • PCT 3097 was discounted due to its floristic description which is inconsistent with the vegetation on site. It states Whalebone Tree (*Streblus brunonianus*) and Brush Bloodwood (*Baloghia inophylla*) are almost always present, often with a high foliage cover, whereas in the site vegetation Brush Bloodwood (*Baloghia inophylla*) was not recorded and Whalebone Tree (*Streblus brunonianus*) was only recorded in low cover. This PCT is also not located within the relevant IBRA sub region within the Project area. • PCT 3098 was discounted due to its occurrence in escarpment ranges north from Dorrigo (inconsistent with the site location), its floristics which almost always includes Grey Myrtle (*Backhousia myrtifolia*) which has the highest foliage cover (present on site but with low cover), commonly includes Brush Box (*Lophostemon confertus*) and rarely various *Eucalyptus* species (not recorded in the vegetation on site), Whalebone Tree (*Streblus brunonianus*) (recorded) and Native Quince (*Alectryon subcinereus*) (not recorded). This PCT is also not located within the relevant IBRA sub region within the Project area. • PCT 3099 was found to be somewhat consistent with the landscape position of the plots. PCT 3099 is located on steep rocky slopes, mainly on clay-rich medasediments, occasionally on sediments. On site, the vegetation is located in a steep gully on rock which formed as a result of volcanic activity. PCT 3099 was found to be moderately consistent with the species identified in the plots, matching with 28 out of 67 species (42%). This PCT was deemed to be the best fit. • PCT 3101 was discounted due to the floristics which are not consistent (the canopy almost always includes a high cover of Shatterwood (*Backhousia sciadophora*) and lower cover of Native Pomegranate (*Capparis arborea*), whereas these species have not been recorded within the vegetation on site). This PCT is also not within the relevant IBRA sub region within the Project area. • PCT 3113 was discounted as it occurs in Washpool National Park, and potentially in sheltered gullies in the area. The Project area is not within or close to the vicinity of this area. This PCT is also not within the relevant IBRA sub region within the Project area. • PCT 3117 was discounted due to the PCTs floristic description which is inconsistent with the vegetation on site. The description notes that this PCT is a low open forest or shrubland of Grey Myrtle (*Backhousia myrtifolia*), Lemon-scented Teatree (*Leptospermum petersonii*), and Large Mock-olive (*Notelaea longifolia*). Only Grey Myrtle (*Backhousia myrtifolia*) has been recorded in the vegetation on site and in low cover. This PCT is also not within the relevant IBRA sub region within the Project area. • PCT 3254 was found to be consistent with the landscape position of the plots, with PCT 3254 located in escarpment ranges. PCT 3254 is, however, found not to support species consistent with the plot data. PCT 3254 consists of Tallowwood (*Eucalyptus microcorys*) as frequently present and sometimes dominating with the highest foliage cover, Brush Box (*Lophostemon confertus*), Sydney Blue Gum (*Eucalyptus saligna*), Thick-leaved Mahogany (*Eucalyptus carnea*), White Mahogany (*Eucalyptus acmenoides*), and rarely with the spotted gums *Corymbia maculata* (incorporating *Corymbia variegata*). Forest oak (*Allocasuarina torulosa*) is almost always present, forming a mid-dense to dense sub-canopy. None of these species are consistent within the plot data. • PCT 3460 was found to be somewhat consistent with the species in the plot data. PCT 3460 has a canopy consisting of Broad-leaved Apple (*Angophora subvelutina*) and Forest Red Gum (*Eucalyptus tereticornis*), and a small tree layer with Forest Oak (Allocasuarina torulosa), Red Kamala (*Mallotus philippensis*) and Sweet Pittosporum (*Pittosporum undulatum*). Broad-leaved Apple (*Angophora subvelutina*) and Red Kamala (*Mallotus philippensis*) was recorded in the plot data. PCT 3460 is, however, inconsistent with the vegetation class of the plot data. PCT 3460 is within the Northern Gorge Sclerophyll Forests vegetation class, while the plot data better reflects a dry rainforest vegetation class. • PCT 3469 was found to be largely inconsistent with species in the plot data. PCT 3469 consists of scattered Yellow Box (*Eucalyptus melliodora*) emergent, with small trees and shrubs including Kurrajong (*Brachychiton populneus*), Brush Wilga (*Geijera salicifolia*), Native Olive (*Notelaea macrocarpa*), Acacia blakei, *Alectryon forsythii* and Narrow-leaved Orangebark (*Denhamia silvestris*). None of these species are consistent with the plot data.

Attribute	Description
	• PCT 4078 was found to be inconsistent with species in the plot data. PCT 4078 consists of River Oak (*Casuarina cunninghamiana* subsp. *Cunninghamiana*), Silky Oak (*Grevillea robusta*), White Cedar (*Melia azedarach*), Weeping Bottlebrush (*Callistemon viminalis*) and scattered individuals of Wiry Spurge (*Phyllanthus virgatus*) or Creek Sandpaper Fig (*Ficus coronata*). None of these species are consistent with the plot data. • PCT 4079 was found to be largely inconsistent with species in the plot data. PCT 4079 consists of River Oak (*Casuarina cunninghamiana*) as the main canopy species and almost always present, rarely other trees are present with low cover, including Broad-leaved Apple (*Angophora subvelutina*), Forest Red Gum (*Eucalyptus tereticornis*) and Dorrigo White Gum (*Eucalyptus dorrigoensis*). Only Broad-leaved Apple (*Angophora subvelutina*) is consistent with the plot data. Based on the above, we believe PCT 3099 is the best fit for the vegetation within the Project area. As legacy PCTs were used and PCT 3099 aligns with PCT 1142, PCT 1142 was used in this assessment.
Status	**BC Act** PCT 1142 is associated with Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion EEC listed under the BC Act. This PCT was determined to be inconsistent with the EEC definitions under the BC Act, irrespective of its condition, based on the PCTs location on higher ground away from the floodplain. PCT 1142 was reviewed against the NSW Scientific Committee Final Determination for the Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC (NSW TSSC, 2011b). • The EEC is associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. Geology and topographic location are consistent with vegetation on site. • In the north of its range, Lowland Rainforest is found up to 600 m ASL. Within the construction envelope this PCT is recorded up to 270 m ASL, with the gully in which it is found extending to 380 m ASL. Elevational range of the EEC is consistent with vegetation within the construction envelope. • The Lowland Rainforest EEC has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous. Several layers occur including, emergents, canopy and sub-canopy, along with a range of plant growth forms, including palms, vines and vascular epiphytes. Scattered eucalypt emergents may occasionally be present. Vegetation within the construction envelope does not typically have a closed canopy, but does have a moderate diversity of mesophyllous trees, vines and epiphytes. • Characteristic species recorded in the plots include Port Jackson Fig (*Ficus rubiginosa*), Snow Wood (*Pararchidendron pruinosum* var*. pruinosum*), Hard Quandong (*Elaeocarpus obovatus*), Red Kamala (*Mallotus philippensis*), Brush Cherry (*Syzygium australe*), Black Plum (*Diospyros australis*), Grey Myrtle (*Backhousia myrtifolia*) and *Tetrastigma nitens*. • The final determination (NSW TSSC, 2011b) notes that while the Lowland Rainforest EEC belongs to the Subtropical Rainforests vegetation class, some stands may be interpreted as structurally complex assemblages within the Dry Rainforests vegetation class. This is consistent with vegetation observed on site. While the vegetation on site does not typically support a closed canopy, other features are consistent and it is conservatively concluded that PCT 1142 within the construction envelope is considered consistent with the Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions EEC. **EPBC Act** PCT 1142 could be associated with Lowland Rainforest of Subtropical Australia CEEC listed under the EPBC Act. All occurrences of this PCT within the construction envelope were determined to be inconsistent with the CEEC definitions under the EPBC Act as it does not meet the species richness required as per the key diagnostic characteristics of the listing advice (DSEWPaC, 2011a). The species richness required is at least 30 woody species from the listing advice in patches of this CEEC (DSEWPaC, 2011a). Only 8 Species from the listing advice were recorded within BAM plots undertaken in PCT 1142.
Estimate of percent cleared value of PCT across its distribution	30%
Patch size	Moderate: >100 ha.

Attribute	Description
Example photo	

Plate 5.7 PCT 1142 BAM plot photo

Table 5.12 PCT 1215 – Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion

Attribute	Description
PCT ID	1215
Common name	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
Vegetation class	Hunter-Macleay Dry Sclerophyll Forests
Extent within the disturbance footprint	53.3 ha, comprising: • High: 52.1 ha • DNG Moderate: 1.2 ha.
Survey effort	**Plots:** • High: EAR09, EAR15, EAR16, EAR28, EAR29, EAR30 and NTL10 • DNG Moderate: NTL09 and NTL11.
Description and condition	This PCT is located along the higher ridges and slopes within the construction envelope, associated with the access road to the east and the northern transmission line in the north. This PCT occurs as an open forest with a dense ground stratum of native vines and patches of *Acacia* spp. regeneration. This growth is likely due to the regeneration response post-fire with Fabaceae species responding to the changed nutrient load within the soil. The canopy is co-dominated by tall Spotted Gum (*Corymbia maculata*), Thick-leaved Mahogany (*Eucalyptus carnea*) and Grey Box (*Eucalyptus moluccana*). Many shrub species which occur within the mid stratum are from the Fabaceae family and comprise Hickory Wattle (*Acacia falcata*), Curracabah (*Acacia leiocalyx* subsp. *leiocalyx*), A Bush Pea (*Pultenaea spinosa*) and Australian Indigo (*Indigofera australis*). Coffee Bush (*Breynia oblongifolia*), Climbing Guinea Flower (*Hibbertia scandens*), *Cassinia* spp. and Forest Oak (*Allocasuarina torulosa*) also occur in moderate densities. The groundcover varies depending on the vegetation zone. The DNG Moderate zone is maintained as an easement and therefore is influenced by ongoing maintenance. Despite these differences, False Sarsaparilla (*Hardenbergia violacea*) still occurs in moderate to high densities, likely as successional following fire. Within the High vegetation zone, grasses co-dominate where False Sarsaparilla (*Hardenbergia violacea*) does not occur, with the natives Jericho Wiregrass (*Aristida jerichoensis*), Kangaroo Grass (*Themeda triandra*), Wiry Panic (*Entolasia stricta*), and Blady Grass (*Imperata cylindrica*) co-dominating with the exotic *Digitaria ischaemum.* Threeawn Speargrass (*Aristida vagans*) and Blue Flax-lily (*Dianella caerulea*) also occur in smaller density.
Condition description	This community is in good condition with all layers intact in forested areas and a high diversity of native species in the DNG condition. • **High:** This vegetation zone has a high native species diversity in all vegetation layers. Low numbers of exotic species are present. • **DNG Moderate:** This vegetation zone is in moderate condition with a high diversity of native species that clearly dominate.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 1215 which also occur within the vegetation community in the construction envelope include: • Spotted Gum (*Corymbia maculata*) • Thick-leaved Mahogany (*Eucalyptus carnea*) • Grey Box (*Eucalyptus moluccana*) • Forest Oak *(Allocasuarina torulosa*) • Wiry Panic (*Entolasia stricta*) • Threeawn Speargrass (*Aristida vagans*) • Blue Flax-lily (*Dianella caerulea*) • Kangaroo Grass (*Themeda triandra*).

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCT 3427 was found to support some species consistent with the plot data. In particular, the vegetation description for PCT 3427 notes the presence of Thick-leaved Mahogany (*Eucalyptus carnea*) and Spotted Gums (*Corymbia maculata*) which have both been recorded in the plot data. The abundance of Spotted Gums in the PCT description is, however, inconsistent with the plot data with the PCT description noting that Spotted Gums are 'occasionally present in localised areas' while on site Spotted Gum (*Corymbia maculata*) was dominant. This PCT is an offspring of PCT 1215. • PCTs 3254, PCT 3252 and PCT 3329 were found not to support species consistent with the plot data and were rapidly discounted. • PCT 3433 is located in the Hunter Coast hinterland from Tuggerah to Stratford and Lower Hunter Valley around Cessnock. As this is outside of the Project area or vicinity it was rapidly discounted. • PCT 3244 was found to support some species consistent with the plot data. In particular, the description for PCT 3244 notes the presence of Thick-leaved Mahogany (*Eucalyptus carn*ea) and Spotted Gum (*Corymbia maculata*) which have both been recorded in the plot data. The dominance of Thick-leaved Mahogany (*Eucalyptus carnea*) in the PCT description is, however, inconsistent with the plot data. The plot data reflects Thick-leaved Mahogany (*Eucalyptus carnea*) as a co-dominant species; however the PCT description notes that Thick-leaved Mahogany (*Eucalyptus carnea*) is 'less regularly present' than species such as Grey Ironbark (E*ucalyptus siderophloia*), White Mahogany (*Eucalyptus acmenoides*), Broad-leaved White Mahogany (*Eucalyptus umbra*) and Grey Gum (*Eucalyptus punctata*), none of which were recorded in the plot data. • PCT 3249 is not a good match floristically due to the frequent presence of Grey Ironbark (*Eucalyptus siderophloia*) which is not present within the vegetation on site. This PCT also primarily occurs on metasediments, which is consistent with the site but not as accurate a description as the substrate description in PCT 3251. This PCT is an offspring of PCT 1215. • PCT 3251 was found to be mostly consistent with the species recorded in the plot data. The description for PCT 3251 notes that the canopy very frequently includes Mahogany species such as Thick-leaved Mahogany (*Eucalyptus carnea*), and that Spotted Gum (*Corymbia maculata*) may be locally prominent. In the shrub layer, the PCT description identifies Forest Oak (*Allocasuarina torulosa*) and Hickory Wattle (*Acacia implexa*) as common. For Forest Oak (*Allocasuarina torulosa*) this is reflective of the plot data but for Hickory Wattle (*Acacia implexa*) it is not, as this species occurs in low densities within the plots. This PCT commonly occurs on metasediments however is also known from volcanic or granitic substrates. This is consistent with the vegetation on site. This PCT is an offspring of PCT 1215. Based on the above data we believe that PCT 3251 is the best fit due to the dominance of Spotted Gum (discounting PCT 3427, where Spotted Gum is noted as 'occasionally present in localised areas'), PCT 3251 being a better fit floristically than PCT 3249, and the soils and substrates being a better fit for PCT 3251 than PCT 3249. As legacy PCTs were used and PCT 3251 aligns with PCT 1215, this PCT was used in this assessment.
Status	**BC Act** PCT 1215 is associated with Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion Endangered Ecological Community (EEC) listed under the BC Act. This PCT was determined to be inconsistent with the EEC definitions under the BC Act, irrespective of its condition, based on: • the PCTs location on higher ground, away from the alluvial flats, drainage lines and river terraces associated with a coastal floodplain • the canopy is dominated by Spotted Gum (*Corymbia maculata*) which is not listed as one of the dominant or locally common species in the TEC description (NSW TSSC, 2010a).
Estimate of percent cleared value of PCT across its distribution	35%
Patch size	• High: >100 ha • DNG_Moderate: >100 ha.

Attribute	Description
Example photo	

Plate 5.8 PCT 1215 BAM plot photo

Table 5.13 PCT 1268 – Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion

Attribute	Description
PCT ID	1268
Common name	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion
Vegetation class	Northern Hinterland Wet Sclerophyll Forests
Extent within the disturbance footprint	1.1 ha of High condition vegetation zone
Survey effort	**Plots:** High: Plots NTL07 and NTL08.

Attribute	Description
Description and condition	This PCT is located along the high ridges and slopes within the Project area, associated with the northern transmission line in the north. This PCT occurs as an open forest dominated by Tallowwood (*Eucalyptus microcorys*). Grey Gum (*Eucalyptus biturbinata*), Forest Oak (*Allocasuarina torulosa*), and White Mahogany (*Eucalyptus acmenoides*) are also present in lower numbers. The shrub and vine layer species vary depending on the aspect. In cooler/moister conditions, ferns such as *Blechnum neohollandicum*, and Bracken (*Pteridium esculentum*) are present. In moister areas, vines such as Water Vine (*Cissus antarctica*), Lawyer Vine (*Smilax australis*), Scrambling Lily (*Geitonoplesium cymosum*), and Native Raspberry (*Rubus parvifolius*) are prevalent. In warmer/drier conditions there is a notable decrease in the variety of vine species. In these drier areas, shrubs such as Dogwood (*Jacksonia scoparia*), Prickly Shaggy Pea (*Podolobium ilicifolium*), and White Dogwood (*Ozothamnus diosmifolius*) are present. Common native grasses include Australian Basket Grass (*Oplismenus aemulus*), Snowgrass (*Poa sieberiana*) and Wiry Panic (*Entolasia stricta*). Two species of *Lomandra* are notable: Spiny-headed Mat-rush (*Lomandra longifolia*) and Wattle Matt-rush (*Lomandra filiformis*). Forbs include species such as Whiteroot (*Lobelia purpurascens*), *Vernonia cinerea,* and Slender Tick-trefoil (*Desmodium varians*). Other species present in smaller densities include Blue Flax-lily (*Dianella caerulea*) and Bracken (*Pteridium esculentum*). Due to the PCTs lack of disturbance, exotic species density is negligible.
Condition description	**High**: This community is in High condition with all layers intact. This vegetation zone has a high native species diversity in all vegetation layers. There is a low abundance and diversity of exotic forbs.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 1268 which also occur within the vegetation community in the construction envelope include: • Tallowwood (*Eucalyptus microcorys*) • Forest Oak (*Allocasuarina torulosa*) • Scrambling Lily (*Geitonoplesium cymosum*) • Native Raspberry (*Rubus parvifolius*) • Whiteroot (*Lobelia purpurascens*) • Bracken (*Pteridium esculentum*) • Blue Flax-lily (*Dianella caerulea*) • *Vernonia cinerea* • Spiny-headed Mat-rush (*Lomandra longifolia*) • Snowgrass (*Poa sieberiana*) • Slender Tick-trefoil (*Desmodium varians*).

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. The following PCTs were considered. • PCT 3244 and 3252 were considered as Tallowwood (*Eucalyptus microcorys*) comprises of the canopy species. These PCTs were determined to be unsuitable due to their landscape position which is on the low foothills, and broader species assemblage. • PCT 3251 showed a strong match comprising a similar floristic structure as per PCT 3254. This PCT occurs in the steep hinterland hills from the Macleay Valley. The environment is hot and wet with a mean annual rainfall typically between 1,000–1,370 mm. This PCT commonly occurs on metasediments; however, it is also known from volcanic or granitic substrates. This fits the location of this PCT within the Project area. • PCT 3253 was discounted due to the floristic description not being consistent with the vegetation on site. Frequent species in this PCT include Small-fruited Grey Gum (*Eucalyptus propinqua*), which often dominates with the highest foliage cover, and Turpentine (*Syncarpia glomulifera*). Neither species were recorded in the plot data for the vegetation on site. • PCT 3254 showed a strong match with the overstorey, with Tallowwood (*Eucalyptus microcorys*) as the dominating species with other known canopy species such as White Mahogany (*Eucalyptus acmenoides*). Forest Oak (*Allocasuarina torulosa*), an indicating species for this PCT, comprised largely of the mid-stratum, and floristic ground cover assemblages comprised a high cover of Snowgrass (*Poa sieberiana*) and other low abundance species, including Blue Flax-lily (*Dianella caerulea*), Climbing Guinea Flower (*Hibbertia scandens*), Spiny-headed Mat-rush (*Lomandra longifolia*) and Slender Tick-trefoil (*Desmodium varians*). PCT 3254 occurs mainly in mild, wet locations receiving 1,040–1,540 mm mean annual rainfall, at mid to high elevations of 250–830 m ASL. It occurs on meta-sedimentary substrates, on ridges which fits the location of this PCT within the Project area. This PCT is known to grade into PCT 3251 in drier or more exposed sites. This suggests that PCT 3254 is a better fit for the vegetation on site as it is in close proximity to areas of PCT 3251 though it is notably wetter and more sheltered. Based on the data we believe that PCT 3254 is the best fit PCT based on floristics and landscape position (wetter, sheltered areas), although PCT 3251 is also a strong fit. As legacy PCTs were used and PCT 3254 aligns with PCT 1268, this PCT was used in this assessment.
Status	Not listed
Estimate of percent cleared value of PCT across its distribution	15%
Patch size	High: >100 ha

Attribute	Description
Example photo	

Plate 5.9 PCT 1268 BAM plot photo

Table 5.14 PCT 1287 – Upland heath swamps of the New England Tableland Bioregion

Attribute	Description
PCT ID	1287
Common name	Upland heath swamps of the New England Tableland Bioregion
Vegetation class	Montane Bogs and Fens
Extent within the disturbance footprint	0 ha. This PCT occurs in 0.2 ha of high condition vegetation zone as an indirect impact only.
Survey effort	**Plots:** • High: URAT08, UR01-2024

Attribute	Description
Description and condition	This PCT is the smallest within the construction envelope. It is located on the Carrai Plateau, on relatively flat topography with impeded drainage. Part of this PCT is located at the beginning of the proposed access road. The PCT has a distinct lack of a canopy layer, with a sparse and scattered cover of species such as Broad-leaved Stringybark (*Eucalyptus caliginosa*) and Diehard Stringybark (*Eucalyptus cameronii*), particularly on the margins. The shrub layer contains a high cover of native species, with the following species from the Leptospermum genus dominant: *Leptospermum gregarium*, Prickly Tea-tree (*Leptospermum juniperinum*) and Tantoon (*Leptospermum polygalifolium*). Other shrubs such as *Baeckea omissa* and Coral Heath (*Epacris microphylla*) are also present. Certain species of native sedges and rushes also have a high cover; notably *Juncus* spp., *Lepidosperma* spp. and Saw-sedge (*Gahnia* sp.). *Lepyrodia* sp. and *Schoenus* sp. are also present with albeit with low cover and abundance. Most of the species diversity within this PCT is found within the groundcover layer. Forb species present in low densities include *Gonocarpus micranthus*, Brown Beaks (*Lyperanthus suaveolens*), and Kidney Weed (*Dichondra repens*). Native grass species within this PCT are also present in low densities. The common native grasses are Snowgrass (*Poa sieberiana*) and Kangaroo Grass (*Themeda triandra*). *Sphagnum cristatum* was also present in trace amounts in one of plots. Exotic species were not recorded in either plot undertaken in this PCT. It is expected that exotic species numbers would be low to non-existent due to the minimal disturbance history within this PCT.
Condition description	This community is in high condition with all layers intact. It should be noted that one area of this PCT has been partially cleared within the last 1.5 years (where the PCT intersects with the beginning of the proposed access road). Despite this, that area is still considered to be in High condition due to the native species diversity present, evidence of regeneration, and lack of exotic species. **High**: This vegetation zone may have scattered trees at most, or none at all, an intact shrub layer, and a high native species diversity in the understory. Only one exotic species in low cover and abundance was recorded in plots undertaken in this condition.
Characteristic species for identification of PCT	The species described in the BioNet Vegetation Classification database for PCT 1287 which also occur within the vegetation community in the construction envelope include: • Coral Heath (*Epacris microphylla*) • *Leptospermum gregarium* • *Gonocarpus micranthus* • *Lepyrodia* sp. (*Lepyrodia anarthria* is the species specified in the BioNet Vegetation Classification database) • *Schoenus sp.* (*Schoenus apogon*) is the species specified in the BioNet Vegetation Classification database) • *Sphagnum cristatum*.

Attribute	Description
Justification of evidence used to identify the PCT	Plot data for this PCT was compared to data held in the VIS Classification with the three dominant species in the overstorey, midstratum and groundcover entered into the PCT filter tool. Note that the term 'plot data' below is often interchangeable with 'vegetation on site'. The following PCTs were considered. • PCTs 3254, 3277, 3672, 3281, 3157, 3205, 3031, 3166, 3206, 3207, 3033, 2079 were found not to support species and vegetation formations consistent with the plot data and were rapidly discounted. • PCT 3944 is located within the Project area according to the state vegetation map type (DPE, 2022a); however, it was found not to support species consistent with the plot data. The vegetation description for PCT 3944 notes that this community tends to be replaced by PCT 3934 on wet habitats on coarse, sandy acidic alluvium. The plot is situated on sandy alluvium, likely explaining its greater affinity with PCT 3934. • PCT 3825 was found not to support species consistent with the plot data. It was also found to be inconsistent with the landscape position of the plot. The PCT is found on rocky outcrops which the plot is not located on, and the PCT occurs at elevations of 1,030-1,100 m ASL while the vegetation recorded on site is situated between 930–980 m ASL. • PCT 3934 is a strong match to the PCT recorded within the Project area. It is generally treeless; however, Wattle-leaved Peppermint (*Eucalyptus acaciiformis*), Mountain Gum (*Eucalyptus dalrympleana*) or White Sally (*Eucalyptus pauciflora*) may be present on swamp margins in small densities. None of these species were observed in the plot data, although six other canopy species listed in the PCT were consistent with the vegetation on site. The midstratum observed on site was somewhat consistent with the description for PCT 3934, with species such as Tantoon (*Leptospermum polygalifolium*), Bracken (*Pteridium esculentum*), and Lemon Bottlebrush (*Callistemon pallidus*) present. The species described as often dominant in the midstratum of PCT 3934 are Coral Heath (*Epacris microphylla*) and *Baeckea omissa*. Coral Heath (*Epacris microphylla*) was recorded within the plot but was not dominant. The ground layer of PCT 3934 is often dominated by sedge and rush species such as from the genera Lepyrodia, Baloskion, and Lepidosperma, and commonly includes sandy swamp-loving forbs such as *Gonocarpus micranthus*, and Swamp Iris (*Patersonia fragilis*). *Lepyrodia* sp. and *Gonocarpus micranthus* were both recorded in the plot, albeit in small quantities. Other widespread groundcover species listed in the description for PCT 3934 include Wiry Panic (*Entolasia stricta*), Kangaroo Grass (*Themeda triandra*), and Spiny-headed Mat-rush (*Lomandra longifolia*). These three species were also recorded in the plot. The landscape position of the PCT (sandy acid alluvium of gentle drainages and hanging swamps on granite and acid volcanic rocks) is consistent with the sandy soil in the plot and granodiorite present within the area surrounding the plot. This PCT elevation (850–1,400 m ASL) is also consistent with the plot elevation (930-940 m ASL). • PCT 3937 is another strong match to the vegetation recorded within the Project area. It consists of a dense to sparse tall shrub layer with *Baeckea omissa* dominant, and Coral Heath (*Epacris microphylla*) and Lemon Bottlebrush (*Callistemon pallidus*) also present. These species were recorded in the plot. Groundcover species described in PCT 3937 include *Lepyrodia scariosa, Xyris operculata,* Christmas Bells (*Blandfordia grandiflora*), and occasionally with Wiry Panic (*Entolasia stricta*). *Leyrodia* sp. and Wiry Panic (*Entolasia stricta*) were both recorded in the plot. Damp loving herbs within PCT 3937 commonly include *Drosera spatulata* and *Goodenia bellidifolia*, occasionally with *Gonocarpus micranthus*. *Gonocarpus micranthus* was recorded in this plot. This PCT occurs in broad slow drainages and hanging swamps on infertile sandy alluvium, at elevations of 850–1,100 m ASL. This is consistent with the landscape position of this plot, which is located on sandy soils between 930–940 m ASL. PCT 3934 and 3937 are both a match floristically, however they differ in the canopy species. Only one of the canopy species matched the vegetation on site in PCT 3937 (*Allocasuarina littoralis*) which is widespread and therefore not a good diagnostic species, while six species matched from PCT 3934. PCT 3934 was therefore selected as the best fit PCT. As the assessment uses legacy PCTs, PCT 1287 was used for this assessment.

Attribute	Description
Status	**BC Act** PCT 1287 is associated with Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions (Montane Peatlands and Swamps) EEC listed under the BC Act. PCT 1287 was review against the NSW Scientific Committee Final Determination for the EEC (NSW TSSC, 2010b). • The EEC is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. It occurs on undulating tablelands and plateaus, above 400–500 m ASL, generally in catchments with basic volcanic or fine-grained sedimentary substrates or, occasionally, granite. This is consistent with the soils, geology and landscape position of vegetation observed on site and more broadly. • The EEC may have small trees present as scattered emergents or absent from the community. The PCT observed on site and more broadly has a distinct lack of a canopy layer, with a sparse and scattered cover of Eucalypt species recorded adjacent to the vegetation on site are not listed in the final determination. This is considered consistent with the EEC. • The EEC typically has an open to very sparse layer of shrubs, 1–5 m tall, including species of *Baeckea*, *Callistemon* and *Leptospermum*. This is consistent with the vegetation observed on site and more broadly across the Carrai plateau. • Species recorded within the PCT, which are consistent with the EEC, include Prickly Tea-tree (*Leptospermum juniperinum*) and Tantoon (*Leptospermum polygalifolium*), Coral Heath (*Epacris microphylla*), *Juncus* spp., Saw-sedge (*Gahnia* sp.). *Lepyrodia* sp. and *Schoenus* sp*., Gonocarpus micranthus,* Snowgrass (*Poa sieberiana*) and *Sphagnum cristatum*. • The EEC is the only type of wetland that may contain more than trace amounts of *Sphagnum* spp. Sphagnum was recorded in the plot data, albeit in trace amounts. Based on the above, it is concluded that PCT 1287 is part of the Montane Peatlands and Swamps EEC.
Estimate of percent cleared value of PCT across its distribution	30%
Patch size	High: >100 ha

5.3.3 Vegetation integrity scores

The following PCTs occur in the disturbance footprint, with vegetation zones mapped and/or entered into the credit calculator to determine vegetation integrity scores. A summary of the vegetation integrity score for each vegetation zone is provided in Table 5.15. The vegetation integrity score is based on the plot data which is compared with benchmark values for each vegetation type.

Table 5.15 Vegetation zone and impact summary

PCT ID	PCT name	Vegetation zones	Extents within disturbance footprint (ha)	Indirect impacts (ha)	Vegetation integrity score
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate	0.5	0.4	55.5
		DNG Moderate	0.2	0.4	0.8
		Poor	0.3	0.3	47.8
		Exotic Grassland	1.6	1.2	3.9

PCT ID	PCT name	Vegetation zones	Extents within disturbance footprint (ha)	Indirect impacts (ha)	Vegetation integrity score
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	168.9	95.6	75.7
		DNG Moderate	37.1	14.0	15
		Poor	1.6	2.9	42.8
		Exotic Grassland	3.7	5.5	1.9
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	61.4	21.0	66.5
		Dry	6.6	6.1	70.8
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	High	7.2	1.6	73.1
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	10.5	8.4	71.4
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High	0.5	1.4	46.2
		Moderate	2.3	3.8	64.8
		Moderate RF	0.9	0.9	62.4
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5.0	0.5	40.6
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	High	52.1	60.6	64.9
		DNG Moderate	1.2	0.4	41
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	High	1.1	1.0	77
1287	Upland heath swamps of the New England Tableland Bioregion	High	0	0.2	55.2

5.3.4 Threatened ecological communities

Candidate TECs were identified in Section 5.3.2 through review of the TEC associations in the BioNet Vegetation Classification database for PCTs recorded in the disturbance footprint. A summary is provided in Table 5.16 for TECs listed under the BC Act and Table 5.17 for TECs listed under the EPBC Act.

Table 5.16 BC Act threatened ecological communities within the disturbance footprint by vegetation zone

PCT ID	PCT Name	TEC Name	Vegetation zones consistent with TEC	Extent in disturbance footprint (ha)
762	Cabbage Gum open forest or woodland on flats of the North Coast	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (BC Act)	Moderate, Poor, DNG Moderate	1.0 Please note this TEC was not associated with Carrai Plateau and Macleay Gorges IBRA sub-regions and therefore could not be included in the BAM-C. Therefore, credits have only been generated for the PCT only, not the TEC. For this assessment we have associated this TEC with these IBRA sub-regions.
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (BC Act)	Moderate, High	2.8 Please note this TEC was not associated with Carrai Plateau and Macleay Gorges IBRA sub-regions and therefore could not be included in the BAM-C. Therefore, credits have only been generated for the PCT only, not the TEC. For this assessment we have associated this TEC with these IBRA sub-regions.
		Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion (BC Act)	Moderate RF	0.9 Please note this TEC was not associated with Carrai Plateau and Macleay Gorges IBRA sub-regions and therefore could not be included in the BAM-C. Therefore, credits have only been generated for the PCT only, not the TEC. For this assessment we have associated this TEC with these IBRA sub-regions.
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (BC Act)	Moderate	5.0 This TEC was not associated with PCT 1142, or the Carrai Plateau and Macleay Gorges IBRA sub-regions. For this assessment it has been associated with PCT 1142 and Macleay Gorges IBRA sub-region. This TEC association could not be entered into the BAM-C. Therefore, credits have only been generated for the PCT only, not the TEC.

PCT ID	PCT Name	TEC Name	Vegetation zones consistent with TEC	Extent in disturbance footprint (ha)
1287	Upland heath swamps of the New England Tableland Bioregion	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	High	0 This TEC is only impacted indirectly by the Project.

Table 5.17 EPBC Act threatened ecological communities within the disturbance footprint by vegetation zone

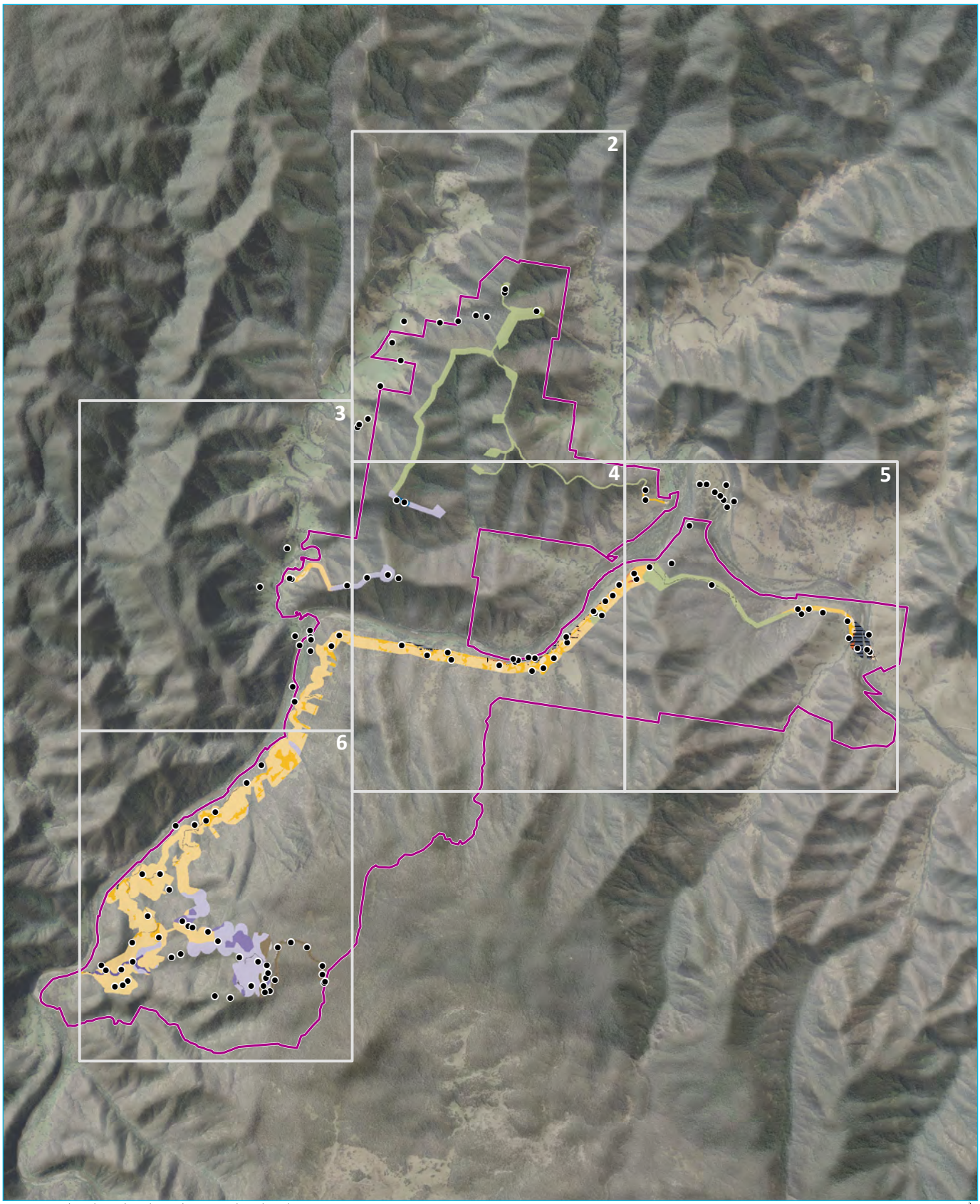
PCT ID	PCT Name	TEC Name	Vegetation zones consistent with TEC	Extent in disturbance footprint (ha)
762	Cabbage Gum open forest or woodland on flats of the North Coast	Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions (EPBC Act)	Moderate (part), Poor (part)	0.3

i Areas not considered to be part of a TEC

The EPBC Act listed TECs predicted to occur in the locality based on searches of the PMST were also considered:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland:
  - This CEEC was determined not to occur within the construction envelope. There is no PCT within the construction envelope that is dominated or co-dominated by the diagnostic species (i.e. White Box (*Eucalytpus albens*), Yellow Box (*Eucalyptus melliodora*), or Blakely's Red Gum (*Eucalyptus blakelyi*)) for this CEEC. Exceptions to this apply for ecological communities located in the Nandewar Bioregion. As the site is not located in the Nandewar Bioregion, this is not considered relevant (DEH, 2006).
- Lowland Rainforest of Subtropical Australia:
  - This CEEC was determined not to occur within the construction envelope as no PCTs within the construction envelope meet the species richness required. The justification for not including this CEEC is discussed in Table 5.8 as this CEEC was also identified in the BioNet Vegetation Classification database, and Table 5.9 as PCT 1142 is floristically similar to the CEEC.
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland:
  - This EEC was determined not to occur within the construction envelope for two reasons. Firstly, this EEC occurs within 20 km of the coast while the Project area is located approximately 65 km from the coast. Secondly, the canopy species within this EEC are dominated by Melaleuca spp. and/or Swamp Mahogany (*Eucalyptus robusta*). This canopy composition is not reflective of any of the PCTs located on site (DAWE, 2021).

- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands:
    - This CEEC was determined not to occur within the construction envelope as one of the key diagnostic requirements for this CEEC is an overstory dominated or co-dominated by New England Peppermint (*Eucalyptus nova-anglica*) (NSW TSSC, 2011c). This does not correlate with any of the PCTs identified on site.



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km
GDA 1994 MGA Zone 56
N

KEY

- Project area
- BAM plot location
- Track/Road

Threatened ecological community
- BC Act
- EPBC Act

PCTID | Condition
- 1106 | High
- 1106 | Moderate
- 1106 | Moderate RF
- 1106 | Poor RF
- 1142 | Moderate
- 1215 | DNG Moderate
- 1215 | High
- 1268 | High
- 1287 | High
- 762 | DNG Moderate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 780 | Moderate
- 842 | DNG Moderate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High
- 979 | High
- 988 | High

Native vegetation
Map 1 of 6

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 5.1

EMM creating opportunities

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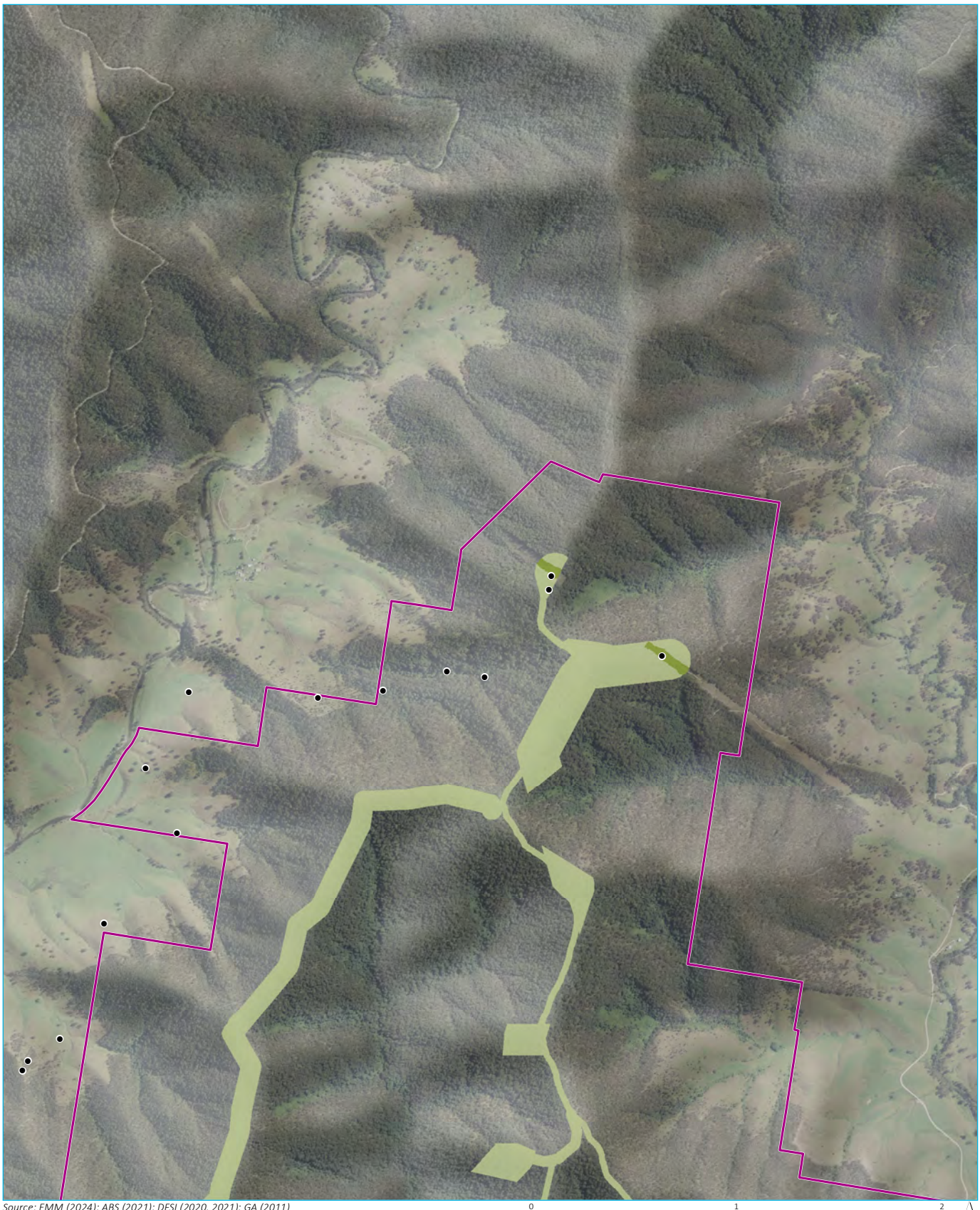

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- BAM plot location
- Track/Road

PCTID | Condition

- 1215 | DNG Moderate
- 1215 | High
- 762 | EG
- 842 | EG
- 868 | High

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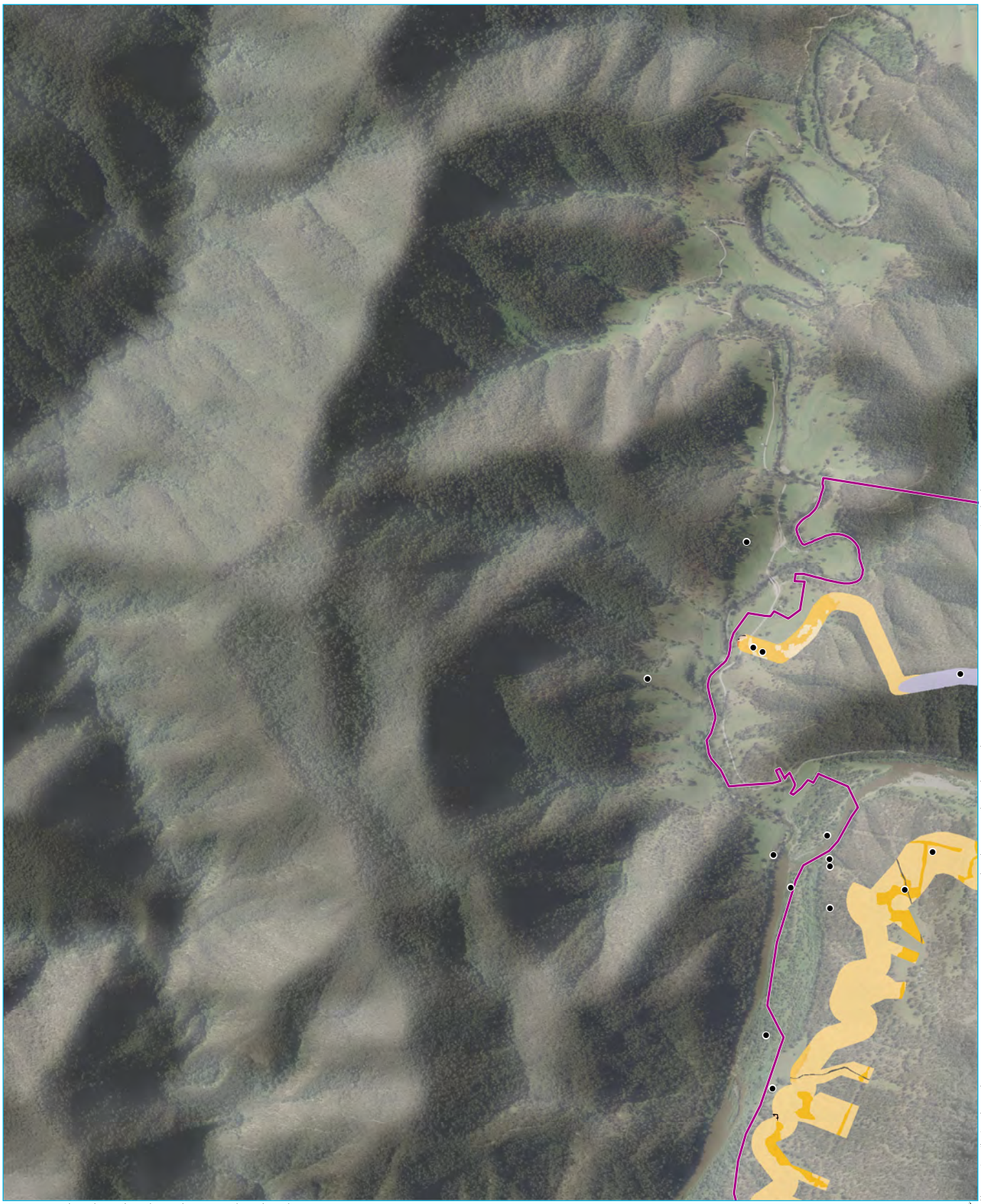
Native vegetation
Map 2 of 6

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 5.1

EMM
creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- BAM plot location
- Track/Road
- Threatened ecological community
- BC Act
- EPBC Act
- PCTID | Condition
- 1106 | High
- 1106 | Moderate
- 1215 | High
- 762 | DNG Moderate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNG Moderate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High

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Native vegetation
Map 3 of 6

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 5.1

EMM
creating opportunities

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- BAM plot location
- Track/Road
- Threatened ecological community
- BC Act
- EPBC Act
- PCTID | Condition
- 1106 | High
- 1106 | Moderate
- 1106 | Moderate RF
- 1106 | Poor RF
- 1215 | High
- 1268 | High
- 762 | DNG Moderate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNG Moderate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High

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Native vegetation
Map 4 of 6

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 5.1

EMM
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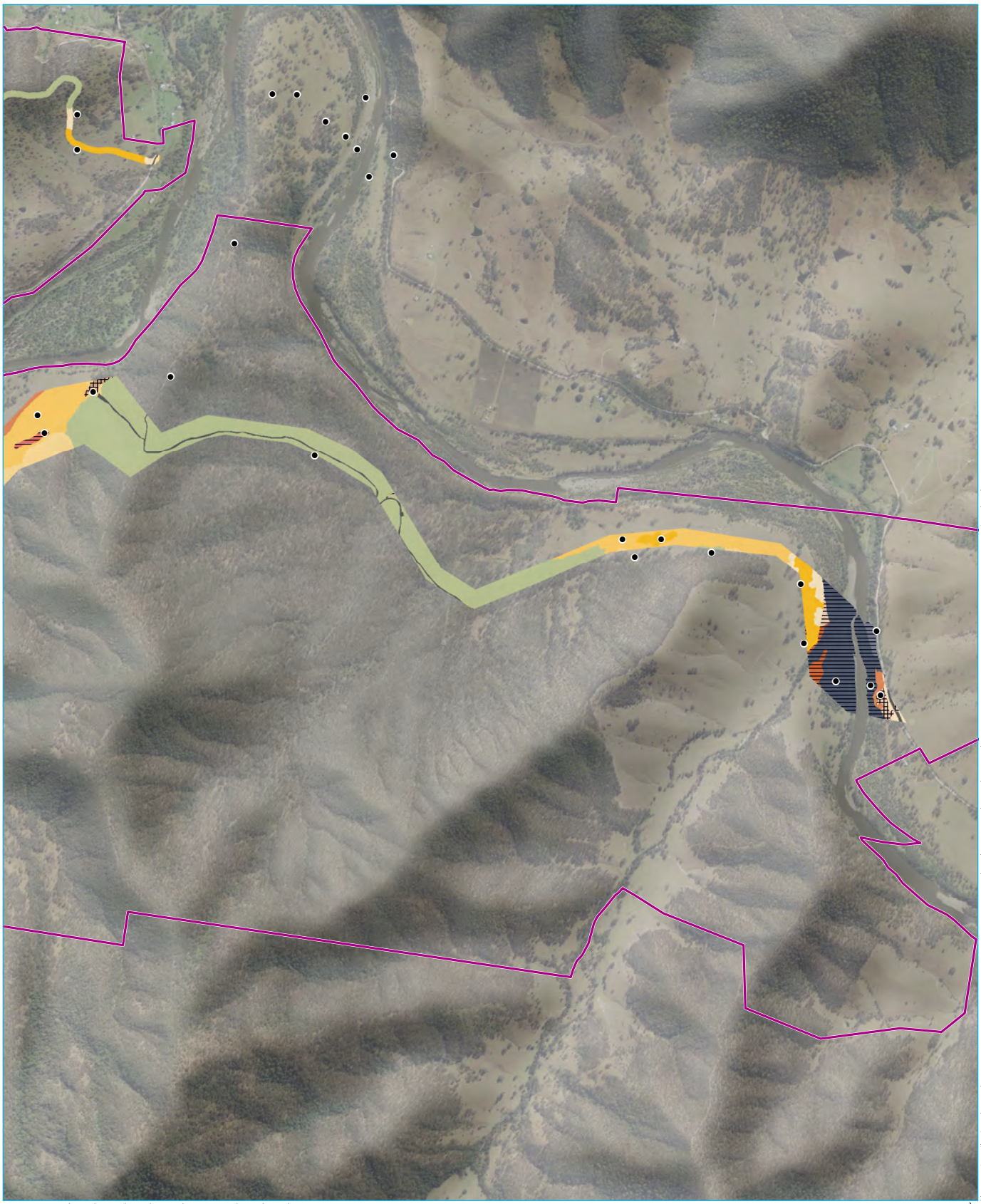

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- BAM plot location
- Track/Road
- Threatened ecological community
- BC Act
- EPBC Act
- PCTID | Condition
- 1106 | High
- 1106 | Moderate
- 1106 | Moderate RF
- 1215 | High
- 762 | DNG Moderate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 780 | Moderate
- 842 | DNG Moderate
- 842 | EG
- 842 | High
- 842 | Poor

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Native vegetation
Map 5 of 6

Oven Mountain Pumped Hydro Energy Storage Project
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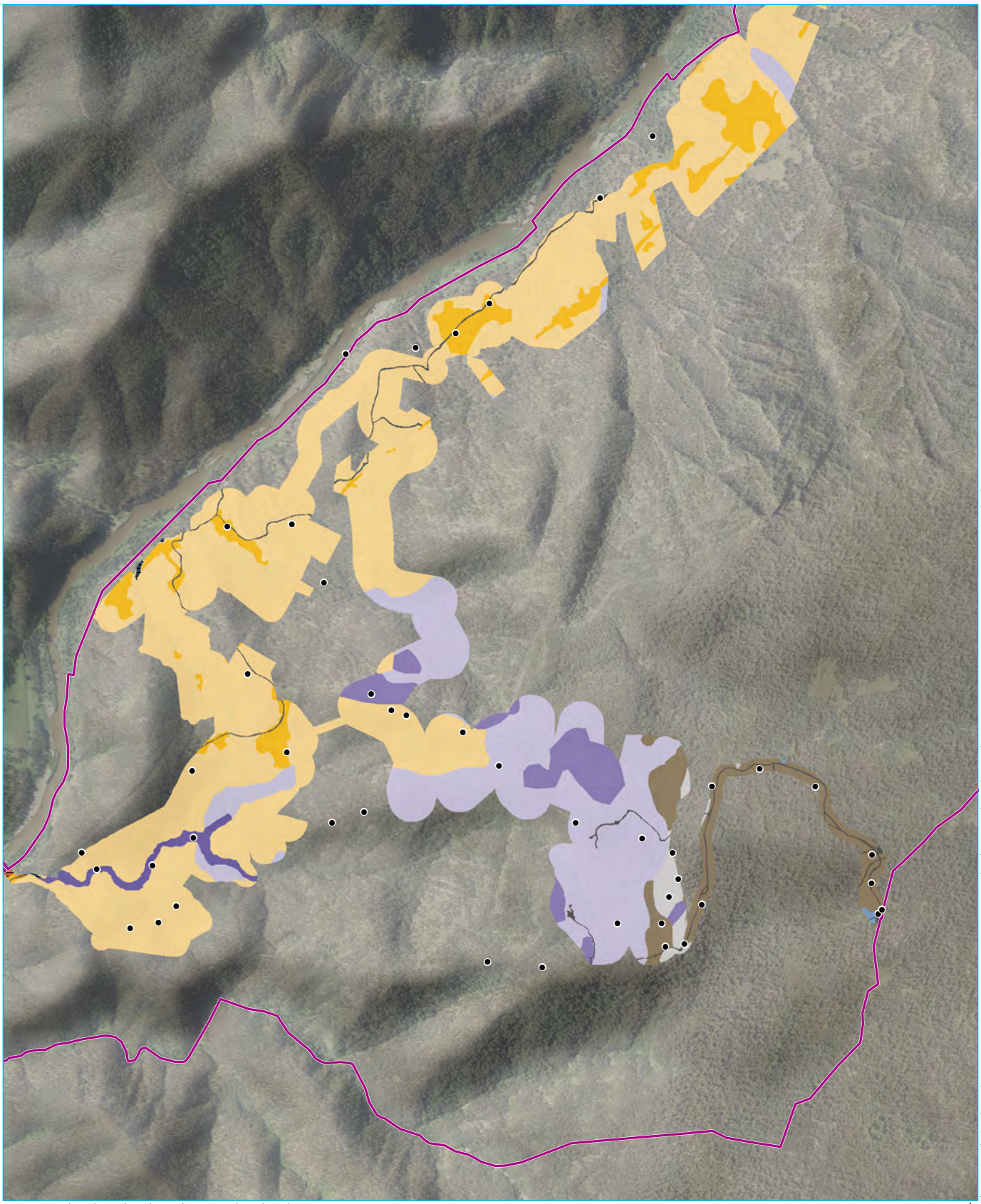
Figure 5.1

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- BAM plot location
- Track/Road

Threatened ecological community

- BC Act

PCTID | Condition

- 1106 | High
- 1142 | Moderate
- 1287 | High
- 762 | DNG Moderate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNG Moderate
- 842 | EG
- 842 | High
- 868 | Dry
- 868 | High
- 979 | High
- 988 | High

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Native vegetation
Map 6 of 6

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Figure 5.1

EMM
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6 Threatened species

6.1 Threatened species habitat description

Concurrent with the vegetation mapping, a habitat assessment was undertaken seeking to identify the following threatened species habitat features within the Project area:

- habitat trees including large hollow bearing trees
- availability of flowering shrubs and feed tree species
- waterway condition
- quantity of ground litter and logs
- cliffs, rocky areas, cave and roosting features
- searches for indirect evidence.

The majority of the Project area is vegetated with disturbance limited to areas where there has been historical use for logging and areas of lower elevation along the Macleay which have been subject to low level clearing associated with grazing activities.

The Project area contains an abundance of fauna habitat features such as cliffs, rocky areas and gorges, suitable to provide refuge habitat for a number of threatened species. Hollow bearing trees are mostly restricted to the steep hills and rocky areas, including along gorges and steeper creek lines, inaccessible for logging. Features, such as fallen timber, are still prevalent throughout the Project area after the 2019/2020 bushfires, with higher abundances associated with areas less impacted by the fires such as creek lines and gorges. The Project area has a very high level of connectivity with surrounding National Parks and forested private properties.

The two reservoirs and associated ancillary facilities are located on a western facing aspect of the Carrai Plateau. As a result, vegetation comprises dry sclerophyll forests with only small areas of remnant rainforest and wetter sclerophyll forests generally restricted to creek lines associated with the Macleay River. As such, associated rainforest species that would be found in the local area would be considered less frequent along the western facing aspects of the Plateau.

Areas of higher elevation, on upper slopes and on the Carrai Plateau, provide a cooler climate and support a mix of escarpments, rocky outcrops, cliffs and steep sections with exposed rock, along with flatter topography on the upper slopes and plateau. These areas support tall forests with a dense groundcover and moderate shrub density, providing suitable coverage for fauna species; these areas also contained the largest number of mature trees and hollows. Escarpments and rocky areas were less vegetated due to shallow soils. Wetter areas of flatter topography on the Carrai Plateau support bogs and fens. These upper slopes contained the least amount of disturbance and are considered suitable to support an array of threatened species.

The lower slopes in the southern section of the Project area had more evidence of impacts from human disturbance, such as grazing, and supported a higher amount of weed species. Minimal areas of clearance for grazing were observed, yet fewer mature trees that support hollows are located in this section, even in areas of higher ground and down steeper slopes. Shrub and ground cover varied in sections; steep aspects were drier and dominated by grass cover, lacking shrubs, while shaded, wetter areas, generally on an east or southern aspect, were observed to contain a higher cover of dense shrubs. The area contained large areas of rocky sections, steep gorges and ephemeral creeks that only flowed during high rainfall. Two creeks contained pooling that may hold water for longer periods after the creeks cease flowing.

The Macleay River flows from south to north along the western boundary of the Project area, turning to the east at Georges Junction. Habitat along the Macleay River includes small open grassland areas used for low intensity grazing. This area contained a limited amount of large hollow bearing trees with such trees limited to riparian zones and fields in the furthest eastern section of the Project area. The shrub layer was open with some small areas containing dense thickets of *Melaleuca* sp. Habitat along the floodplain contained areas of steep rocky slopes that lead to flatter areas of the flood plain that was largely covered by long grasses and weed species. A large number of 1st to 3rd order creeks flow from the higher elevations into the Macleay River. Some creek lines contained remnant rainforest patches, though mostly adjacent to the Macleay River; these creeks are impacted by weed species. Areas along the floodplain were also observed to be impacted by higher cover of weed species. Shrub species, excluding weed species, were observed to be less dominant in this area with groundcover largely comprising grasses, forbs and weeds.

North of the Macleay River the Project area rises from the Macleay River valley to a ridgeline with various aspects. Steep gullies and slopes with an easterly aspect contain wet sclerophyll forests habitat in gullies with rainforest habitat in lower elevation areas. For the other aspects, habitat was dry and in places contained areas of thick climbers and shrubs that have recolonised after the 2019/2020 bush fires. This area contains some mature trees with hollows, with the understorey largely intact with thick shrub and groundcover. This habitat was considered to provide suitable habitat to support various threatened species.

6.2 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE, 2020a), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the Project area, based on the PCTs present and generated by the calculator associated within the BAM is provided in Table 6.1. The potential for these species to occur within the Project area was assessed in accordance with Section 5.2.2 of the BAM (DPIE, 2020a).

Table 6.1 Assessment of ecosystem credit species within the Project area

Scientific name	Common name	Associated PCTs	Habitat constraint	Geographic constraint	Justification for addition or exclusion
Amaurornis moluccana	Pale-vented Bush-hen	1106 and 1268	-	North of South West Rocks	Excluded, geographic limitation is north of South West Rocks.
Anthochaera phrygia	Regent Honeyeater (Foraging)	842, 868, 1106 and 1215	-	-	Included based on associated PCT(s) and IBRA subregion.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	768, 842, 868, 979,988, 1106, 1268 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.
Botaurus poiciloptilus	Australasian Bittern	1106 and 1287	• Waterbodies. • Brackish or freshwater wetlands.	-	Included based on associated PCT(s) and IBRA subregion.
Chalinolobus nigrogriseus	Hoary Wattled Bat	762, 842, 868, 1106 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.

Scientific name	Common name	Associated PCTs	Habitat constraint	Geographic constraint	Justification for addition or exclusion
Chthonicola sagittata	Speckled Warbler	762, 842, 868 and 1215	-	-	Included based on associated PCT(s) and IBRA subregion.
Circus assimilis	Spotted Harrier	1106 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	762, 842, 868, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Coracina lineata	Barred Cuckoo-shrike	762, 842, 868, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Daphoenositta chrysoptera	Varied Sittella	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Dasyurus maculatus	Spotted-tailed Quoll	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Ephippiorhynchus asiaticus	Black-necked Stork	1106 and 1287	• Swamps. • Shallow lakes, lake margins and estuaries within 300 m of these waterbodies.	-	Excluded, no swamps, shallow freshwater, shallow lakes or estuaries within the Project area suitable to support this species.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	762, 842, 868, 979, 988, 1106 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Glossopsitta pusilla	Little Lorikeet	762, 842, 868, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Hirundapus caudacutus	White-throated Needletail	762, 842, 868, 979, 988, 1106, 1215, 1268 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.

Scientific name	Common name	Associated PCTs	Habitat constraint	Geographic constraint	Justification for addition or exclusion
Ixobrychus flavicollis	Black Bittern	1106	• Waterbodies. • Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation.	-	Included based on associated PCT(s) and IBRA subregion.
Lathamus discolor	Swift Parrot (Foraging)	762, 842, 868, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Lophoictinia isura	Square-tailed Kite (Foraging)	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	762, 842, and 868	-	-	Included based on associated PCT(s) and IBRA subregion.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	762, 842, 868, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Neophema pulchella	Turquoise Parrot	842, 868, and 1106	-	-	Included based on associated PCT(s) and IBRA subregion.
Petaurus australis	Yellow-bellied Glider	762, 842, 868, 979, 988, 1215 and 1268	• Hollow bearing trees. • Hollows >25 cm diameter.	-	Included based on associated PCT(s) and IBRA subregion and presence of habitat constraints.
Petroica boodang	Scarlet Robin	762, 842, 868, 979, 988, 1106, 1215 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.
Petroica phoenicea	Flame Robin	762 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.
Phoniscus papuensis	Golden-tipped Bat	868, 1106 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	842, 868, 979, 988, 1106 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.

Scientific name	Common name	Associated PCTs	Habitat constraint	Geographic constraint	Justification for addition or exclusion
Pseudomys oralis	Hastings River Mouse	None	-	-	Not predicted by BAM-C as no associated PCTs present, but species included as it was recorded within the construction envelope.
Ptilinopus magnificus	Wompoo Fruit-Dove	None	-	-	Not predicted by BAM-C as no associated PCTs present, but species included as it was recorded within the construction envelope.
Ptilinopus superbus	Superb Fruit-Dove	1106	-	-	Included based on associated PCT(s) and IBRA subregion.
Rostratula australis	Australian Painted Snipe	1106	-	-	Excluded, as this species is associated with wetland and marsh habitat which is absent within the Project area.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	762, 842, 868, 979, 988, 1106, 1215, 1268 and 1287	-	-	Included based on associated PCT(s) and IBRA subregion.
Scoteanax rueppellii	Greater Broad-nosed Bat	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	Included based on associated PCT(s) and IBRA subregion.
Stagonopleura guttata	Diamond Firetail	762, 842, 868, 1106 and 1215	-	North of Kempsey and west of Skillion Nature Reserve.	Included based on associated PCT(s) and IBRA subregion and within geographic constraint.
Stictonetta naevosa	Freckled Duck	1106	-	-	Included based on associated PCT(s) and IBRA subregion.
Syconycteris australis	Common Blossom-bat	1268	-	-	Included based on associated PCT(s) and IBRA subregion.

6.3 Species credit species

6.3.1 Candidate species assessment

In accordance with Step 3 (Section 5.2.3 of BAM (DPIE, 2020a)), a field assessment of habitat constraints and microhabitats was undertaken in the field to determine the suitability of habitat within the Project area for:

- predicted species (ecosystem credit species associated with recorded PCTs, predicted by the BAM Calculator (BAMC))
- candidate species (species credit species associated with specific geographic and landscape feature constraints)
- candidate species as per the SEARs
- species predicted to occur by the EPBC Act Protected Matters Search Tool.

Candidate species predicted by the BAMC are shown in Table 6.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2.1 to 5.2.3) of the BAM.

Table 6.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Flora								
Acacia courtii	North Brother Wattle	1268	-	-	Queens Lake (Laurieton) to Johns River	-	No	Excluded. Project area is outside of its geographic restriction.
Asperula asthenes	Trailing Woodruff	762, 868 and 1106	-	-	-	-	-	Included. Microhabitat: Occurs in damp sites, often along riverbanks. This species is associated with PCTs located in the Macleay Hastings IBRA subregion. The stream and creek lines that run into the Maclear River are ephemeral, with rocky areas that can trap areas of water creating small areas of damp habitat that may be suitable for this species. Species excluded from exotic grasslands.
Banksia conferta	*Banksia conferta*	842	-	-	West of the Pacific Highway, south of Oxley Highway and south and east of the Wauchope to Wingham Road	-	No	Excluded. Project area is outside of its geographic restriction.
Bertya ingramii	*Narrow-leaved Bertya*	No associated PCT	• Cliffs. • Or within 20 m/escarpments. • Or within 20 m/rocky areas. • Or within 20 m.	-	-	-	Yes	Included. Microhabitat: Grows among rocks or in thin soils close to cliff-edges in dry woodland with she-oaks, wattles and tea-trees.
Callistemon pungens	*Callistemon pungens*	No associated PCT	-	-	-	-	-	Included. Microhabitat: Grows along rivers and creeks. The Project area contains suitable habitat for this species.
Cryptostylis hunteriana	Leafless Tongue Orchid	842, 868, 1106, 1215 and 1268	-	-	-	-	-	Included. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The Project area contains suitable habitat for this species.
Cynanchum elegans	White-flowered Wax Plant	842 and 1215	-	-	-	-	-	Included. Microhabitat: Usually occurs on the edge of dry rainforest vegetation. The Project area contains suitable habitat for this species.
Dendrobium melaleucaphilum	Spider orchid	1106	-	-	-	-	-	Included. Microhabitat: Grows frequently on *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks in coastal districts. The Project area contains marginal habitat for this species, with a general lack of suitable host trees or habitat. Areas of DNG and exotic grassland that lack any canopy species are considered unsuitable for this species. Species excluded from DNG and exotic grasslands.
Diuris eborensis	*Diuris eborensis*	No associated PCT	-	-	-	-	-	Included. Microhabitat: Found mainly in damp grassland and woodland sites or in areas of sedge and swampy sites. Main locations are higher altitude. Project area contains some marginal habitat for this species.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Diuris disposita	Willawarrin Doubletail	1215 and 1268	-	-	-	-	-	Included. Species is only known from Willawarrin, not much is known about its habitat.
Diuris pedunculata	Small Snake Orchid	No associated PCT	-	-	-	-	-	Included. Microhabitat: Grows on grassy slopes or flats in peaty or mist areas. Also, can occur on shale and traps soils among boulders. Project contains habitat for this species.
Eucalyptus seeana - endangered population	*Eucalyptus seeana* population in the Greater Taree local government area	762, 842, 868, 1106, 1215, 1268 and 1287	-	-	Greater Taree LGA	-	No	Excluded. Project area is outside of its geographic restriction.
Eucalyptus magnificata	Northern Blue Box	842	-	-	-	-	-	Included. Microhabitat: Occurs in grassy open forests and woodlands on moderately hilly sites and at the edge of gorges, usually at altitudes from 900–1,050 m. Only a small area of the site occurs above 900 m on hilly terrain.
Euphrasia arguta	*Euphrasia arguta*	No associated PCT	-	-	-			Included. Microhabitat: Occurs in eucalypt forests with mixed grass and shrub understorey. Semi-parasitic species that attaches to roots of other plants. The Project area contains suitable habitat for this species.
Grevillea beadleana	Beadle's Grevillea	842	• Cliffs. • Or within 20 m of escapements or rocky areas. • Or within 200 m of these features.	-	-	-	Yes	Included. Microhabitat: Open eucalypt forest and woodland with a shrubby understorey on granite. The Project area contains suitable habitat for this species.
Grevillea guthrieana	Guthrie's Grevillea	842 and 868	-	-	-	-	-	Included. Microhabitat: Grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil. The Project area contains suitable habitat for this species.
Hakea archaeoides	Big Nellie Hakea	1268	-	-	2 disjunct populations (West of Pacific Highway and either (1) South of Macleay River and Dungay Creek and north of Oxley and Papinbarra rivers, or (2) South of Oxley Highway and south and east of Wauchope to Wingham Road)	-	No	Excluded. Project area is outside of its geographic restriction.
Hakea fraseri	Gorge Hakea	842	• Rocky areas. • Rocky slopes of river gorges or gorge rims or within 50 m.	-	-	-	Yes	Included. Microhabitat: Mainly occurs on the dry and steep rocky slopes of river gorges. The Project area contains suitable habitat for this species.
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	842 and 868	-	-	-	-	-	Included. Microhabitat: Grows in damp places near watercourses and in woodland on the steep rocky slopes of gorges. Local occurrences of the species are from creek lines and the floor of a gully on rocky colluvial soil and alluvium. The project area contains suitable habitat for this species.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Hibbertia hexandra	Tree Guinea Flower	1268	-	-	-	-	-	Included. Microhabitat: Typically grows in heath, open forest or rainforest. The Project area contains suitable habitat for this species.
Lepidium peregrinum	Wandering Pepper Cress	No associated PCT	-	-	-	-	-	Included. Not associated with any PCTs on site. This species was recorded during targeted flora surveys. Restricted to the floodplain along the Macleay River, largely on the eastern bank.
Lindernia alsinoides	Noah's False Chickweed	762	• Damp areas or adjacent to riparian areas (including disturbed areas) or swamps). • Shallow, freshwater areas.	-	-	-	Yes	Included. Microhabitat: Grows in swamp forests and wetlands along coastal and hinterland creeks. Project area contains damp areas, but no swamp forests or wetlands along creek-lines.
Marsdenia longiloba	Slender Marsdenia	1268	-	-	-	-	-	Included. Microhabitat: Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.
Maundia triglochinoides	*Maundia triglochinoides*	No associated PCT	• Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep/Semi-permanent/ephemeral wet areas/Swamps • Shallow swamps up to 1 m deep/Waterbodies • Shallow waterbodies up to 1 m deep	-	-	-	Yes	Excluded. This species is restricted to coastal NSW and extending into southern Queensland. Microhabitats such as swamps, lagoons, dams, channels, creeks or shallow freshwater 30–60 cm deep on heavy clay, low nutrients are absent from the construction envelope.
Melaleuca biconvexa	Biconvex Paperbark	762, 1106, 1215 and 1268	-	-	South of Kempsey	-	No	Excluded. Project area is outside of its geographic restriction.
Melaleuca groveana	Grove's Paperbark	1215 and 1268	-	-	-	-	-	Included. Microhabitat: Grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs. The Project area contains some suitable habitat to support this species.
Niemeyera whitei	Rusty Plum, Plum Boxwood	1268	-	-	-	-	-	Included. Microhabitat: Found in gully, warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest. Occurs on poorer soils in areas below 600 m above sea level. The Project area contains some suitable habitat to support this species. Areas of DNG and exotic grassland are not considered suitable habitat for this species due to a lack of trees. Species excluded from DNG and exotic grasslands.
Oberonia titania	Red-flowered King of the Fairies	1268	-	-	-	-	-	Included. Microhabitat: Occurs in littoral and subtropical rainforest and paperbark swamps, but it can also occur in eucalypt-forested gorges and in mangroves. The Project area contains some suitable habitat to support this species. Areas of DNG and exotic grassland do not support suitable host plants or rocky habitats for this species. Species excluded from DNG and exotic grasslands.
Parsonsia dorrigoensis	Milky Silkpod	1215 and 1268	-	-	-	-	-	Included. Microhabitat: Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800 m, on brown clay soils. The Project area contains some suitable habitat to support this species.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Pomaderris queenslandica	Scant Pomaderris	1215 and 1268	-	-	-	-	-	Included. Microhabitat: Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. The Project area contains some suitable habitat to support this species. Areas of DNG and exotic grassland contain weed invasion and considered marginal habitat for this species. Species excluded from DNG and exotic grasslands.
Rhodamnia rubescens	Scrub Turpentine	1142	-	-	-	-	-	Included. Microhabitat: Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Not associated with any PCT; however, the Project area contains suitable habitat to support this species and specimens were recorded in the fringes of PCTs within the Project area. Areas of DNG and exotic grassland considered marginal habitat for this species. Species excluded from DNG and exotic grasslands.
Pultenaea rubescens	*Pultenaea* sp. Werrikimbe NP	No PCT associations exist for this species.	• Swamps. • Swamp margins or creek edges/waterbodies. • Waterbody margins, drainage lines, creek edges or within 50 m.	-	-	-	Yes	Included. Microhabitat: The species grows in swampy drainage depressions in Eucalypt forest with a sparse canopy, with a ground layer of grasses, sedges and forbs, in sand over granite, at 900–1,030 m altitude (Barrett, in prep 2023). This species is not associated with any PCTs within the study area. Specimens of a *Pultenaea* sp. recorded on site during targeted surveys have been sent to herbarium for identification but could not be definitively identified at that time. At the time of survey, it was considered that the specimen could be Parris' Bush-pea (*Pultenaea parrisiae*) or a yet undescribed *Pultenaea* species. In July 2023 confirmation was received from the herbarium that the plants recorded on site were a new species for the genus. There is an existing phrase name for this taxon; *Pultenaea* sp. Werrikimbe NP. However, it is proposed to recognise this as a distinct species, *Pultenaea rubescens* (Barrett, in prep 2023).
Sarcochilus fitzgeraldii	Ravine Orchid	979, 988	• Exposed rockfaces and vertical moist cliffs • Exposed rockfaces and boulders	-	-	-	Yes	Included. Microhabitat: Grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. The Project area contains some marginal habitat that may support this species.
Senna acclinis	Rainforest Cassia	842, 868 and 1106	-	-	-	-	-	Included. Microhabitat: Grows on the margins of subtropical, littoral and dry rainforests. The project area contains suitable habitat to support this species. Areas of DNG and exotic grassland do not support shrubs likely to be *Senna* sp. and are considered marginal habitat for this species. Species excluded from DNG and exotic grasslands.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Tylophora woollsii	Cryptic Forest Twiner	Not associated with a PCT[1]	-	-	-	-	-	Included. Microhabitat: Grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. This species is not associated with any PCTs within the study area. A number of possible records of the species have been recorded during targeted surveys but could not be confirmed as Cryptic Forest Twiner. Specimens have been sent to the herbarium for identification but could not be definitively identified due to a lack of fertile material. The known locations of this species were resurveyed in the flowering period in 2023 and 2024. Both survey efforts failed to observe this species in flower, which is the key distinguishing feature to identify this species from the more Thin-leaved Twiner (*Tylophora paniculata*). Due to the lack of flowering specimens, samples were undertaken in 2024 for genetic analysis. Genetic analysis showed that the plants sampled from the Project area are genetically similar to both the Thin-leaved Twiner and Cryptic Forest Twiner. Based on the data analysis conducted to date, the species may not be clearly distinguishable based on commonly used plant genetic barcodes. Using the precautionary principle, the records within the construction envelope remain as assumed to be Cryptic Forest Twiner.
Fauna								
Aepyprymnus rufescens	Rufous Bettong	762, 842, 868, 979, 988,, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Forest and woodland with a with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. DNG and exotic grassland PCTs and fragment vegetation zones does not contain a dense cover of tall native grasses and these zones are considered unlikely to be potential habitat for this species. Other vegetation zones contain patches of dense ground layer vegetation and are considered potential habitat. Species excluded from DNG, exotic grasslands and fragmented zones.
Anthochaera phrygia	Regent Honeyeater (Breeding)	842, 868, 1106 and 1215	• As per mapped areas.	-	-	-	No	Excluded. Project area is not within mapped areas.
Argynnis hyperbius	Australian Fritillary	N/A	• Arrowhead Violet (*Viola betonicifolia*)	-	Within 15 km of coast	-	No	Excluded. Project area is outside of its geographic restriction and does not meet this species habitat constraints.
Burhinus grallarius	Bush Stone-curlew	762, 842, 868, 1106, 1215 and 1268	• Fallen/standing dead timber including logs.	-	-	-	Yes	Included. Microhabitat: Open forests and woodlands with a sparse grassy ground-layer and fallen timber. The majority of vegetation zones within project area support fallen/standing dead timber including logs. Areas of DNG and exotic grassland vegetation zones lack suitable habitat such as fallen timber and are unlikely suitable for this species. Species excluded from DNG and exotic grasslands.
Calidris canutus	Red Knot (Breeding)	N/A	• As per Important Habitat Map	-	-	-	No	Excluded Project area is not within mapped areas.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	762, 842, 868, 979, 988,1215 and 1268	• Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground.	-	-	-	Yes	Included. Habitat constraint: Trees with hollows greater than 15 cm diameter and 8 m above ground level were sparse throughout the Project area, other than in unlogged old-growth forests, and absent from DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Carterornis leucotis	White-eared Monarch	1106	-	-	-	-	-	Included. Microhabitat: Occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. This species is associated with PCTs located in the Macleay Hastings IBRA subregion. The Project area contained dry sclerophyll forests that is considered suitable to support this species. Species excluded from DNG and exotic grasslands.
Cercartetus nanus	Eastern Pygmy-possum	762, 842, 868, 1106, 1215, 1268 and 1287	-	-	-	-	-	Included. Microhabitat: Woody vegetation with sheltering sites and a substantial component of food resources such as nectar and pollen from banksias, eucalypts and bottlebrushes or fleshy fruits. DNG, exotic grassland and fragmented vegetation zones provide very limited shelter or food resources due to a lack of hollow bearing trees or other potential shelter and/or the absence of a diverse suite of tree and shrub species and associated food resources. Species excluded from DNG and exotic grasslands.
Chalinolobus dwyeri	Large-eared Pied Bat	762, 842, 868, 1106, 1215 and 1268	• Cliffs. • Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	-	-	-	Yes	Included. Microhabitat: Found in well-timbered areas containing gullies. Probably forages for small, flying insects below the forest canopy. The Project area contains and is within 2 km of features such as rocky areas containing overhangs, escapements and potentially small caves. Due to their lack of woody vegetation and associated habitat complexity and relatively low attractiveness to likely prey species (small flying insects), DNG and exotic grassland vegetation zones are likely to be of low value as foraging habitat for the species. Species excluded from DNG, exotic grasslands and fragmented zones.
Crinia tinnula	Wallum Froglet	No associated PCT	-	-	Within 10 km of coast	-	No	Excluded. Project area is outside of its geographic restriction.
Dasyurus maculatus maculatus	Spotted-tailed Quoll	762, 842, 868, 979, 988,1106, 1215 and 1268,	-	-	-	-	-	Included. Microhabitat: Uses hollow-bearing trees, fallen logs other animal burrows, small caves and outcrops as den sites. Species excluded from DNG and exotic grasslands.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	762, 1106 and 1287	• Waterbodies. • Within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	-	-	-	Yes	Included. Trees potentially suitable as nesting sites for these species are found in the Project area. Large trees were mostly absent within DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Hieraaetus morphnoides	Little Eagle (Breeding)	762, 842, 868, 1106, 1215 and 1287	• Nest trees – live (occasionally dead) large old trees within vegetation).	-	-	-	Yes	Excluded. Species was included in surveys but has since been excluded from further assessment for species credits as no nest trees or other signs of breeding activity found within the construction envelope or a 100m buffer surrounding the construction envelope.
Hirundapus caudacutus	White-throated Needletail	762, 842, 868, 979, 988,1106, 1215 and 1268,	-	-	-	-	-	Included. Species excluded from DNG and exotic grasslands.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Hoplocephalus bitorquatus	Pale-headed Snake	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Riparian areas with a high density of large, live hollow bearing trees. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines that are located away from riparian areas. The Project area contains marginal habitat for this species. Large trees were mostly absent or considered fragmented in DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Hoplocephalus stephensii	Stephens' Banded Snake	1106 and 1268	• Fallen/standing dead timber including logs, or within 500 m of this habitat. • Hollow bearing trees, or within 500 m of this habitat. • Within 500 m of arboreal vine tangles.	-	-	-	Yes	Included. Microhabitat: Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day. The Project area contains suitable habitat for this species. Large trees were mostly absent or considered fragmented in DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Lathamus discolor	Swift Parrot (Breeding)	762, 842, 868, 1106, 1215 and 1268	• As per mapped areas.	-	-	-	No	Excluded. Project area is not within mapped areas.
Limosa lapponica baueri	Bar-tailed Godwit (baueri) (Breeding)	N/A	• As per Important Habitat Map	-	-	=	No	Excluded Project area is not within mapped areas.
Litoria aurea	Green and Golden Bell Frog	1106	• Semi-permanent/ephemeral wet areas. • Within 1 km of wet areas/swamps. • Within 1 km of swamp/waterbodies.	-	-	-	No	Excluded. Project area does not contain swamp semi-permanent/ephemeral wet areas considered suitable for support this species.
Litoria booroolongensis	Booroolong Frog	1106	-	-	-	-	-	Excluded. Microhabitat: Permanent, or near permanent river environment with rocky structures (bedrock or cobble). Occurs predominantly along the western-flowing streams of the Great Dividing Range. The Project area does not contain permanent or near permanent rivers considered suitable to support this species.
Litoria brevipalmata	Green-thighed Frog	762, 868, 979, 988, 1106, 1215 and 1268	• Semi-permanent/ephemeral wet areas/swamps/waterbodies.	-	-	-	No	Excluded. Microhabitat: Suitable breeding habitat is any semi-permanent or ephemeral waterbody of >25 square metres within or adjacent to 10 m of native vegetation. The Project area is too steep and largely comprised of a thin soils with igneous parent rock that is not suitable to support areas of breeding habitat such as semi-permanent or ephemeral waterbodies.
Litoria subglandulosa	Glandular Frog	979, 988 and 1287	-	-	-	-	-	Excluded. Microhabitat: Found along streams in rainforest, moist and dry eucalypt forest or in subalpine swamps. Occurs in habitat above 500 m. The Project area contains no subalpine swamps or suitable streams that occur above 500 m.
Litoria daviesae	Davies' Tree Frog	868, 979, 988,, 1106 and 1215	• South of Hastings River.	-	South of Hastings River	-	No	Excluded. Disturbance footprint is outside of its geographic restriction.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Lophoictinia isura	Square-tailed Kite (Breeding)	762, 842, 868, 979, 988, 1106, 1215 and 1268	• Nest trees.	-	-	-	No	Excluded. Species was included in surveys but has since been excluded from further assessment for species credits as no nest trees or other signs of breeding activity found within the construction envelope or a 100 m buffer surrounding the construction envelope.
Macropus parma	Parma Wallaby	1268	-	-	-	-	-	Included. Microhabitat: Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. The project area contains suitable habitat for this species, including moist forest with a dense ground layer. DNG and exotic grassland PCTs and fragment vegetation zones do not contain a dense cover of tall native grasses and these zones are considered unlikely to be potential habitat for this species. Species excluded from DNG and exotic grasslands.
Miniopterus australis	Little Bent-winged Bat (Breeding)	762, 868, 979, 988, 1106, 1215 and 1268	• Caves. • Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'. • Observation type code 'E nest-roost'. • With numbers of individuals >500. • Or from the scientific literature.	-	-	-	No	Excluded. The Project area contains and is within 2 km of features such as rocky areas containing overhangs, escapements and potentially small caves. Due to their lack of woody vegetation and associated habitat complexity and relatively low attractiveness to likely prey species (small flying insects), DNG and exotic grassland vegetation zones are likely to be of low value as foraging habitat for the species. Species was included in harp surveys but has since been excluded from further assessment for species credits as suitable caves or signs of breeding activity (lactating females recorded during harp trapping) found within the Project area or a 100 m buffer surrounding the Project area.
Miniopterus orianae oceanensis	Large Bent-winged Bat (Breeding)	762, 842, 868, 979, 988, 1106, 1215, 1268 and 1287	• Caves. • Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'. • Observation type code 'E nest-roost'. • With numbers of individuals >500. • Or from the scientific literature.	-	-	-	No	Excluded. The Project area contains and is within 2 km of features such as rocky areas containing overhangs, escapements and potentially small caves. Due to their lack of woody vegetation and associated habitat complexity and relatively low attractiveness to likely prey species (small flying insects), DNG and exotic grassland vegetation zones are likely to be of low value as foraging habitat for the species. Species was included in surveys harp but has since been excluded from further assessment for species credits as suitable caves or signs of breeding activity (lactating females recorded during harp trapping) found within the Project area or a 100 m buffer surrounding the Project area.
Mixophyes balbus	Stuttering Frog	979, 988, 1106 and 1268	-	-	-	-	-	Included. Microhabitat: Found in rainforest and wet, tall open forest. Requires deep leaf litter and thick understorey vegetation on the forest floor. The creeks running into the Macleay River are ephemeral. Only two creeks were observed to have areas of pooling that may retain water in drier years. Creeks had open canopies and lacked leaf litter. The Project area contains marginal habitat to support this species.
Mixophyes iteratus	Giant Barred Frog	988, 1106 and 1268	• Land within 50 m of semi-permanent and permanent drainages.	-	-	-	Yes	Excluded. Microhabitat: Found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. No creeks within the Macleay Hastings IBRA sub-region contained suitable habitat such as rainforest with deep leaf litter that were permanent or semi-permanent (ephemeral creeks only). The Project area contains no habitat considered suitable to support this species.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Myotis macropus	Southern Myotis	762, 842, 868, 979, 988, 1106, 1215 and 1268	• Hollow bearing trees. • Within 200 m of riparian zone. • Bridges, caves or artificial structures within 200 m of riparian zone/waterbodies. • This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200 m of the site.	-	-	-	Yes	Included. Microhabitat: Forage over streams and pools catching insects and small fish by raking their feet across the water surface. Roost close to water in caves, mine shafts, hollow bearing trees, storm water channels, buildings, under bridges and in dense foliage. Habitat constraints are present and the Macleay River is considered suitable habitat to support this species.
Ninox connivens	Barking Owl (Breeding)	762, 842, 868, 979, 1106, 1215 and 1268	• Hollow bearing trees. • Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	-	-	-	Yes	Included. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. Sections of the Project area contain suitable breeding habitat for this species. Large trees were mostly absent in DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Ninox strenua	Powerful Owl (Breeding)	762, 842, 868, 979, 988, 1106, 1215 and 1268	• Hollow bearing trees. • Living or dead trees with hollow greater than 20 cm diameter.	-	-	-	Yes	Included. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. Sections of the project area contain suitable breeding habitat for this species. Large trees were mostly absent in DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Numenius madagascariensis	Eastern Curlew (Breeding)	N/A	• As per Important Habitat Map	-	-	-	No	Excluded. The Project area is not within mapped areas.
Ocybadistes knightorum	Black Grass-dart Butterfly	N/A	-	-	-	-	-	Excluded. The Black Grass-dart Butterfly occurs only on the NSW mid north coast from Coffs Harbour to Scotts Head. It is currently known from two disjunct areas: a northern population centred around Sawtell and a southern population along Warrell Creek. The Black Grass-dart Butterfly is considered to be monophageous, with Floyd's Grass (*Alexfloydia repens*) being the only larval food plant known. The butterfly is generally restricted to within about 50 m of suitable patches of Floyd's Grass (*Alexfloydia repens*). Floyd's Grass (*Alexfloydia repens*) which is absent from the construction envelope.
Pandion cristatus	Eastern Osprey (Breeding)	1106	• Presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.	-	-	-	No	Excluded. Species was included in surveys but has since been excluded from further assessment for species credits as no nest trees or other signs of breeding activity found within the construction envelope or a 100 m buffer surrounding the construction envelope.
Petalura gigantea	Giant Dragonfly	1287	• Swamps. • Within 500 m of swamps.	-	-	-	No	Excluded. Microhabitat: permanent swamps and bogs with free water and open vegetation. Construction envelope contains no swamps with standing water, and none are located within 500 m of the disturbance footprint.
Petauroides volans	Greater Glider	842,868, 979, 988, 1106, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Eucalypt forest with a high density of hollow bearing trees. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. The Project area contains habitat for this species. DNG and exotic grassland vegetation zones provide no to very limited shelter or food resources due to a lack of hollow bearing trees or other potential shelter and/or the absence of a diverse suite of tree and shrub species and associated food resources. 'Fragments' vegetation zones were also considered unsuitable due to their isolation from woodland or forest habitat. These vegetation zones are unlikely to be suitable for this species. Species excluded from DNG, exotic grasslands and fragmented zones.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Petaurus norfolcensis	Squirrel Glider	762, 842, 868, 979, 988, 1106, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: woodlands, often dominated or co-dominated by box-type eucalypts, either containing abundant tree hollows or well-connected areas with such areas and containing a shrubby (particularly Acacia species) midstorey. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. The Project area contains habitat for this species. DNG and exotic grassland vegetation zones provide no to very limited shelter or food resources due to a lack of hollow bearing trees or other potential shelter and/or the absence of a diverse suite of tree and shrub species and associated food resources. 'Fragments' vegetation zones were also considered unsuitable due to their isolation from woodland or forest habitat. These vegetation zones are unlikely to be suitable for this species. Species excluded from DNG, exotic grasslands and fragmented zones.
Petrogale penicillata	Brush-tailed Rock-wallaby	842, 868, 979, 988,and 1268	• Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	-	-	-	Yes	Included. Microhabitat: foraging areas adjacent to rocky areas that have sufficient cover from predators. Suitable habitat such as denning sites, refuge areas for this species is present in the generation site area, south of the Macleay River. North of the Macleay River lacked features such as rocky escarpments and rock outcrops.
Phascogale tapoatafa	Brush-tailed Phascogale	762, 842, 868, 979, 988, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Areas containing dry sclerophyll open forest with sparse groundcover, tree hollows and rough barked trees of 25 cm DBH or greater constitute highly suitable habitat. Other areas would be considered marginal as habitat. Suitable habitat is present within the Project area. DNG, exotic grassland and fragmented vegetation zones provide very limited shelter or food resources due to a lack of hollow bearing trees or other potential shelter and/or the absence of a diverse suite of tree and shrub species and associated food resources. 'Fragments' vegetation zones were also considered unsuitable due to their isolation from woodland or forest habitat. These vegetation zones are unlikely to be suitable for this species. Species excluded from DNG, exotic grasslands and fragmented zones.
Phascolarctos cinereus	Koala	762, 842, 868, 979, 988, 1215 and 1268	• Presence of koala use trees – refer to survey comments field in TBDC.	-	-	-	Yes	Included. Koala use trees were present in most vegetation zones of all PCTs. Areas of DNG and exotic grassland do not support suitable Koala use trees. Species excluded from DNG and exotic grasslands.
Planigale maculata	Common Planigale	762, 868, 1106, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. Shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. The Project area within the MacLeay's Hastings IBRA subregion contains some suitable habitat to support this species.
Potorous tridactylus	Long-nosed Potoroo	1106, 1142 and 1268	• Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).	-	-	-	Yes	Included Microhabitat: 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 grasstrees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. Not associated with any PCTs; however, suitable habitat is considered to occur in the upper areas of the generation site within areas of flatter topography that were observed to contain a dense understory. DNG and exotic grassland PCTs and fragment vegetation zones does not contain a dense cover of tall native grasses and these zones are considered unlikely to be potential habitat for this species. Species excluded from DNG, exotic grasslands and fragmented vegetation zones.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	762, 842, 868, 979, 988, 1106, 1215 and 1268	• Breeding camps.	-	-	-	No	Excluded. Project area contains no breeding camps.
Pseudomys oralis	Hastings River Mouse	Not associated with a PCT[1]	-	-	-	-	-	Included. Microhabitat: Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops and fallen logs. Species excluded from DNG and exotic grasslands.
Pseudomys novaehollandiae	New Holland Mouse	Not associated with a PCT[1]	-	-	-	-	-	Excluded. Microhabitat: Open heathlands, woodlands and forests with a heathland understorey. This species occurs on sandstone country (Wilson & Laidlaw 2003), this species requires deeper topsoils and softer substrates for digging burrows. Sandstone and heathland habitat is absence from site. Species excluded from DNG and exotic grasslands.
Pezoporus wallicus wallicus	Eastern Ground Parrot	No associated PCT	-	-	-	-	-	Excluded. The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). This habitat is absent from the construction envelope.
Turnix maculosus	Red-backed Button-quail	762, 868, 1215 and 1268	-	-	-	-	-	Included. Microhabitat: Occurs in grasslands, heath and crops, prefer sites close to water. Typically, only in regions subject to annual summer rainfall greater than 400 mm. Breed in dense grass near water. Habitat is present within the DNG and exotic grassland for the Macleay Hastings sub-region close to the Macleay River flood plain. Excluded from non-DNG and exotic grassland PCTs.
Tyto novaehollandiae	Masked Owl (Breeding)	762, 842, 868, 979, 988, 1106, 1215 and 1268	• Hollow bearing trees. • Living or dead trees with hollows greater than 20 cm diameter.	-	-	-	Yes	Included. Habitat constraint: Living or dead trees with hollows greater than 20 cm diameter. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. Sections of the Project area contain suitable breeding habitat for this species. Large trees were mostly absent in DNG and exotic grassland vegetation zones. Species excluded from DNG and exotic grasslands.
Tyto tenebricosa	Sooty Owl (Breeding)	1106	• Caves. • Caves or clifflines/ledges/hollow bearing trees. • Living or dead trees with hollows greater than 20 cm diameter.	-	-	-	Yes	Excluded. Microhabitat: Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree-hollows. Rainforest and wet sclerophyll forest habitat is largely absent within the Project area south of the Macleay River. This species was only associated with PCT 1106 which was located along the Macleay River and only had small section of rainforest species associated with some creek lines that floweed into the Macleay River. Due to historical logging, high density of hollow bearing trees is limited to the old growth forest areas along the clifflines. Large trees were mostly absent or considered fragmented in DNG and exotic grassland vegetation zones. Given the lack of suitable hollows, particularly within the highly limited habitat, the microhabitats required by the species are considered not to occur.

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints						Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Associated PCT**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species**	**Constraint present in Project area?**	**Candidate species (yes/no) and rationale**
Vespadelus troughtoni	Eastern Cave Bat	762, 868, 979, 988,1215 and 1268	• Caves • Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	-	-	-	Yes	Included Microhabitat: Relatively fertile, vegetated areas that are likely to support high prey densities. The Project area contains and is within 2 km of features such as rocky areas containing overhangs, escapements and potentially small caves. Due to their lack of woody vegetation and associated habitat complexity and relatively low attractiveness to likely prey species (small flying insects), DNG and exotic grassland vegetation zones are likely to be of low value as foraging habitat for the species.
Xenus cinereus	Terek Sandpiper (Breeding)		• As per Important Habitat Map	-	-	-	No	Excluded The Project area does not contain this species habitat constraint.

Notes: 1. Species predicted to occur by PMST only.

6.3.2 Candidate species credit species requiring further assessment

Candidate species for further assessment were identified in accordance with Step 1 to 2 (Section 5.2.1 to 5.2.2) of BAM (DPIE, 2020a) and includes species that require assessment as listed in Table 1.2 of the SEARs. A list of species requiring further assessment is provided in Table 6.3.

Table 6.3 Candidate species credit species requiring further assessment

Scientific name	Common name	EPBC Act	BC Act	Survey location
Flora				
Asperula asthenes	Trailing Woodruff	Vulnerable	Vulnerable	All associated PCTs Excluded from exotic grasslands.
Bertya ingramii	Narrow-leaved Bertya	Endangered	Endangered	All associated PCTs.
Callistemon pungens	*Callistemon pungens*	Vulnerable		Along river banks and creek lines.
Chiloglottis platyptera	Barrington Tops Ant Orchid	-	Vulnerable	All associated PCTs.
Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Vulnerable	All associated PCTs
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	All associated PCTs.
Dendrobium melaleucaphilum	Spider orchid	-	Endangered	All associated PCTs Species excluded from DNG and exotic grasslands.
Diuris eborensis	*Diuris eborensis*	Endangered	Endangered	Within suitable habitat associated with wet PCTs in the Carrai Plateau.
Diuris disposita	Willawarrin Doubletail	-	Endangered	All associated PCTs
Diuris pedunculata	Small Snake Orchid	Endangered	Endangered	Within suitable habitat associated with grassy slopes and flats in peaty and moist areas and around boulders.
Eucalyptus magnificata	Northern Blue Box	-	Endangered	All associated PCTs.
Euphrasia arguta	*Euphrasia arguta*	Critically Endangered	Critically Endangered	All PCTs.
Grevillea beadleana	Beadle's Grevillea	Endangered	Endangered	All associated PCTs.
Grevillea guthrieana	Guthrie's Grevillea	Endangered	Endangered	All associated PCTs.
Hakea fraseri	Gorge Hakea	Vulnerable	Vulnerable	All associated PCTs.
Haloragis exalata subsp. Velutina	Tall Velvet Sea-berry	Vulnerable	Vulnerable	All associated PCTs.
Hibbertia hexandra	Tree Guinea Flower	-	Endangered	All associated PCTs

Scientific name	Common name	EPBC Act	BC Act	Survey location
Lepidium peregrinum	Wandering Pepper Cress	Endangered	Endangered	Macleay River Floodplain recorded in PCT 1106.
Lindernia alsinoides	Noah's False Chickweed	-	Endangered	All associated PCTs
Marsdenia longiloba	Slender Marsdenia	Vulnerable	Endangered	All associated PCTs.
Melaleuca groveana	Grove's Paperbark	-	Vulnerable	All associated PCTs.
Niemeyera whitei	Rusty Plum, Plum Boxwood	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands.
Oberonia titania	Red-flowered King of the Fairies	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands
Parsonsia dorrigoensis	Milky Silkpod	Endangered	Vulnerable	All associated PCTs
Pomaderris queenslandica	Scant Pomaderris	-	Endangered	All associated PCTs. Species excluded from DNG and exotic grasslands.
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	-	Endangered	Swampy drainage depressions in Eucalypt Forest (Barrett, in prep 2023).
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Critically Endangered	In suitable habitat considered to support this species, such as the PCTs adjoining wetter forests, species recorded in PCT 1215. Species excluded from DNG and exotic grasslands.
Sarcochilus fitzgeraldii	Ravine Orchid	Vulnerable	Vulnerable	Within suitable habitat, such as shady gorges between 500 and 700 m altitude.
Senna acclinis	Rainforest Cassia	-	Endangered	All associated PCTs. Species excluded from DNG and exotic grasslands.
Tylophora woollsii	Cryptic Forest Twiner	Endangered	Endangered	In suitable habitat considered to support this species, such as the PCTs adjoining wetter forests.

Scientific name	Common name	EPBC Act	BC Act	Survey location
Fauna				
Aepyprymnus rufescens	Rufous Bettong	-	Vulnerable	All associated PCTs. Species excluded from DNG, exotic grasslands and fragmented zones.
Burhinus grallarius	Bush Stone-curlew	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Carterornis leucotis	White-eared Monarch	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands.
Cercartetus nanus	Eastern Pygmy-possum	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Dasyurus maculatus maculatus	Spotted-tailed Quoll	Endangered	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Hieraaetus morphnoides	Little Eagle (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Hirundapus caudacutus	White-throated Needletail	Vulnerable		All associated PCTs. Species excluded from DNG and exotic grasslands.
Hoplocephalus bitorquatus	Pale-headed Snake	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.

Scientific name	Common name	EPBC Act	BC Act	Survey location
Hoplocephalus stephensii	Stephens' Banded Snake	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands.
Lophoictinia isura	Square-tailed Kite (breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Macropus parma	Parma Wallaby	-	Vulnerable	All associated PCTs Species excluded from DNG and exotic grasslands.
Miniopterus australis	Little Bent-winged Bat (Breeding)	--	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Miniopterus orianae oceanensis	Large Bent-winged Bat (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Mixophyes balbus	Stuttering Frog	Vulnerable	Endangered	All associated PCTs.
Myotis macropus	Southern Myotis	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Ninox connivens	Barking Owl (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Ninox strenua	Powerful Owl (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Pandion cristatus	Eastern Osprey (Breeding)	-	Vulnerable	All associated PCTs. Species excluded from DNG and exotic grasslands.
Petauroides volans	Greater Glider	Endangered		All associated PCTs.. Species excluded from DNG and exotic grasslands.
Petaurus norfolcensis	Squirrel Glider	-	Vulnerable	All associated PCTs. Species excluded from DNG, exotic grasslands and fragmented zones.
Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable	Endangered	All associated PCTs.

Scientific name	Common name	EPBC Act	BC Act	Survey location
Phascogale tapoatafa	Brush-tailed Phascogale	-	Vulnerable	All associated PCTs. Species excluded from DNG, exotic grasslands and fragmented zones.
Phascolarctos cinereus	Koala	Endangered	Endangered	All associated PCTs. Species excluded from DNG and exotic grasslands.
Planigale maculata	Common Planigale	-	Vulnerable	All associated PCTs
Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable	In PCTs with suitable understory on flatter grounds near the upper reservoir. Recorded in PCT 1215 and 822. Species excluded from DNG, exotic grasslands and fragmented vegetation zones.
Pseudomys oralis	Hastings River Mouse	Endangered	Endangered	Within suitable habitat that is near creeks, gullies with sheltering areas such as rocky outcrops and fallen logs. Species excluded from DNG, exotic grasslands
Turnix maculosus	Red-backed Button-quail	-	Vulnerable	All associated PCTs
Tyto novaehollandia	Masked Owl (Breeding)	-	Vulnerable	All associated PCTs. Excluded from non-DNG and exotic grassland PCTs.
Vespadelus troughtoni	Eastern Cave Bat	-	Vulnerable	All associated PCTs Excluded from non-DNG and exotic grassland PCTs

6.3.3 Targeted species survey methods and effort

Targeted candidate species surveys were undertaken to determine whether candidate species occupy the construction envelope and to define the condition and the extent of habitat for candidate species present (i.e. the species polygons).

i Targeted flora surveys

Table 6.4 provides a summary of the threatened flora species surveys, including survey period for each candidate species. Where feasible, surveyors visited known populations of threatened species nearby to check flowering and become familiar with the appearance of the target species and its habitat in order to maximise the likelihood of detection. Targeted threatened flora surveys were carried out during appropriate detection periods between 2021, 2022 and 2023 in January, March, April, May, July, August, September, October, November and December. Some species were targeted during multiple searches over several months.

Targeted threatened flora surveys were conducted in all vegetation zones identified as suitable habitat at Step 3. Some other vegetation zones were, however, surveyed opportunistically during these surveys.

The BAM guideline for surveying threatened plants and their habitats (DPIE, 2020b) recognises that "the survey design described in this guide may be impractical for some large-scale projects where the time taken to search large areas of suitable habitat for small threatened species is high" and includes a two-phase grid-based systematic survey approach for large areas of suitable habitat (> 50 ha). The first phase of a two-phase grid-based survey involves searches of 40 m diameter areas at 100 m grid intersections. If a target species is located, a finer-scale grid survey is used (second phase). This is used to locate the population extent, which will help define the species polygon. The finer-scale grid was used as per Table 4 of DPIE (2020b) which is dependent on the habitat type, vegetation type and condition and landscape attributes surrounding the locations where the target species was detected. Requirements to use GPS to demonstrate survey effort using the two-phase grid-based points is not a requirement. As per the NSW Guidelines for Surveying Threatened Plants and their Habitats (DPIE, 2020b), where applicable, surveys are to be undertaken using a 40 m diameter area at each grid point. If targeted species are located, a finer-scale grid survey is to be used. This is how the data is presented on Figure 6.1. The GPS tracks between the two-phased grid-based points are displayed to show additional survey effort (incidental sightings) between points. Two-phase grid-based points that do not contain GPS tracks between each other were either not recorded or where team members split between points that were not carrying a GPS to record their separate tracks. Refer to Figure 6.1 for completion status of the two-phased grid-based points as per the information shown in the Key.

The two-phase grid-based systematic survey was not used for species where their suitable habitat was < 50 ha. In these areas, targeted flora surveys were undertaken in accordance with DPIE (2020b) and DoE (2013a) guidelines and included transects using spacing as defined in Table 1 of DPIE (2020b), generally spaced at intervals of 5 m (closed vegetation) to 10 m (open vegetation). As much of the hillside habitat in the construction envelope is very steep and, in places, near-vertical, often with loose unstable soil, exposed rock cliffs and dense spiny shrub thickets, walking of closely spaced and parallel transects was not always safe or feasible. In such areas, transects were more meandering with their path dictated by safe access. The survey areas where meandering occurred were along small sections of a creek that runs through the proposed lower reservoir and at a small section of the northern transmission line. These areas represent less than 0.5 ha of the area surveyed. Small sections of the transects were briefly interrupted by areas of exposed steep rock and thick areas native and non-native shrubs and vines that prevented safe access. Areas that could not be physically walked were checked where vantage points allowed. These areas were very small along the transects; refer to Figure 6.1 that shows areas where transects were undertaken.

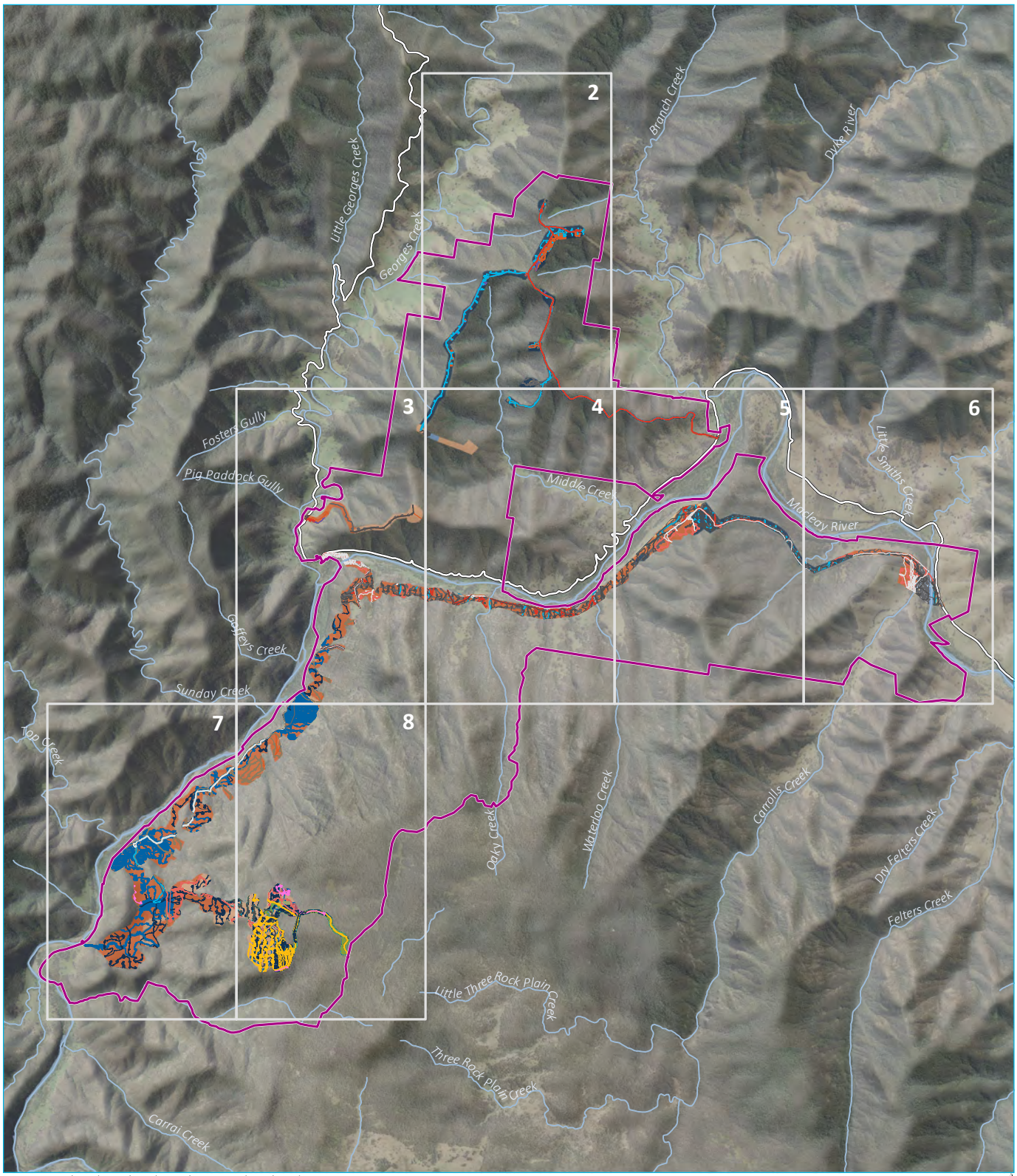
Targeted flora survey effort is indicated in Figure 6.1. The transects shown represent surveys undertaken; however, the actual area surveyed was greater than that shown as each transect was undertaken by two observers.

During the mapping of vegetation and the survey of BAM plots, most of the more heavily vegetated parts of the construction envelope, and much of the derived native grassland, was traversed on foot. In addition to targeted surveys, threatened species detectible year-round were searched for opportunistically during vegetation mapping, which included identification of plants, particularly trees and shrubs for the purposes of PCT identification. BAM plots also provided opportunities for detection of threatened species, particularly ground layer species.

Table 6.4 Targeted candidate flora species survey period

Scientific name	Common name	Recommended survey period	Survey dates onsite
Asperula asthenes	Trailing Woodruff	October, November, December	November
Bertya ingramii	Narrow-leaved Bertya	All year	January, April, May, July, August, November
Callistemon pungens	Callistemon pungens	September to February	November, January
Chiloglottis platyptera	Barrington Tops Ant Orchid	October	October
Cryptostylis hunteriana	Leafless Tongue Orchid	November to January	November
Cynanchum elegans	White-flowered Wax Plant	All year	January, April, May, July, August, November
Dendrobium melaleucaphilum	Spider orchid	August to September	September
Diuris eborensis	*Diuris eborensis*	November to December	November
Diuris disposita	Willawarrin Doubletail	September to October	October
Diuris pedunculata	Small Snake Orchid	September to October	October
Eucalyptus magnificata	Northern Blue Box	All year	January, April, May, July, August, November
Euphrasia arguta	*Euphrasia arguta*	November to March	November
Grevillea beadleana	Beadle's Grevillea	All year	January, April, May, July, August, November
Grevillea guthrieana	Guthrie's Grevillea	All year	January, April, May, July, August, November
Hakea fraseri	Gorge Hakea	All year	January, April, May, July, August, November
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	All year	January, April, May, July, August, November
Hibbertia hexandra	Tree Guinea Flower	All Year	April, May, July, August
Lepidium peregrinum	Wandering Pepper Cress	November to May	November, January, April, May
Lindernia alsinoides	Noah's False Chickweed	November to February	November
Marsdenia longiloba	Slender Marsdenia	November to February	November
Melaleuca groveana	Grove's Paperbark	All year	April, May, July, August
Niemeyera whitei	Rusty Plum, Plum Boxwood	All year	April, May, July, August
Oberonia titania	Red-flowered King of the Fairies	All year	April, May, July, August
Parsonsia dorrigoensis	Milky Silkpod	All year	April, May, July, August
Pomaderris queenslandica	Scant Pomaderris	All year	April, May, July, August
Rhodamnia rubescens	Scrub Turpentine	All year	April, May, July, August
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	October – November	October, November

Scientific name	Common name	Recommended survey period	Survey dates onsite
Sarcochilus fitzgeraldii	Ravine Orchid	October to November	October
Senna acclinis	Rainforest Cassia	All year	January, April, May, July, August, November
Tylophora woollsii	Cryptic Forest Twiner	January to April	January, March, April



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Map reference
- Named watercourse
- Major road
- River/Stream
- Track/Road

Plant community types within the construction envelope

- PCT762 Cabbage Gum open forest or woodland on flats of the North Coast
- PCT842 Forest Redgum - Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion
- PCT979 New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and
- PCT868 Grey gum - stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion
- PCT988 New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion
- PCT1106 River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
- PCT1142 Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion
- PCT1215 Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
- PCT1268 Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion
- PCT1287 Upland heath swamps of the New England Tableland Bioregion

Targeted flora surveys transect

- October 2021
- November 2021
- January 2022
- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- September 2022
- October 2022
- November 2022
- October 2023
- December 2023
- June 2024

Targeted flora surveys
Map 1 of 8

Oven Mountain Pumped Hydro Energy Storage Project
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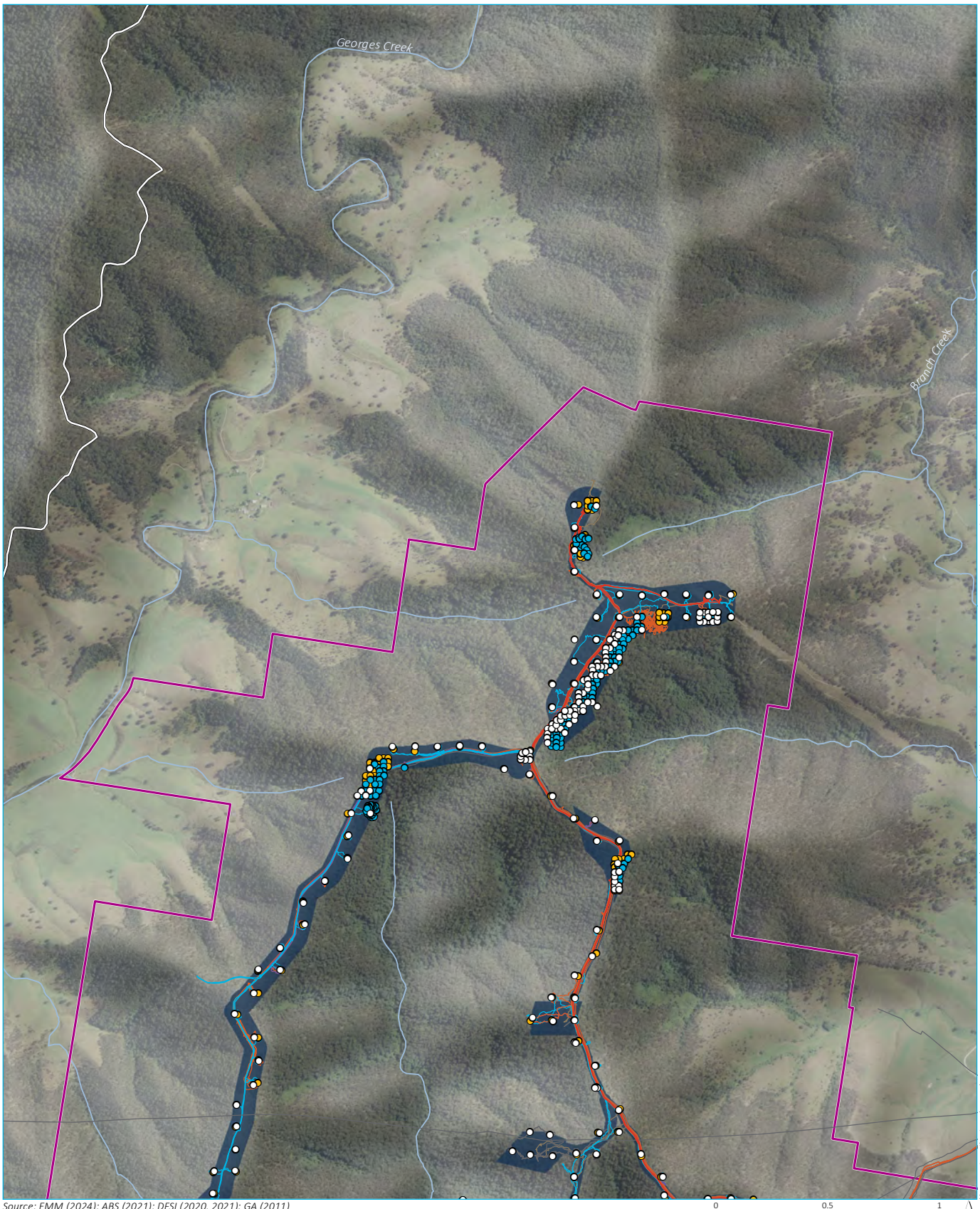
Figure 6.1

EMM
creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- Major road
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase gird point - Targeted species
- Two phase grid point - Summer/Spring 2022

Plant community type

- PCT762
- PCT842
- PCT868
- PCT1215

Targeted flora surveys transect

- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- October 2022

Targeted flora surveys
Map 2 of 8

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 6.1

EMM creating opportunities

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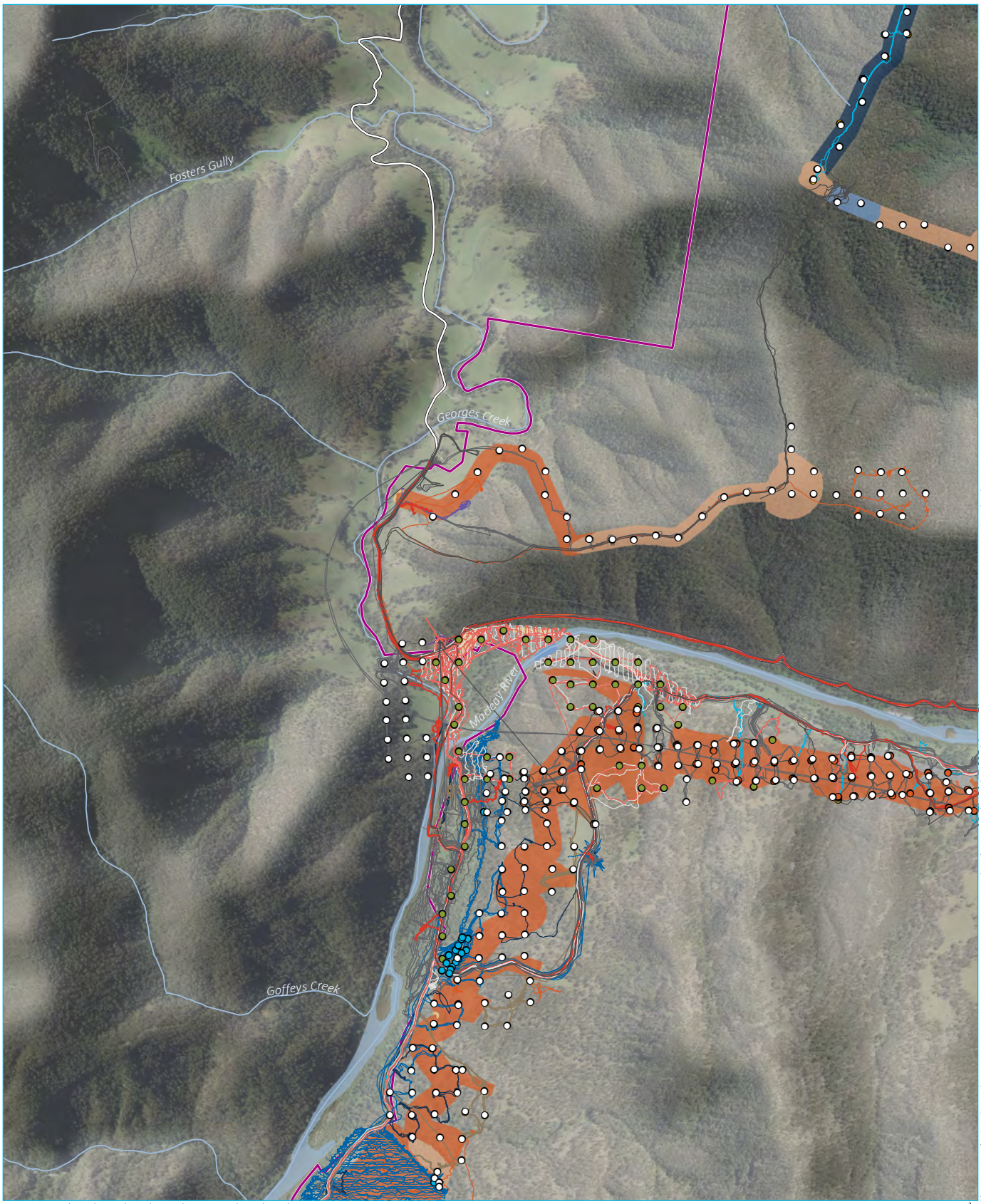

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- Major road
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - Oct 2023
- Two phase grid point - Nov/Dec 2022
- Two phase gird point - Targeted species
- Two phase grid point - Summer/Spring 2022

Plant community type

- PCT762
- PCT842
- PCT868
- PCT1106
- PCT1215
- PCT1268

Targeted flora surveys transect

- November 2021
- January 2022
- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- October 2022
- November 2022
- October 2023
- December 2023

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Targeted flora surveys
Map 3 of 8

Oven Mountain Pumped Hydro Energy Storage Project
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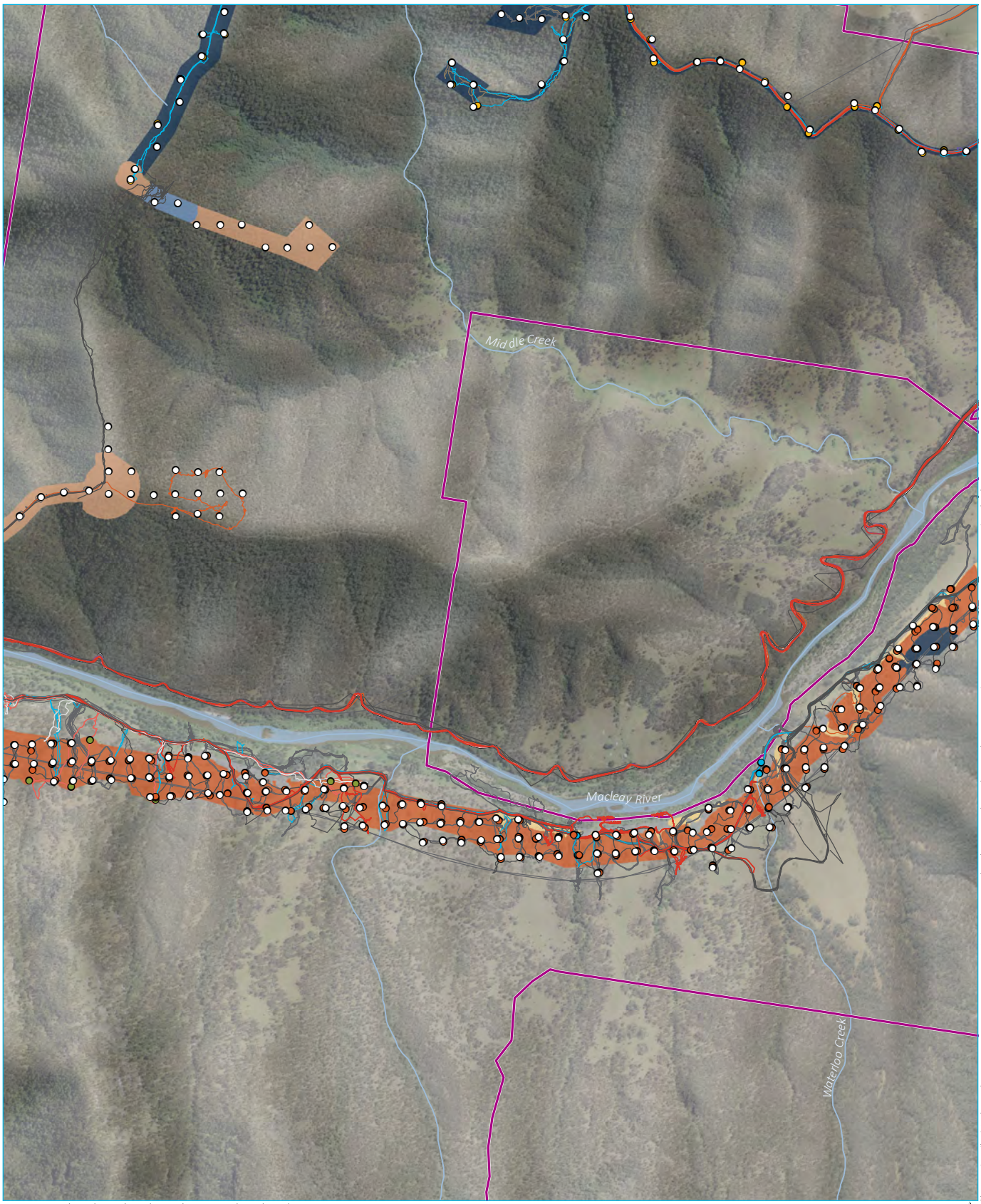
Figure 6.1

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

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N

KEY

- Project area
- Named watercourse
- Major road
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - Oct 2023
- Two phase grid point - Nov/Dec 2022
- Two phase gird point - Targeted species
- Two phase grid point - Summer/Spring 2022

Plant community type

- PCT762
- PCT842
- PCT868
- PCT1106
- PCT1215
- PCT1268

Targeted flora surveys transect

- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- October 2022
- November 2022
- October 2023
- December 2023

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Targeted flora surveys
Map 4 of 8

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 6.1

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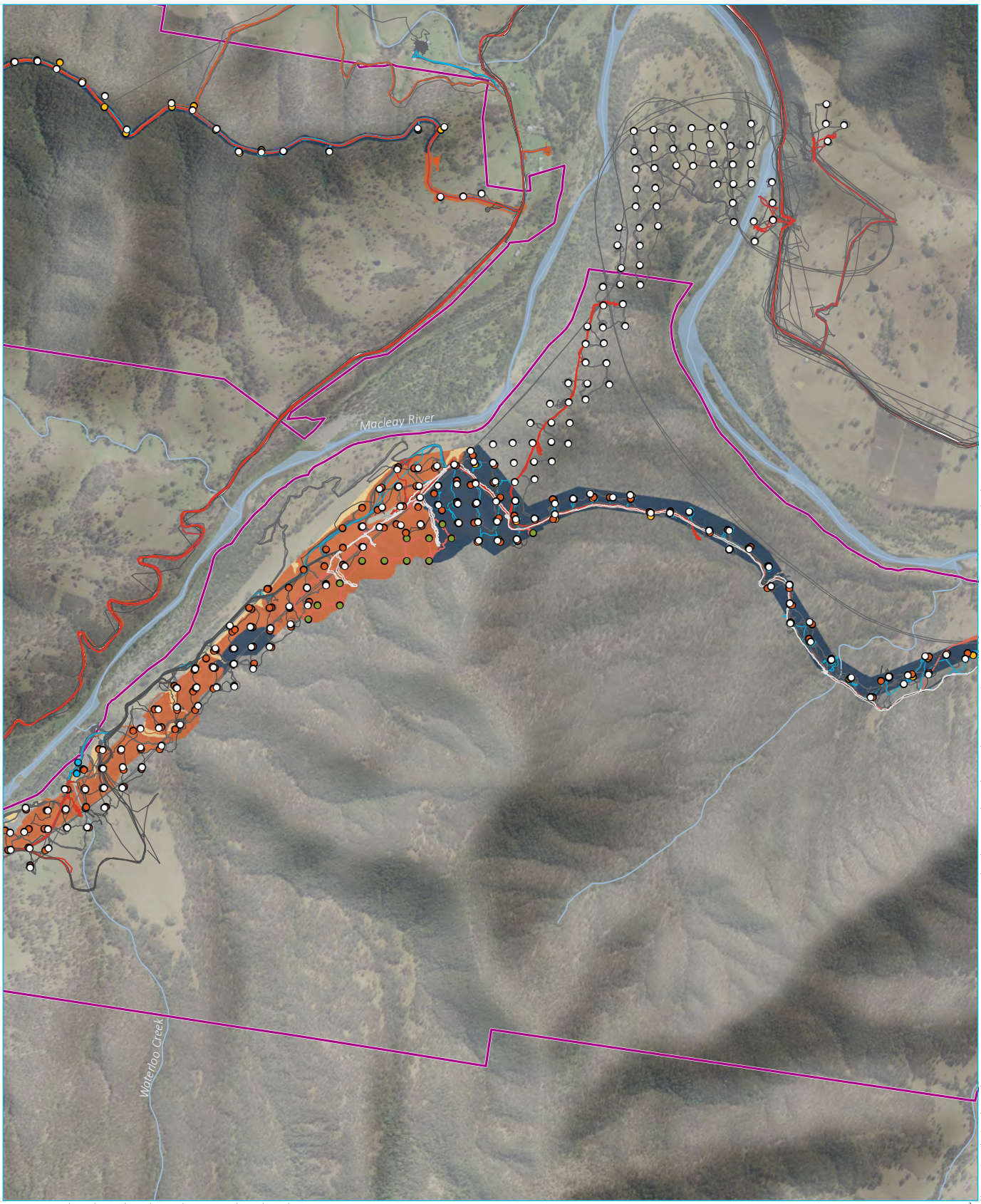

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- Major road
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - Oct 2023
- Two phase grid point - Nov/Dec 2022
- Two phase gird point - Targeted species
- Two phase grid point - Summer/Spring 2022

Plant community type

- PCT762
- PCT842
- PCT1106
- PCT1215

Targeted flora surveys transect

- April 2022
- May 2022
- June 2022
- July 2022
- August 2022
- October 2022
- November 2022
- October 2023
- December 2023

Targeted flora surveys
Map 5 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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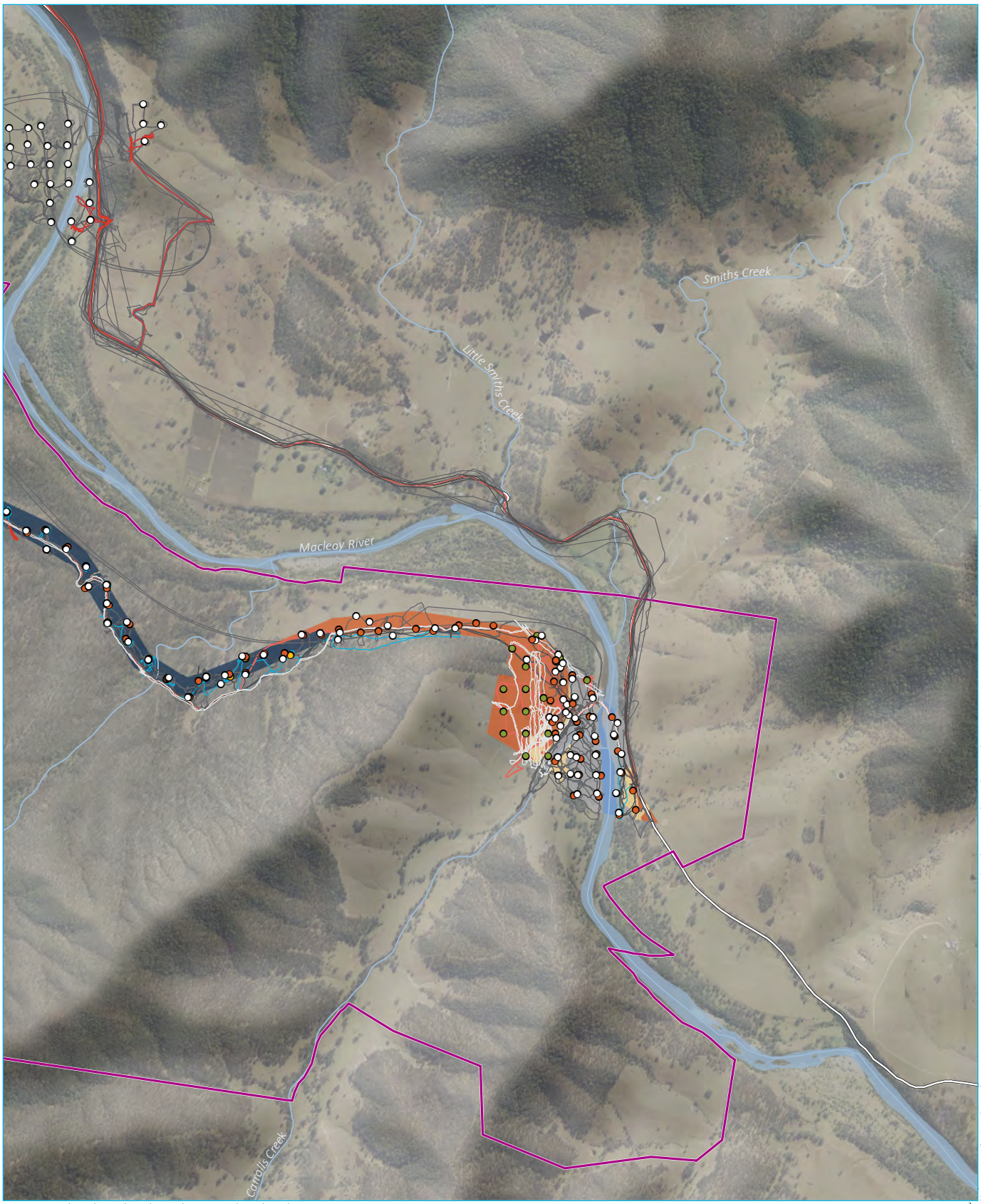
Figure 6.1

EMM creating opportunities



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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- Major road
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - Oct 2023
- Two phase grid point - Nov/Dec 2022
- Two phase grid point - Summer/Spring 2022

Plant community type

- PCT762
- PCT842
- PCT1106
- PCT1215

Targeted flora surveys transect

- May 2022
- June 2022
- July 2022
- August 2022
- October 2022
- November 2022
- October 2023
- December 2023

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Targeted flora surveys
Map 6 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.1

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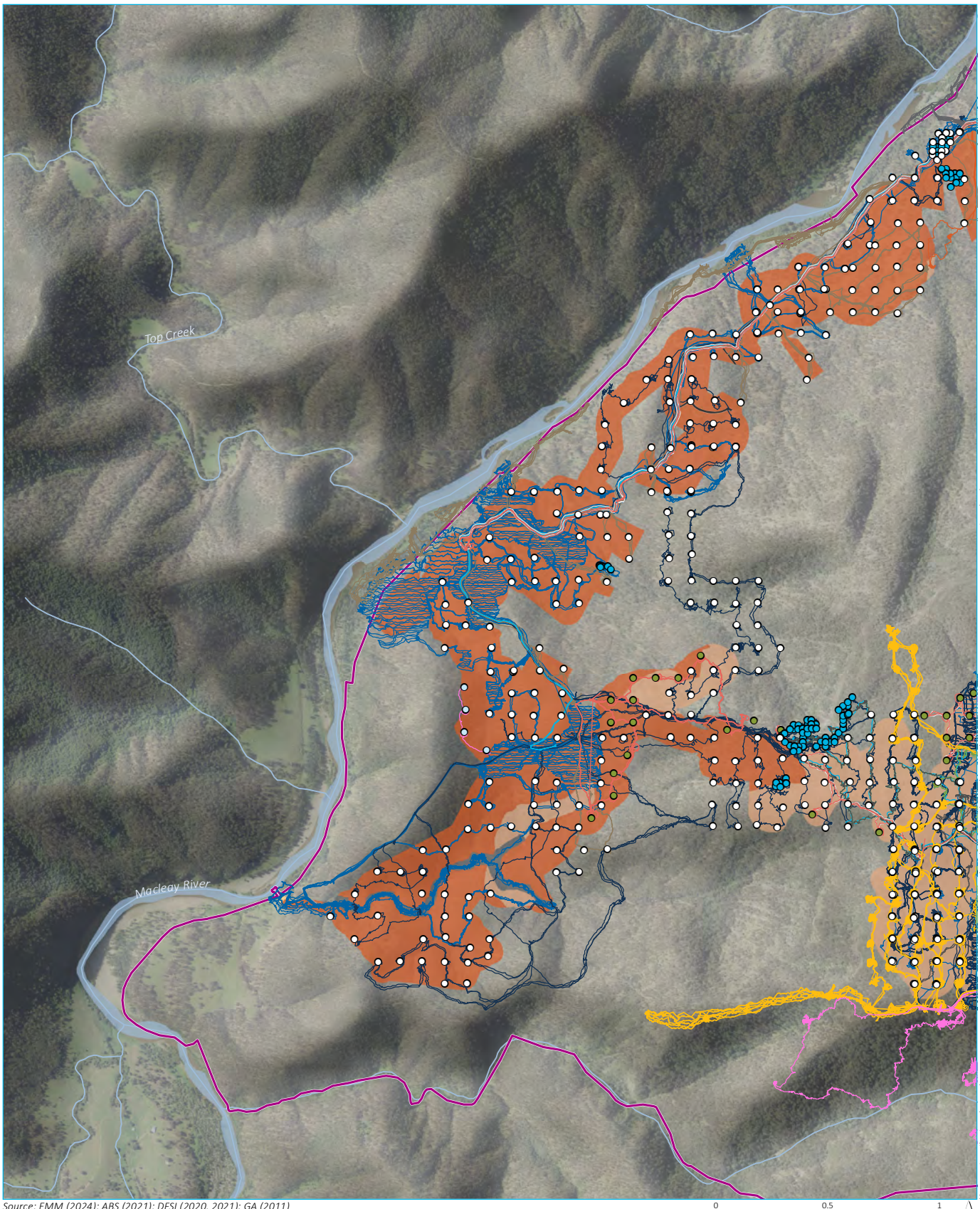

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - June 2024
- Two phase grid point - Oct 2023
- Two phase gird point - Targeted species

Plant community type

- PCT762
- PCT842
- PCT979
- PCT868
- PCT988
- PCT1106
- PCT1142

Targeted flora surveys transect

- October 2021
- November 2021
- January 2022
- April 2022
- May 2022
- July 2022
- September 2022
- October 2022
- November 2022
- October 2023
- December 2023
- June 2024

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Targeted flora surveys
Map 7 of 8

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 6.1

EMM
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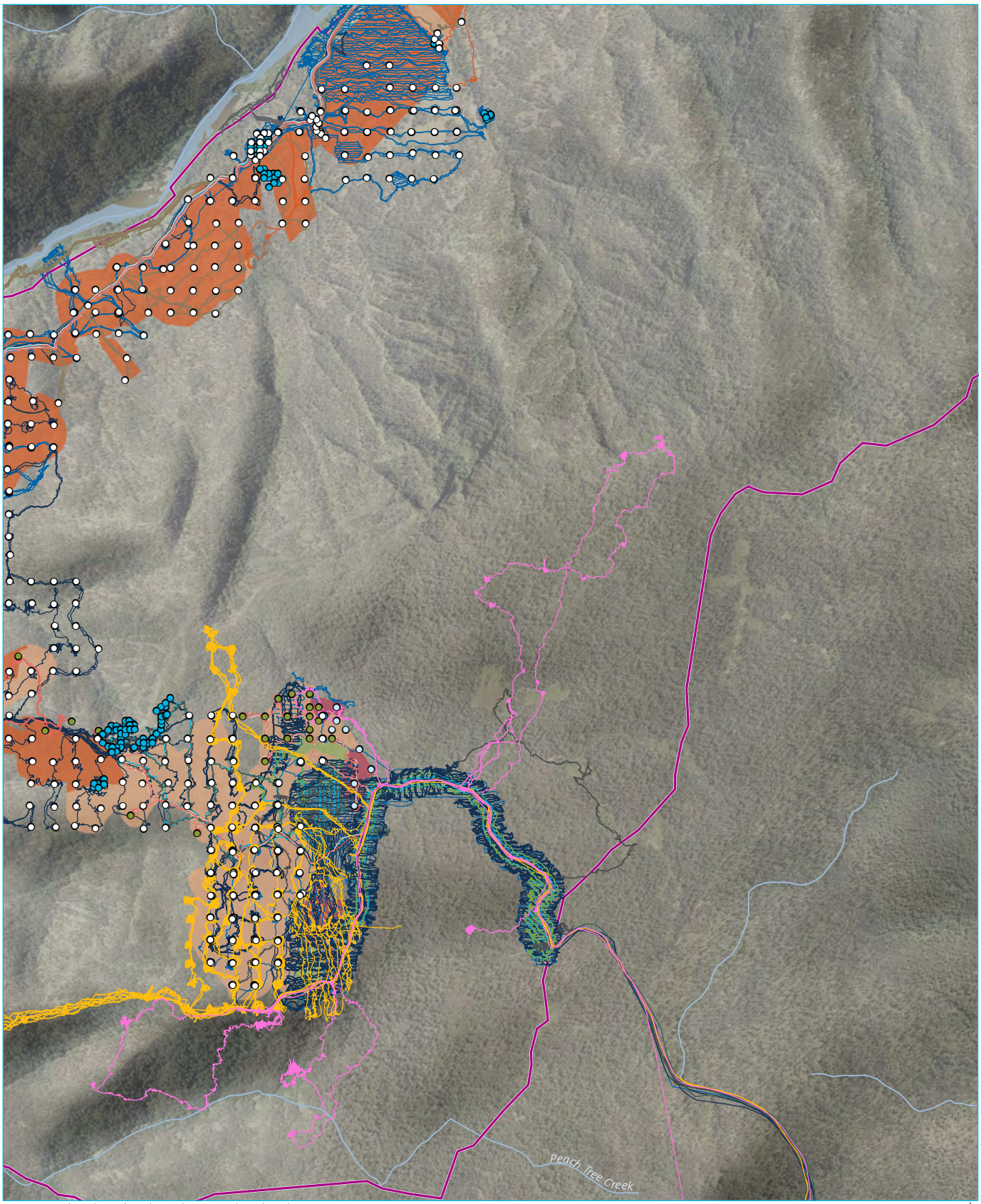

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Named watercourse
- River/Stream
- Track/Road
- Two phase grid point - Complete
- Two phase grid point - June 2024
- Two phase grid point - Oct 2023
- Two phase gird point - Targeted species

Plant community type

- PCT762
- PCT842
- PCT979
- PCT868
- PCT988
- PCT1106
- PCT1142
- PCT1287

Targeted flora surveys transect

- October 2021
- November 2021
- January 2022
- April 2022
- May 2022
- July 2022
- September 2022
- October 2022
- November 2022
- October 2023
- December 2023
- June 2024

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Targeted flora surveys
Map 8 of 8

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Figure 6.1

EMM
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ii Targeted fauna surveys

Table 6.5 provides a summary of the threatened fauna species surveys, including survey period for each species. Targeted fauna surveys were conducted within the survey area in accordance with various NSW and Commonwealth guidelines for the corresponding species groups below.

Survey methods and effort are outlined for each fauna group in Sections 6.3.3.ii.a to 6.3.3.ii.g below. Fauna survey locations are illustrated in Figure 6.2. A summary of fauna survey effort is provided below, while weather data for the survey period is provided in Appendix B.

Table 6.5 Targeted fauna survey method

Target species group	Target species	Survey method	Recommended survey period	Survey timing
Birds	Bush Stone-curlew	Call playback and spotlighting surveys	All year	July, August
	Glossy Black-Cockatoo (Breeding)	Hollow bearing tree survey, targeted nest, bird area and thermal drone surveys	January to September	May, June, July, August
	White-eared Monarch	Area searches	All year	August
	White-bellied Sea-Eagle (Breeding)	Nest tree searches, area and transect searches	July to December	July, August, October
	Little Eagle (Breeding)	Nest tree searches, area and transect searches	August to October	July, August, October
	Square-tailed Kite (breeding)	Nest tree searches, area and transect searches	September to January	July, August, October
	Barking Owl (Breeding)	Evidence of breeding surveys, hollow bearing tree survey, targeted nest tree searches, call playback, listening surveys and thermal drone surveys	May to December	July, August
	Powerful Owl (Breeding)	Evidence of breeding surveys, hollow bearing tree survey, targeted nest tree searches, call playback, listening surveys and thermal drone surveys	May to August	July, August
	Eastern Osprey (Breeding)	Nest tree searches, area and transect searches	April to November	July, August, October
	Red-backed Button-quail	Transects and nocturnal listening and flushing surveys	All year	January

Target species group	Target species	Survey method	Recommended survey period	Survey timing
	Masked Owl (Breeding)	Evidence of breeding surveys, hollow bearing tree survey, targeted nest tree searches, call playback, listening surveys and thermal drone surveys	May to August	July, August, October
	White-throated Needletail	Opportunistic	n/a	Opportunistic
Mammals	Rufous Bettong	Remote camera surveys	All year	January, February, June, July, August, November
	Eastern Pygmy-possum	Remote camera surveys	October to March	January, March, November, December, January
	Parma Wallaby	Remote camera surveys	All year	January, February, June, July, August, November
	Greater Glider	Remote camera, spotlighting surveys, hair and arboreal trapping	All year	March, April, May, June, November, January
	Yellow-bellied Glider	Remote camera, spotlighting surveys, hair and arboreal trapping	All year	March, April, May, June, November, January
	Squirrel Glider	Remote camera, arboreal trapping, hair and spotlighting surveys	All year	March, April, May, June, November, December, January
	Brush-tailed Rock-wallaby	Remote camera, scat searches (including genotype analysis) and aerial surveys	All year	January, February, June, July, August, October, November
	Brush-tailed Phascogale	Remote camera, arboreal trapping, hair and spotlighting surveys	December to June	March, April, May, June, December, January
	Koala	Detection dogs, thermal drone, and spotlighting surveys	All year	March, April, May, June, August, November
	Common Planigale	Funnel trapping. Remote cameras surveys	All year	January, February, June, July, August, November
	Long-nosed Potoroo	Remote camera surveys	All year	January, February, June, July, August, November
	Spotted-tailed Quoll	Remote camera surveys	All year	January, February, June, July, August, November
	Hastings River Mouse	Remote camera surveys	N/A	January, February, June, July, August, November

Target species group	Target species	Survey method	Recommended survey period	Survey timing
Microbats	Large-eared Pied Bat	Anabat detection, roost searches and harp trapping surveys	November to January	January, December
	Little Bent-winged Bat (Breeding)	Anabat detection, roost searches and harp trapping surveys	December to February	January, February, March, October, December
	Large Bent-winged Bat (Breeding)	Anabat detection, roost searches and harp trapping surveys	December to February	January, February, March, October, December
	Southern Myotis	Anabat detection, roost searches and harp trapping surveys	October to March	January, February, March, October, November
	Eastern Cave Bat	Anabat detection, roost searches and harp trapping surveys	November to January	January, February, March, October, November
Reptiles	Pale-headed Snake	Spotlighting surveys and funnel trapping	November to March	March, November, December, January
	Stephens' Banded Snake	Spotlighting surveys	October to March	January
Amphibians	Stuttering Frog	Aural-visual surveys	September to March	September, March, January

a Diurnal birds

Diurnal bird surveys were undertaken for the following species:

- Glossy Black-cockatoo
- White-eared Monarch
- Red-backed Button-quail
- White-throated Needletail
- White-bellied Sea-eagle
- Little Eagle
- Square-tailed Kite
- Eastern Osprey.

Bird survey methods and survey effort have been developed in accordance with DPE threatened biodiversity profile data collection (TBDC), DEC (2004), (DSEWPaC, 2010a) guidelines. Methods include a mix of area and vantage point surveys to record species presences, hollow bearing tree surveys, targeted nest searches and use of thermal drones. Thermal drones have been successfully used for arboreal mammal species such as Koalas and have been used for more mobile species such as Greater Gliders (Vinson et al, 2020). It has also been used successfully for nesting birds to detect nest heat signatures for much smaller species such as nightjars in Wales (Sherwing M & Vafidis J, 2021) and marshbirds in Canada (McKellar et al, 2021). It was applied to Glossy Black-cockatoos to detect potential nesting trees.

Additional surveys were undertaken in August 2023 included undertaking suitable hollow nest searches and surveys as per the guidance in the TBDC.

Methods and survey effort are outlined in Table 6.6.

Table 6.6 Methods and survey effort – diurnal birds

Method	Survey description	Survey effort
Area searches/vantage point surveys (All species)	Area searches and vantage point surveys include: • land based area and vantage point searches • surveyors conducted area and vantage point surveys within the construction envelope • all calls and habitat features were investigated • birds observed or heard were recorded.	(DEC, 2004)has not resolved bird survey requirements and does not provide guidance on survey effort, particularly for nesting birds. (DSEWPaC, 2010a) was reviewed, and sympatric species survey efforts indicated 8 hours over 4 days (2 hours per day) for sites less than 50 ha. No survey effort for larger sites is provided. Based on suitable habitat within the disturbance footprint (363 ha), area searches were carried out in locations that were identified as suitable nesting sites for raptors, or at locations where multiple habitat features, such as hollow bearing trees were located close together. Vantage point surveys took advantage of locations where large areas of the construction envelope could be viewed for larger species such as raptors and Glossy Back-Cockatoos. This survey methodology was undertaken for all components of the Project, provided a large coverage of the survey area. Twenty-five areas searches were undertaken, totalling 79 hours and 40 mins over 20 days. Nine bird transects/meandering were undertaken totalling 24 hours over 8 days.
Flushing surveys. (Red-backed Button-quail)	Flushing surveys included: • land based transect/flushing surveys • surveyors walked and/or used a buggy to undertake the surveys • all calls and habitat features were investigated • birds observed or heard were recorded.	DPE is currently developing survey guidance for threatened bird species. The TBDC for Red-backed Button-quail survey comments state that nocturnal surveys to flush birds from habitat should be used (see nocturnal birds surveys); however, identification is difficult. Flushing surveys were undertaken in areas containing suitable habitat for flushing such as areas of long grass. These were generally undertaken at dusk and dawn where identification of any flushed birds could be more accurately identified. Six flushing surveys were undertaken targeting Red-backed Button-Quail over four days, totalling approximately 3 hours.

Method	Survey description	Survey effort
Targeted nest searches/hollow bearing tree/signs of breeding surveys (Glossy Black-Cockatoo and raptors)	Diurnal surveys included: • observers travelled across available habitat, seeking out habitat features including nest trees and hollows • suitable nest or breeding hollows were marked and observed for breeding activity. The TBDC recommends that surveys for Glossy Black-cockatoos assessors should apply the following: • Look for signs of breeding: (a) begging birds of any age or sex: or (b) lone adult males identified during the breeding season (April to August) or (C) an occupied nest. • Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees contain hollows that are; (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical. • Where potential nest trees are identified on site, monitor for this species during the breeding season (Apr – Aug) to confirm the presence of any actual nest trees on site.	DPE is currently developing survey guidance for nest searches. The TBDC outlines that active nest should be assessed for the presence of each target species. This survey methodology was undertaken for all components of the Project, provided a large coverage of the survey area. Thirty-nine potential nest hollows were surveyed for 20 minutes with one repeat. The minimum survey effort was reached.

Method	Survey description	Survey effort
Thermal drone surveys (Glossy Black-Cockatoo)	Flight altitude is maintained, where possible, at a consistent level from which objects may be identified using the above thermal detection methods combined. No one detection method alone allows a singular point of truth regarding confirmation of object. A combination of various thermal detection methods (outlined above) allows the pilot a confidence in the object detected during search but also confirms this detection through an inspection at lower altitude to understand the object for identification. During this Project, where physically possible, ground crew from EMM mobilised on foot to confirm object detected in flight by the pilot/operator. Understanding the correct time for flights to occur requires no daylight due to reflected radiation giving false positive returns from direct sunlight which shines from objects over the flight area such as tree trunks, rocks and other surfaces. Generally, flights occur during the normalised radiation ground emission under night conditions, where a suitable temperature contrast between object for detection and background features can occur. The project area in this instance was between -5–21 degrees (circa day to night temperature range) with an average of ±4 degrees Celsius observed during most flight conditions being during late winter conditions which allowed flights to occur soon after last light each day of operations. Day time ambient temperature conditions being low meant features not for inspection did not hold significant temperatures which would bias the inspection with false temperature positives.	Thermal drone surveys were used in areas on site (where access could be achieved for drone operation) as a substitute where safe access cannot be achieved and/or coverage was considered efficient using this methodology. Drone surveys were used to target nesting Glossy Black-Cockatoos. 643 ha of the project area was surveyed using the thermal drone. Coverage included the majority of the generation site, with some coverage of the access and transmission line. Thermal drone surveys were completed in 2021 and further survey in 2022/23 was undertaken as per the TBDC guidance (as described above).

b Nocturnal birds

Nocturnal bird surveys were undertaken for the following species:

- Bush Stone-curlew
- Red-backed Button-quail
- Barking Owl
- Powerful Owl
- Masked Owl.

Bird survey methods and survey effort were developed using a combination of survey guidelines within the TBDC and DEC (2004) . Methods used to look for signs of breeding included, hollow bearing tree surveys, call playback, spotlighting, listening surveys, nest hollow monitoring (where potential presences of male and female were recorded in an area that contained potential hollows, were access could be safely achieved) and thermal drones. Thermal drones have been successfully used for arboreal mammal species such as Koalas and have successfully been used for nesting birds to detect nest heat signatures for much smaller species such as nightjars in Wales (Sherwing M & Vafidis J, 2021) and marshbirds in Canada (McKellar et al, 2021). It was applied to forest owls to detect occupied nest trees.

Additional surveys were undertaken in August 2023 included undertaking suitable hollow nest searches, call playback and surveys as per the guidance in the TBDC.

For forest owls the TBDC recommended (prior to the 14 March 2024 update) that where no known nest trees are known to occur, assessors should apply the following process:

1. Look for signs of breeding: (a) identifying suitable habitat (and) presences of male and female or (b) pair calling to each other (duetting) or (c) finding nest.

2. Where signs of breeding on site are present, potential nest trees should be identified (suitable hollows greater than 20 cm diameter).

3. Where potential nest trees are identified, night monitoring at the potential nest locations for a minimum of two nights should be undertaken to detect the presence of any owl of this species using a potential nest tree or demonstrating behaviour focussed on a potential nest tree (e.g. investigating the hollow or roosting within 10 m).

On 14 March 2024, forest owls changed from dual species credits to species credits. The BOS did not allow any transitional arrangements for exiting projects, including projects that have finalised BAM – C. All BAM-C cases will be automatically updated when any cases are re-opened.

Survey methodology from the 14 March 2024 TBDC was also updated to involve the following:

Call playback (can be undertaken during survey months listed above) – must be conducted at night (preferably around dawn and dusk) during calm (i.e. 0 beaufort scale, <1 km/hr) and dry weather because responses may be erratic and quiet. Survey as follows:

- Allow 10 minutes listening and observation time prior to broadcasting. If the target owl(s) is observed or call is heard during this period, call playback is not required.

- Evenly distribute call playback stations within areas of up to 1000 hectares of suitable habitat (as per the Threatened Biodiversity Database Collection (TBDC)) approximately 1000 m apart (I.e.1000 m x 1000 m grid or every 100 ha). This equates to 10 stations for 1000 ha of suitable habitat.

- Broadcast pre-recorded calls (e.g. single male, single female, duet and for masked owl, screech and chatter) for no more than 15 seconds followed by at least 30 seconds of listening time. Listen for the response or appearance of the target owl(s) during the listening time. Watch/listen for an owl that may be circling overhead.

- At each station repeat the broadcast and listening sequence for 15 minutes for each target owl, unless the target owl is detected before 15 minutes expires. Increase the volume from 20% of natural volume up to 200% of natural volume with each repeated broadcast.

- Search for owls drawn in by the broadcast within a 1 hectare circular plot around each broadcast station (radius approximately 57 metres) at the end of the 15 minute repeated broadcast and listening sequence. Look and listen for the target species using a spotlight for 15 minutes, unless the target owl is detected before 15 minutes expires. Watch/listen for an owl that may be circling overhead.

- Record the direction of fly in and time to respond to playback of detected owls, to reduce multiple counts of the same owl at different sample stations.

- If simultaneously surveying for multiple owl species (e.g. Masked Owl, Sooty Owl, Powerful Owl and Barking Owl), the playback sequence may include an escalating sequence of calls of these species punctuated with listening periods between each species' call. The Masked Owl calls should come at the end of the sequence so that if birds respond with a single shriek the response is not obscured by further playback.

- Repeatedly sample at each survey station with up to 15 minutes of broadcast calls and listening sequences (as above), until an owl responds, or for at least 6 nights.

- For areas of suitable habitat greater than 1000 hectares, place sampling stations at a density of approximately one every 1500 m (i.e. 1500 m x 1500 m grid or every 225 hectares), distributed evenly to cover at least half of the area of suitable habitat.

As these survey updates occurred after the survey effort for forest owls were completed, and no transitional arrangements were provisioned in the updates, survey effort was not completed as per the 14 March 2024 updates. It is considered that the historical survey effort undertaken within the construction envelope is still suitable to meet most of the requirements for the 14 March 2024 updates.

Methods and survey effort are outlined in Table 6.7.

Table 6.7 Methods and survey effort – nocturnal birds

Method	Survey description	Survey effort
Call playback and spotlighting (Forest owls and Bush Stone-curlew)	DEC (2004) recommends call playback and spotlighting are undertaken to target Bush Stone-curlew: • Surveys were commenced with a 15 minute listening period. Calls were played for 30 seconds, followed by 5 minutes of listening. This 5 minute cycle was repeated three times. This was followed by spotlighting on foot after the call playback period throughout the construction envelope. All observed fauna species were identified and recorded. DEC (2004) recommends call playback and spotlighting are undertaken to target these owl species. To determine presence, at least five visits are recommended for the Powerful Owl and Barking Owl, and eight visits for the Masked Owl. It is recommended that sites should be separated by 800 m to 1 km. The following method is recommended in DEC (2004): • Commence surveys with a 10-15 minute listening period. • Spotlighting for 10 minutes after the listening period in the immediate vicinity. • Call playback undertaken with the call of each target species played intermittently for a 5 minutes period followed by a 10 minute listening period. Following call playback a further 10 minutes of spotlighting. If forest owls were found to be present within the survey area, surveys would try to identify nesting sites by listening to roosting males calling to nesting females on dusk. Female calls would be triangulated and nest searches undertaken in identified areas over several nights.	DEC (2004) recommends a number of survey methods for the Bush-stone Curlew, including: • call playback: 2–4 km apart and conducted during the breeding season • spotlighting: by foot or from a vehicle driven in first gear. Based on the above, and availability of suitable habitat, nine playback sites were surveyed over two nights per location. This survey methodology was undertaken for all components of the Project, provided a large coverage of the survey area. Nine call playback locations with a repeat were undertaken with 17 hours and 15 minutes of total survey effort. Spotlighting on foot was undertaken when travelling from vehicles to call playback locations for each visit. The minimum survey effort was exceeded. Call playback for forest owls was used to determine species presence within the construction envelope. Broadcast locations were separated approximately 1 km from each other as per the DEC (2004) guidance. 12 main locations were used for broadcast surveys, with variations on five of these locations were shifted around to change locations near potential nest trees. Survey guidance was meet for Powerful Owl and Barking Owl as per DEC (2004) – six survey nights undertaken. Presence was confirmed for Masked Owl as such, surveys DEC (2004) which is used to determine presence / absence was not required to complete the full survey effort. A total of 24 hours and 25 mins of broadcast survey was undertaken.

Method	Survey description	Survey effort
Spotlighting and listening surveys (All species)	Spotlight surveys were undertaken using handheld LED spotlights and included: • 1 km or 500 m transects were undertaken by two observers • observers moved at a speed of less than 1 km per hour (i.e. one hour for the 1 km transect) scanning vegetation and trees for animals using both spotlights • all animals observed were recorded • spotlighting for Red-backed Button-quail was done concurrently with nocturnal reptile and arboreal mammals surveys.	DPE is currently developing survey guidance for threatened bird species. The TBDC states that call playback for Powerful Owl and Songmeters for all Red-Backed Button-Quail are not known to be effective. Listening surveys for Red-backed Button-quail calls were undertaken as part of the spotlighting surveys. Nine transects within the generation site were completed, totalling 15 km in length, with two transect located in the generation site not being replicated due to impacts from weather preventing safe access to transects within the survey period. Overall survey effort was not impacted as a result of this. Fourteen area surveys with one repeat were undertaken along the transmission line and access road, incorporated with the breeding owl surveys. A total of 9 hours and 18 minutes were undertaken. Four transects with four repeats were undertaken along the transmission line and access road. Totalling 907 minutes of searching.
Targeted nest searches (Forest owls)	Nocturnal surveys included: • observers travelled across available habitat, seeking out habitat features like suitable hollows that were identified during the hollow bearing tree surveys targeting suitable owl breeding hollows • suitable nest or breeding hollows were marked and observed for breeding activity.	DPE is currently developing survey guidance for nest tree searches and do not currently provide guidance on survey effort. The TBDC outlines that active nest should be assessed for the presence of each target species. For forest owls, the TBDC states that the surveyors should look for signs of breeding. Where signs of breeding are present, potential nest trees should be identified. Potential nest trees are to be monitored during the breeding season to confirm actual nest trees. A minimal of two nights survey at each potential nest tree is required to detect the presence of any owl species using the tree. This survey methodology was undertaken throughout construction envelope. Sixteen nocturnal targeted nest surveys with one repeat visit were undertaken with a total of 12 hours and 51 minutes targeted breeding hollow surveys undertaken at the targeted nest locations.
Listening point surveys (Forest owls)	Nocturnal surveys included: • observers undertake listening surveys for forest owls to determine presence and indications of breeding activity • when forest owls are heard observers, searched for active nest tree.	DPE is currently developing survey guidance for forest owl survey and does not provide guidance on survey effort. Listening point surveys were undertaken in combination with the thermal drone surveys. Generally, these surveys were located less than 1 km apart from each other. Survey times continued for the duration of time as the drone was flown at each survey location. Thirteen listening survey locations were surveyed for 17 hours and 31 minutes.

Method	Survey description	Survey effort
Thermal drone surveys (Forest Owls)	As above for diurnal birds.	Thermal drone surveys were used in areas on site (where access could be achieved for drone operation) as a substitute where safe access could not be achieved and/or coverage was considered efficient using this methodology. Drone surveys used to target forest owls. 643 ha of the Project area was surveyed using the thermal drone. Coverage included the majority of the generation site, with some coverage of the access and transmission line. Thermal drone surveys were completed in 2021 and further survey in 2022/23 was undertaken as per the TBDC guidance (as described above).

c Terrestrial mammals

Targeted terrestrial mammal surveys were undertaken for the following species:

- Eastern Pygmy-possum
- Rufous Bettong
- Brush-tailed Rock-wallaby
- Spotted-tailed Quoll
- Parma Wallaby
- Long-nosed Potoroo
- Hastings River Mouse
- Common Planigale.

Methods and survey effort have been developed in accordance with DEC (2004), DSEWPaC (2011b) and Meek PD, Cook CR (2022) and included a mix of terrestrial trapping, remote camera surveys. Survey effort was increased for Brush-tailed Rock-wallaby to greater understand any potential impacts for this species. Additional surveys included species distribution modelling, as per Thurtell et al (Thurtell, 2021) and Gowen (Gowen, 2015), to inform targeted aerial surveys and scat collection for genotype analysis. Methods and survey effort are outlined in Table 6.8.

Table 6.8 Methods and survey effort – terrestrial mammals

Method	Survey description	Survey effort
Remote cameras (all species)	Remote camera surveys were undertaken in accordance with the following method: At each site two cameras were placed at least 100 m apart. Cameras were attached to tree or stake and positioned approximately 25 cm above ground with bait stations placed 1.5 m away. Bait stations were baited with a mixture of peanut butter, rolled oats and honey.	DSEWPaC (2011b) recommends cameras are placed out for at least one week. However, long term monitoring surveys undertaken by EMM have determined one week may not be sufficient to reliably detect the small, cryptic species (such as Long-nosed Potoroo) and surveys were extended to a minimum of 14 days. DEC (2004) does not include remote camera surveys. However, as cameras are used to replace hair tubes a similar survey effort was utilised. DEC (2004) recommends ten hair tubes left in place for at least four days and nights per 50 ha stratification unity, with replication for every additional 100 ha. DSEWPaC (2011b) recommends that ten cameras are deployed per hectare. To cover the disturbance footprint of suitable habitat 330 ha, you would require 3,300 cameras. This level of survey effort is considered unreasonable for large projects. Based on the survey effort for hair traps, 40 remote cameras and 560 survey nights are required for the disturbance footprint. Camera surveys were undertaken at 77 sites, with 154 cameras deployed, with cameras left in place for a minimum of 14 nights. A total of 7,527 camera nights were undertaken. This survey methodology was undertaken for all components of the Project. NGH also deployed nine cameras in (NGH, 2021), however, didn't provide survey effort or camera placement (ground or tree) only results. The minimum survey effort required was exceeded.
Remote cameras (Common Planigale)	Camera traps used to identify Common Planigale used a modified magnification lens on camera traps to improve the identification for small mammals that could be used for Common Planigale as per Meek PD, Cook CR (2022). Identification followed the below steps that David Milledge (previous species expert) provided (per coms): Whenever a small dasyurid is detected, the criteria used to separate the Common Planigale from other similar species comprises of: the very small size the presence of a slightly domed head profile and relatively small ears compared with other small dasyurid species (as illustrated in the cover photograph, and contrary to data in the TBDC) the relatively shorter tail length compared with other small dasyurid species	The TBDC recommends that for the Common Planigale a minimum of three pitfall trap arrays must be used for an area of suitable habitat up to 1 ha. For suitable habitat >1 ha–10 ha, one additional pitfall trap array must be used for every additional hectare, with a maximum of 10 pitfall trap arrays for any one patch of suitable habitat. Where suitable habitat patches are separated by 200 m or greater, the same survey effort must be applied in each patch. Pitfall traps could not be used within the Project area due to the rocky nature of the suitable habitat where these surveys were to be targeted. As such, camera traps using a modified magnification lens was used instead. Based on the survey effort required for pitfall trapping within suitable habitat in the Macleay Hastings sub-IBRA region, 10 trap locations are needed for a minimum of four consecutive nights. Requiring a total of 40 trap nights. Twenty-two camera traps were used over 20 traps nights totalling 440 trap nights. The minimum survey effort required was exceeded.

Method	Survey description	Survey effort
Species distribution modelling (SDM) and targeted aerial surveys. (Brush-tailed Rock-wallaby)	SDM was run for the greater locality using existing records for the Brush-tailed Rock Wallaby and data collected by EMM. These records were input into the model as per the appendices Thurtell (2021). The resultant model was used to guide targeted aerial surveys. Using the SDM and records on site, transects were created to target suitable Brush-tailed Rock Wallaby habitat within the Project area and greater survey location. Transects were surveyed using three spotters in a helicopter flying along survey transects at 45 knots between 8:00 am–11:00 am.	Gowen (2015) requires four repeats of each transect. Three transects were identified as suitable target locations for the Brush-tailed Rock Wallaby surveys. The minimum survey effort required was met.
Scat collection and genotype analysis (Brush-tailed Rock-wallaby)	Brush-tailed Rock Wallaby scat collection involves collection of fresh scats, one scat each using papers to collect and minimise physical touching into a dry paper bag. Clean sampling protocols were employed to avoid cross-contamination. Scats were stored out of sunlight and frozen in individual packs until being transported to the laboratory for processing. DNA was extracted from scat samples using Qiagen soil kits (Qiagen). Extracted DNA was first screened to confirm the presence of Brush tailed rock wallaby DNA using specific primers in a qPCR assay. Genotype analysis was undertaken by Cesar Australia.	80 Brush tailed Rock-wallaby scats were collected during August 2022. Samples were collected at nine microsatellite locations that were identified in the field as possible colonies.

d Arboreal mammals

Targeted arboreal mammal surveys were undertaken for the following species:

- Squirrel Glider
- Greater Glider
- Yellow-bellied Glider
- Brush-tailed Phascogale
- Koala.

Methods and survey effort have been developed in accordance with OEH (2018), DEC (2004), (DSEWPaC, 2011b) and DPE (2022b) and survey effort is outlined in Figure 6.6. It should be noted that the majority of the surveys for Koala were undertaken prior to the release of DPE (2022b) guidance. These guidelines require the employment of two survey methods to achieve coverage. Species surveys used within the project area included a mix of four survey methods for Koala that is considered to provide suitable coverage for this species. The field surveys for the Project were near completion when DPE (2022b) was published.

Table 6.9 Methods and survey effort – arboreal mammals

Method	Survey description	Survey effort
Grey headed flying fox camps	Camp sites for flying foxes were searched for throughout the site on foot.	OEH (2018) guidelines do not require targeted surveys. The entire construction envelope was covered on foot during other flora and fauna surveys. This survey methodology was undertaken for all components of the Project. The minimum survey effort required was met.
Arboreal trapping (Squirrel Glider, Greater Glider, Yellow-belled Glider, Brush-tailed Phascogale)	Transect lines containing ten Elliot B traps were placed at 2 m above the ground. Where possible, traps were placed 50 m apart on suitable trees within the construction envelope: Traps were baited with a mixture of peanut butter, rolled oats and honey. A mixture of water and honey was sprayed on each tree trunk. Traps were checked early in the morning and closed for the day. Traps were re-opened and rebaited in the late afternoon.	DEC (2004)requires 24 trap nights over 3–4 consecutive days per 50 ha of stratification unit, with replication for every additional 100 ha. Based on the stratification units within the disturbance footprint of suitable habitat of approximately 330 ha, this would equate to a minimum survey effort of 96 trap nights. Remote cameras targeting Brush-tailed Phascogales in the Lower Reservoir area of the generation site confirmed presences of Squirrel Glider. No targeted trapping for Squirrel Glider was therefore required in suitable habitat of the survey area. Ten survey transects were undertaken over 4 nights in the upper reservoir and transmission line, equating to 400 trap nights. The minimum survey effort was exceeded.
Spotlighting (All species)	Spotlight surveys were undertaken using handheld LED spotlights and included: 1 km or 500 m transects were undertaken by two observers observers moved at a speed of less than 1 km per hour (i.e. one hour for the 1 km transect) scanning vegetation and trees for animals using both spotlights all animals observed were recorded. Spotlighting for arboreal mammals was done concurrently with nocturnal reptile and bird spotlighting surveys.	DSEWPaC (2011b) recommends two parallel transects per 5 ha site, while DEC (2004)recommends two transects per 200 ha of stratification unit, repeated across two nights. In line with DSEWPaC (2011b)) and DEC (2004), a survey effort of 1 km transects per 200 ha stratification units was undertaken with each site replicated. These surveys were undertaken prior to the publication of the Koala survey guidance (DPE, 2022b). Based on the above stratification units, this would equate to two 1 km spotlighting surveys, repeated on two occasions. Requiring a total of 4 km in length. Nine transects within the generation site were completed, totalling 15 km in length, with two missing a repeat survey were undertaken in the generation site. Fourteen area surveys with one repeat were undertaken along the transmission line and access road, incorporated with the breeding owl surveys. A total of 558 minutes were undertaken. Four transects with four repeats were undertaken along the transmission line and access road. Totalling 907 minutes of searching. The minimum survey effort was exceeded.

Method	Survey description	Survey effort
Camera trapping (All species)	Remote camera surveys were undertaken in accordance with the following method: At each site two cameras were placed at least 100 m apart. Cameras were attached to tree or stake and positioned approximately 2 m or higher above ground with bait stations placed 1.5 m away. Cameras were baited with a baited canister with small holes and capped at either end, to limit bait theft by other species, or honey-water sprayed very liberally in front of each camera.	DSEWPaC (2011b) recommends cameras are placed out for at least one week. However, long term monitoring surveys undertaken by EMM have determined one week may not be sufficient to reliably detect the small, cryptic species, and surveys were extended to a minimum of 14 days. DEC (2004) does not include remote camera surveys. However, as cameras are used to replace hair tubes a similar survey effort was utilised. DEC (2004) recommends ten hair tubes left in place for at least four days and nights per 50 ha stratification unity, with replication for every additional 100 ha. DSEWPaC (2011b) recommends that ten cameras are deployed per hectare. To cover the disturbance footprint of suitable habitat 330 ha, you would require 3,300 cameras. No survey effort for larger sites is described. The threatened biodiversity profile data collection (TBDC) states that for the Brush-tailed Phascogale survey effort must be undertaken using baited cameras. Cameras must remain in place for a minimum of 4 weeks with cameras checked and baits replaced after 2 weeks. A minimum of four cameras, independent of the size of the construction envelope, must be used for sites up to 1 ha, then an additional two cameras for every ha of potential habitat thereafter. To cover the disturbance footprint of suitable habitat 330 ha you will require 662 cameras. No survey effort is described for large sites and consultation was undertaken with BCD. Based on the survey effort for hair traps described in DEC (2004), 40 remote cameras and 1,120 survey nights are required for the construction envelope. Camera surveys were undertaken at 98 sites, with 195 cameras deployed, with cameras left in place for a minimum of 28 nights. 5,124 nights of active bait survey were undertaken, with bait replaced after 14 days. An extra 6,771 camera nights were undertaken after the 28 days. A total of 11,895 camera nights were undertaken. NGH also deployed nine cameras in (NGH, 2021), however, didn't provide survey effort or camera placement (ground or tree) only results. The minimum survey effort required was exceeded.
Thermal drone surveys (Koala)	As above for diurnal birds.	Thermal drone surveys were used in areas on site (where access could be achieved for drone operation) as a substitute where safe access could not be achieved and/or coverage was considered efficient using this methodology. Thermal drone surveys were used to target Koala. DPE (2022b) requires the full extent of suitable habitat to be surveyed with a 30% overlap between flight paths. DPE (2022b) requires a second night of survey if no Koala presence is observed. Drone surveys were undertaken in winter 2021 prior to the publication of the survey guidance. No second survey night was undertaken in areas surveyed with no results. Due to the large area of the site, four nights of survey were undertaken to cover the accessible extent of the site. 643 ha of the Project area was surveyed using the thermal drone. Coverage included the majority of the generation site, with some coverage of the access and transmission line.

Method	Survey description	Survey effort
Koala Detection Dog Survey	Field detection dogs were used to detect Koala scats, comprising the following method: Field quality assurance (FQA) procedures and field quality control (FQC) searches were conducted on site prior to daily surveys. Two handheld GPS units were used to record scat locations. Tracking collars were also used to record tracks of the detection dogs. Opportunistic observations were also carried out when dogs were not actively searching.	(DPE, 2022b) requires three 200 m transects for every 5 ha of suitable habitat, spaced approximately 100 m apart. To cover suitable habitat within the disturbance footprint 330 ha requires 198 transects. No survey effort is described for large sites. Presence absence transects of 200 x 50 m were conducted every 500 m and/or at most suitable habitat areas. Sample surveys within suitable habitat were also undertaken between sites. 73 transects were undertaken along the access road, transmission line and in safe to access areas of the generation site.
Regularised Grid Based (RGB) Spot Assessment Technique (SAT) (Koala)	The RGB SAT method requires application of a uniform assessment method across a broad area. At each grid point, a SAT (Phillips & Callaghan , 2011) survey is undertaken, as follows: Centre tree (nearest tree irrespective of species) is located and marked with flagging tape. The 29 nearest trees to the centre tree are also identified. Koala faecal pellets are searched for beneath each of the 30 trees within a distance of 100 cm of tree trunks. Initial inspections of undisturbed ground surface are followed by a more thorough inspection involving disturbance of leaf litter and ground cover (if no faecal pellets are initially detected). An average of approximately two person minutes per tree is dedicated to the faecal pellet search. Activity levels can be interpreted using Table 2 from Phillips and Callaghan ((DSEWPaC, 2011b)).	A 250 m x 250 m grid was applied to the survey area to identify survey locations. Surveys were undertaken where the grid points intersected areas with >10% native tree canopy. A total of three SAT surveys were undertaken (NGH, 2021).
Hair Trapping (Squirrel Glider, Greater Glider, Yellow-belled Glider, Brush-tailed Phascogale)	Transect lines containing ten hair traps were placed at 2 m above the ground. Where possible, traps were placed 50 m apart on suitable trees within the construction envelope: Traps were baited with a mixture of peanut butter, rolled oats and honey. A mixture of water and honey was sprayed on each tree trunk. Traps were left for 26 nights. Hair samples sent for analysis.	DEC (2004) recommends ten hair tubes left in place for at least four days and nights per 50 ha stratification unity, with replication for every additional 100 ha. Eleven hair trap lines-were undertaken by NGH (2021). The minimum survey effort required was exceeded.

e Microchiropteran bats

Microbat surveys were undertaken for the following species:

- Large-eared Pied Bat
- Little Bent-winged Bat
- Large Bent-winged Bat
- Southern Myotis
- Eastern Cave Bat

Methods and survey effort have been developed in accordance with DEC (2004), OEH (2018) and DSEWPaC (2010b). Methods and survey effort are outlined in Table 6.10.

Table 6.10 Methods and survey effort – Microchiropteran bats

Method	Survey description	Survey effort
Breeding habitat identification (all species)	Roost searches were undertaken in accordance with the following: Potential roost sites across the disturbance footprint (caves, scarps, cliffs, rock overhangs, disused mines, tunnels, bridges, culverts, old buildings, sheds) were searched for signs of use by microbats. Searches included searching for signs of microbats (urine stains, droppings, remains, and bat fly casings) during the daytime. Searches were done using handheld torches shined into cracks and crevices. A handheld detector was used to alert the observers to any ultrasonic calls. Where bats were recorded the species was identified by capture/through additional surveys (see below).	OEH (2018) requires a 30-minute search per roost. Features such as cliffs, rock areas, overhangs were inspected where access could be achieved safely on foot. Suitable features in and within 100 m of the construction footprint that could not be safely accessed used binoculars to check potential features at suitable vantage points. No potential roost sites were identified within 100 m from the disturbance footprint.
Acoustic detection (all species)	Acoustic surveys were undertaken as follows: Detectors were set out over waterways and in flyways likely to be utilised by bats. Detectors were placed a minimum of 50 m apart. Detectors were placed out for a minimum of four nights, with devices set to record between dusk and dawn. Calls were analysed by a person experienced in bat call analysis.	The OEH (2018) guidelines specify a minimum survey effort of four sites surveyed for four night (16 detector nights) for sites with less than 50 ha of habitat/riparian stream lengths less than 2.5 km. Larger sites are required to be scaled up with the same effort required for 50 ha/2.5 km stream lengths. It is estimated that approximately 5 km of the disturbance footprint may fall within 200 m of the riparian area, requiring 80 detector nights (Southern Myotis) and 330 ha of suitable habitat requiring 112 detector nights (remaining candidate species). Surveys for riparian stream length were undertaken over five sites, across two nights, equating to 10 detector nights. These surveys had to be shortened due to rising river levels that would have washed away the detectors. Surveys for suitable habitat with the survey area were undertaken by NGH in 2020. Surveys were undertaken over four sites across 21 nights, equating to 84 detector nights (NGH, 2021).

Method	Survey description	Survey effort
Harp trapping (all species)	Harp trapping was undertaken as follows: Two to three bank harp traps, with a minimum catch area of 4.2 m^2, strung with monofilament nylon line were placed out over waterways and in flyways likely to be utilised by bats. Harp traps were placed a minimum of 20 m apart. Each harp trap location was surveyed for a single night, in line with OEH (2018), to minimise trap avoidance. Harp traps surveys were undertaken across the Project area over four nights. Harp traps were set prior to dusk and checked at dawn.	The OEH (2018) guidelines specify a minimum survey effort of four sites surveyed for four night (16 trap nights) for sites with less than 50 ha of habitat/riparian stream lengths less than 2.5 km, for Southern Myotis. Due to La Nina events, harp trapping for Southern Myotis was undertaken during unfavourable conditions. Rapid river level rise reaching harp traps required surveyed to be discontinued due to animal welfare concerns. Survey effort included four sites with one trap night (total of four trap nights) before surveys had to be called off. Main survey effort for Southern Myotis was therefore undertaken using acoustic detection and analysis. Cave dwelling bat maternity roost surveys were undertaken using harp trapping. It was identified during the roost searches that the construction envelope and habitat within 2 km contained over 5 km of features that could be considered habitat for cave dwelling bats. Due to the inaccessibility and safety of accessing these potential features within the construction envelope, harp trapping was used to determine if any lactating females were present. This would determine if a maternity roost was near the construction envelope. Four sites were surveyed for four night (16 trap nights) and four sites were surveyed over three nights (12 trap nights) equalling 28 trap nights near suitable features to support maternity roosts were undertaken. Surveys guidelines were met.

f Amphibians

Amphibian (frog) surveys were undertaken for the Stuttering Frog.

Stratification units for frogs are based on lengths of suitable habitat for Stuttering Frog. Stratification units used to inform frog surveys are outlined in Table 6.11.

Table 6.11 Stream lengths for frogs

Target Species	Waterway/feature	Length (m)/area (ha)
Stuttering Frog	Macleay River – Strahler 9	22,804 m
Stuttering Frog	Lower Reservoir – Strahler 3	1,336 m
Stuttering Frog	Lower to Upper access – Strahler 2	826 m

Methods and survey effort has been developed in accordance with DPIE (2020c) and is outlined in Table 6.12.

Table 6.12 Methods and survey effort - Amphibians

Method	Survey description	Survey effort
Aural-visual surveys	Aural-visual surveys comprise the following: • Each survey requires a minimum 120 minute period of listening for calling frogs and conducting a visual search along a 500 m transect in breeding habitat along, around or through a suitable waterbody. • Survey comprises of 5 minutes of listening every 50 m. • Spotlighting for eyeshine along each 50 m section. • Using call playback at the same location as the aural-visual survey. • Each transect requires four repeats with at least one transect separated by a two week period. • Each transect requires 450 survey minutes in total.	DPIE (2020c) survey guidelines for aural-visual surveys are to be undertaken along transects of 500 m in suitable breeding habitat for four surveys nights. Where habitat is greater than 5 km, a minimum of five 500 m is required. NGH conducted surveys in 2020 at one transect over four nights, 60 minutes each night equalling to 240 surveys minutes. Five transects with two repeats equalling 1,200 survey minutes were undertaken along the Macleay River. During these surveys it was identified that habitat along the Macleay was not considered suitable to support this species and no further surveys were undertaken along the Macleay. Three transects with four repeats equalling 1,440 survey minutes were undertaken along the Lower Reservoir – Strahler 3 creek and Strahler 2 creek. Both creeks are considered sub-optimal habitat. Survey effort meets the guideline requirements.

g Reptiles

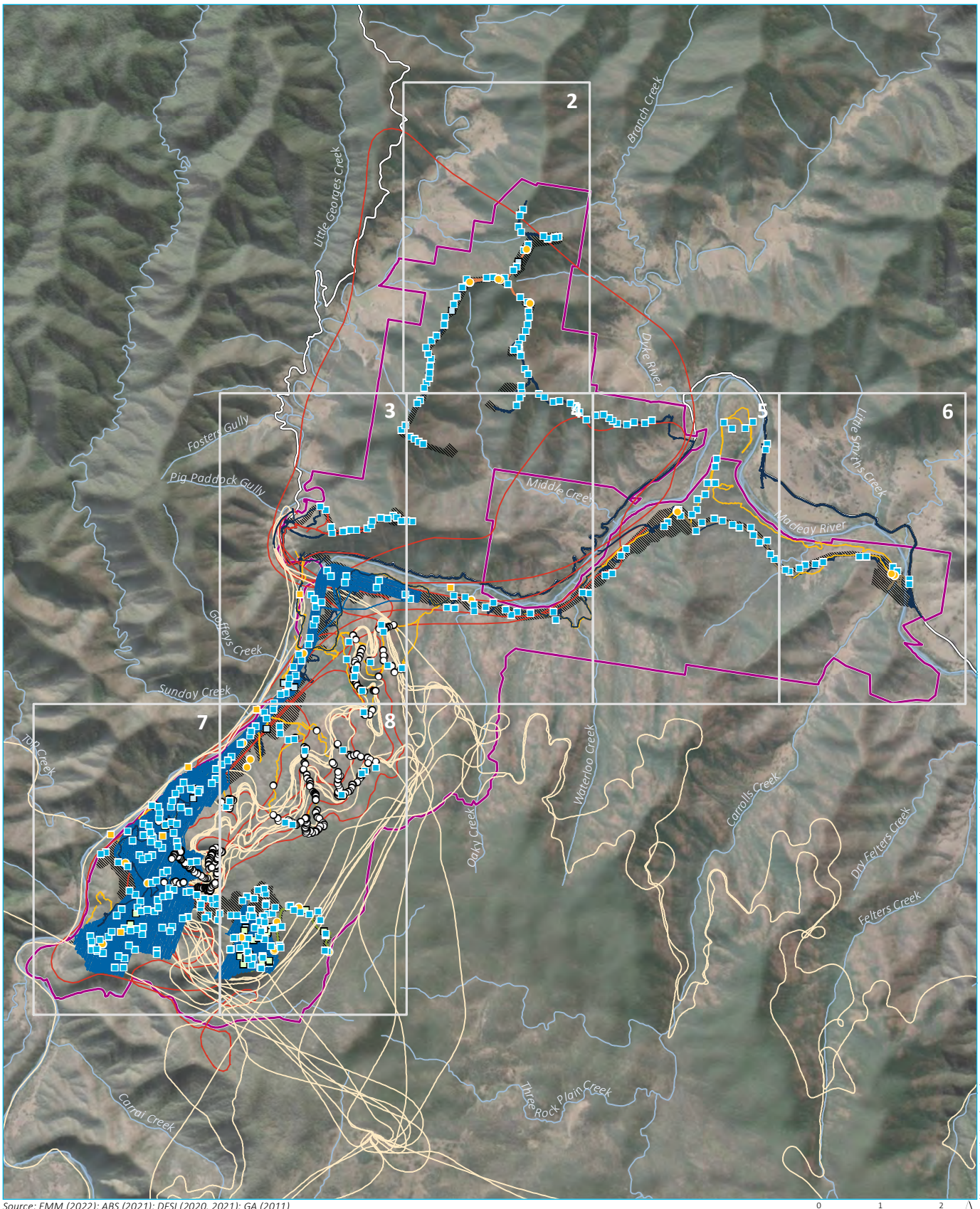
Reptile surveys were undertaken for the following species:

- Pale-headed Snake
- Stephen's Banded Snake.

Methods and survey effort have been developed in accordance with DEC (2004), DPE (2022c) and DSEWPaC (DSEWPaC, 2011c) and are outlined in Table 6.13.

Table 6.13 Methods and survey effort - Reptiles

Method	Survey description	Survey effort
Spotlighting (all species)	Spotlight surveys (DPE, 2022b) were undertaken using handheld LED spotlights and included: Usually a 1 km transect, was undertaken in areas of suitable habitat, targeting microhabitats likely to support the species (e.g. under bark and hollow bearing trees and along riparian areas). Observers scanned vegetation and trees for animals using spotlights, as well as targeted searching in suitable microhabitat. All animals observed were recorded.	DEC (2004) requires one search per 100 ha of habitat, replicated over two nights, conducted between November and March. DPE released threatened reptiles survey guidance in November 2022 (DPE, 2022c) after the survey effort for Pale-headed Snake was undertaken within the Generation site. DPE (2022c) requires 120 people minutes per 50 ha of suitable habitat with four repeats for both species. The new guidance was only applied to the transmission line and access road as these surveys occurred after the release of the new survey guidance (DPE, 2022c). Generation site: Five transects were completed with one repeat on two transects only. Totalling 444 minutes of searching. The minimum survey effort was exceeded under the DEC 2004 guidelines, which would have required a maximum of four transects. Access road and transmission line: Four transects with four repeats were undertaken along the transmission line and access road totalling 1,814 people minutes of searching. The minimum survey effort was exceeded for the transmission line and access road which would have required a maximum of 480 people minutes of searching under the DPE (2022c) guidelines. In addition, fourteen area surveys with one repeat were undertaken along the transmission line and access road, incorporated with the breeding owl surveys. A total of 1,116 people survey minutes were undertaken. As part of the frog aural visual surveys, which targets habitat where both snake species would be hunting for prey, an additional 5,280 person minutes was undertaken with three transects having four repeats that meet DPE (2022c) guidelines, totalling 2,880 person hours. Under the DPE (2022c) guidance, a maximum of 2,880 person minutes would have been required with transects having four repeats. 3,254 person minutes were achieved under the DPE (2022c) guidance. An additional 6,840 person minutes of spotlighting that did not have the four repeats were also undertaken for the Project. Survey effort exceeded the guideline requirements.
Funnel Traps (Pale-headed Snake)	Funnel traps were set in suitable habitat such as near riparian habitat (where present) for 4 nights. Funnel traps were 75 cm x 18 cm x 18 cm. Traps were spaced approximately 3 m apart. Drift fences were used to funnel snakes towards traps. Traps were checked twice daily, in the morning and evenings. Trapping occurred during high humid nights during afternoon storms that occurred most days.	Surveys within the generation site were undertaken prior to the new DPE (2022c) guidance was issued. As such, no funnel traps were conducted in this section of the Project. DPE (2022c) survey guidelines were only applied to the transmission line and access road that is within the Hasting Macleay sub-IBRA region. DPE (2022c) requires 72 trap nights with 4 replicates per 50 ha within suitable habitat. The area of both the transmission line and access road is less than 50 ha. Five traplines with 5 traps were undertaken along the transmission line with four survey nights. Totalling 100 trap nights. Five trapline with 5 traps were undertaken along the access road with four survey nights. Totalling 100 trap nights. A total of 200 trap nights were undertaken which exceeded the guideline requirements within the Hastings Macleay Sub-IBRA region.



Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

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KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Brush-tailed Rock-wallaby scat collection
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Aerial survey - October - November 2022
- Brush-tailed Rock-wallaby scat survey - August 2022
- Spotlighting - November 2021
- Spotlighting - March 2022
- Thermal drone transect - August 2021
- Koala detection dog transect - August 2022
- Aerial survey - August 2022
- Spotlighting - December 2022
- Spotlighting - January 2023

Targeted mammal surveys
Map 1 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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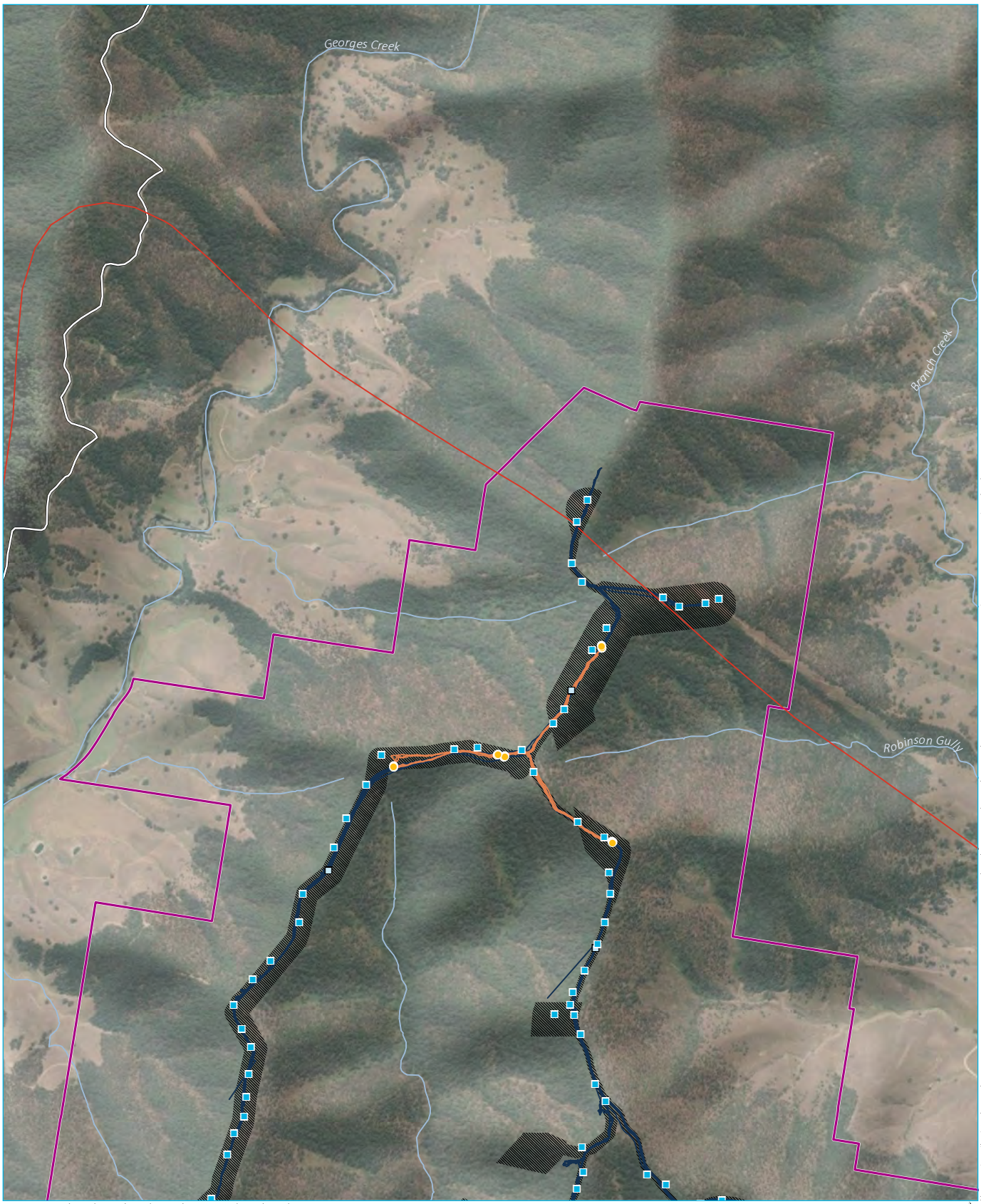
Figure 6.2a

EMM creating opportunities



Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Koala detection dog transect - August 2022
- Aerial survey - August 2022
- Spotlighting - December 2022

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Targeted mammal surveys
Map 2 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM
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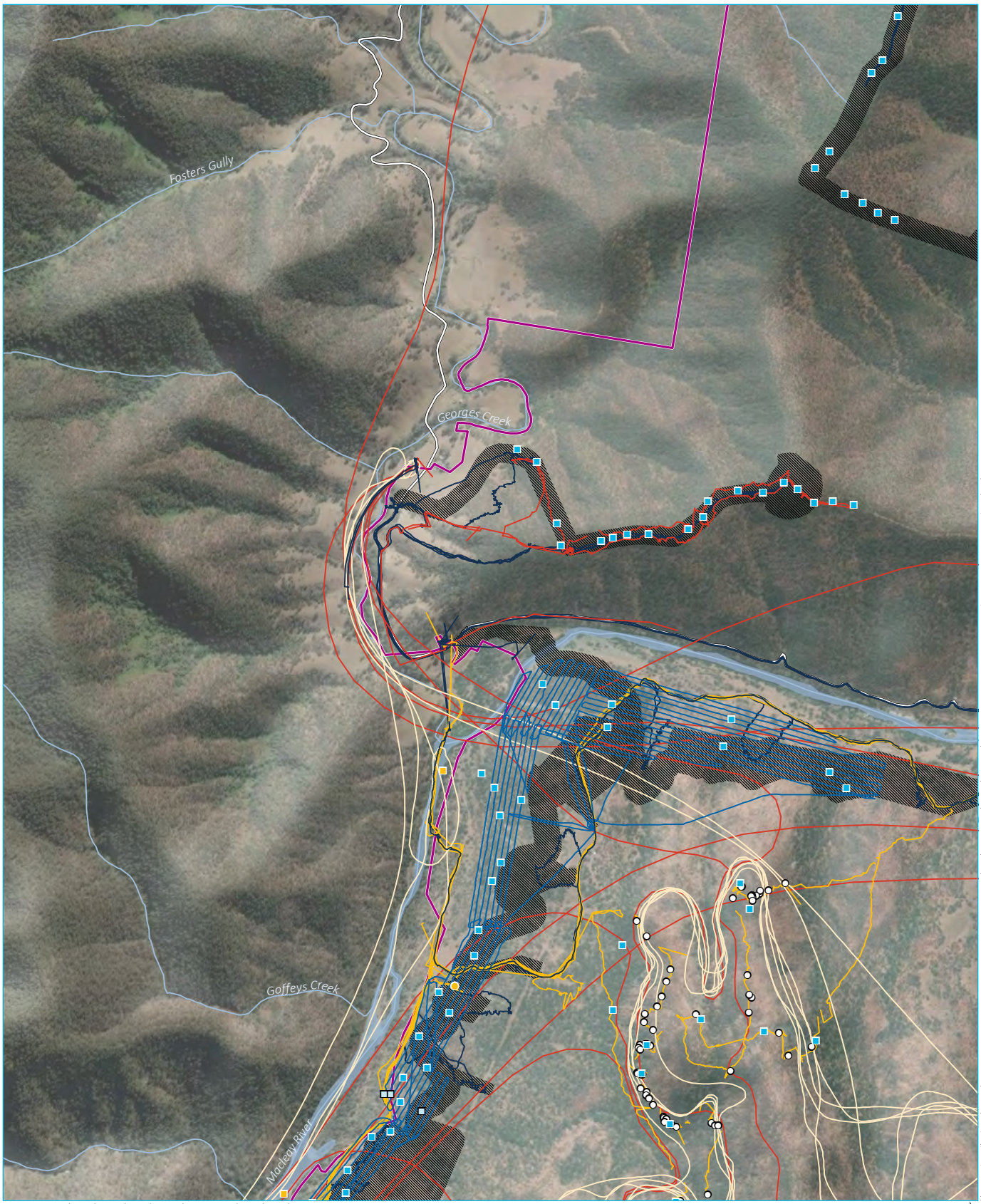

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Brush-tailed Rock-wallaby scat collection
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Aerial survey - October - November 2022
- Brush-tailed Rock-wallaby scat survey - August 2022
- Thermal drone transect - August 2021
- Koala detection dog transect - August 2022
- Aerial survey - August 2022

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Targeted mammal surveys
Map 3 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM
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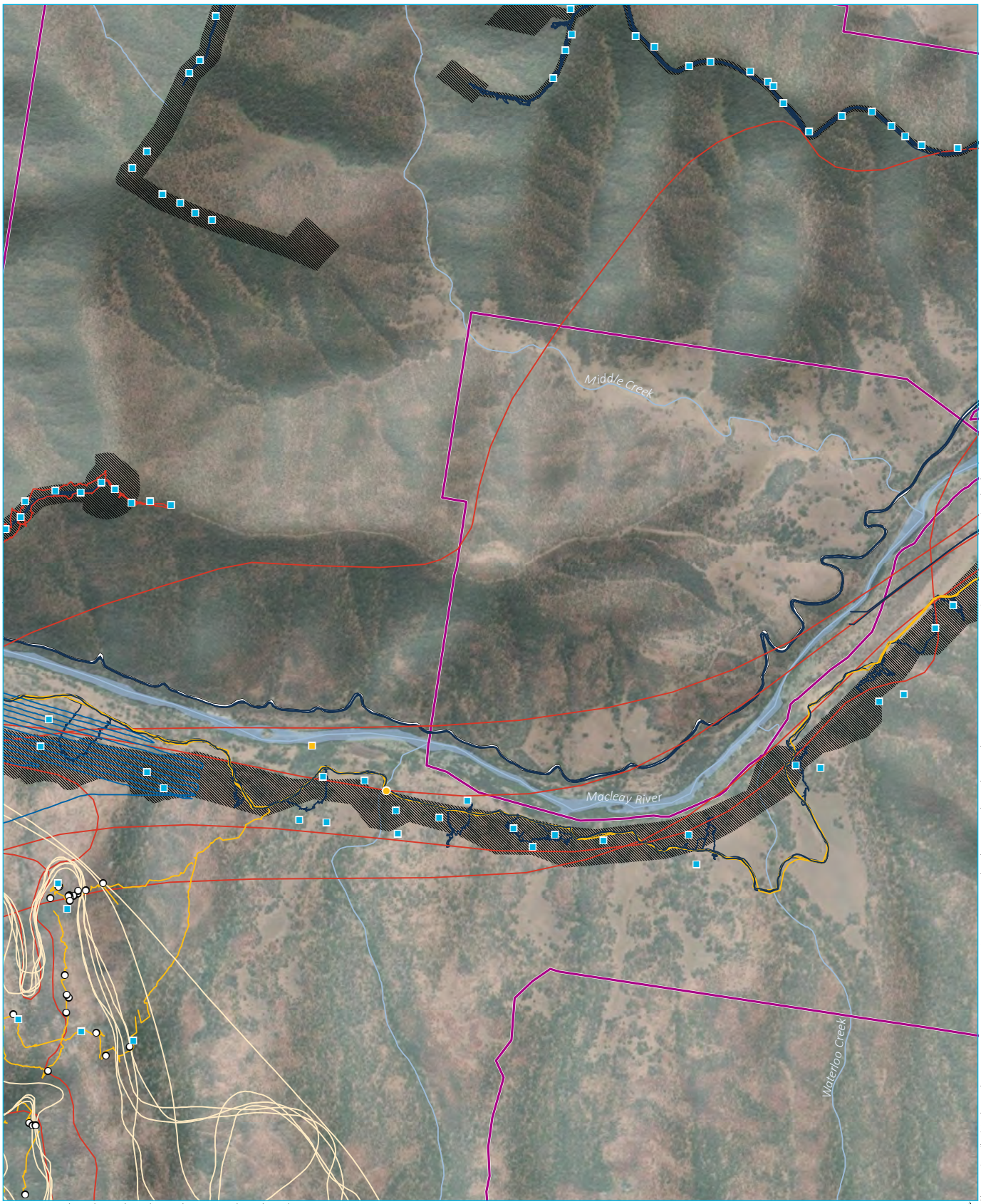

Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Brush-tailed Rock-wallaby scat collection
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Aerial survey - October - November 2022
- Brush-tailed Rock-wallaby scat survey - August 2022
- Thermal drone transect - August 2021
- Koala detection dog transect - August 2022
- Aerial survey - August 2022

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Targeted mammal surveys
Map 4 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM
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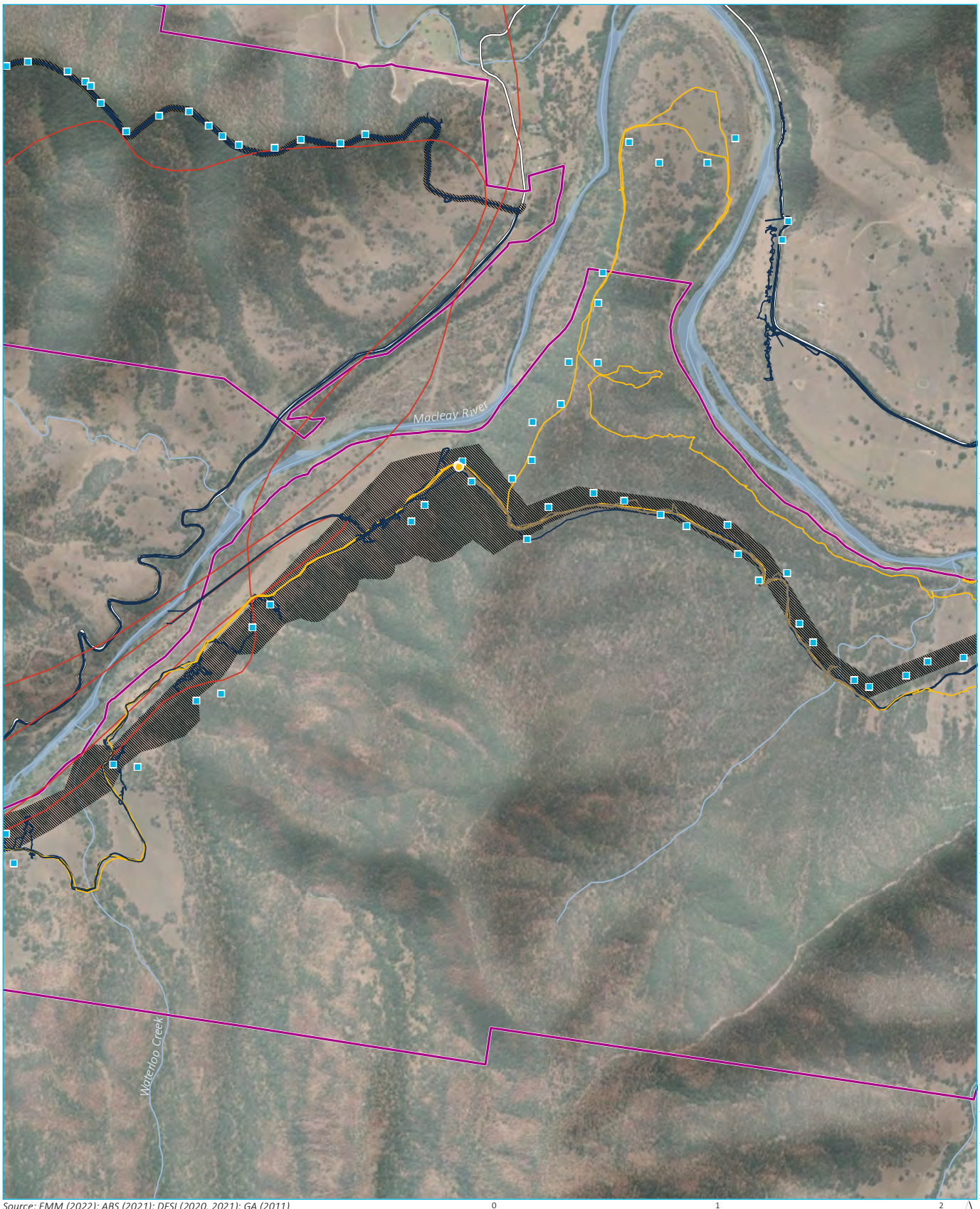

Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Brush-tailed Rock-wallaby scat survey - August 2022
- Koala detection dog transect - August 2022
- Aerial survey - August 2022
- Spotlighting - January 2023

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Targeted mammal surveys
Map 5 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM
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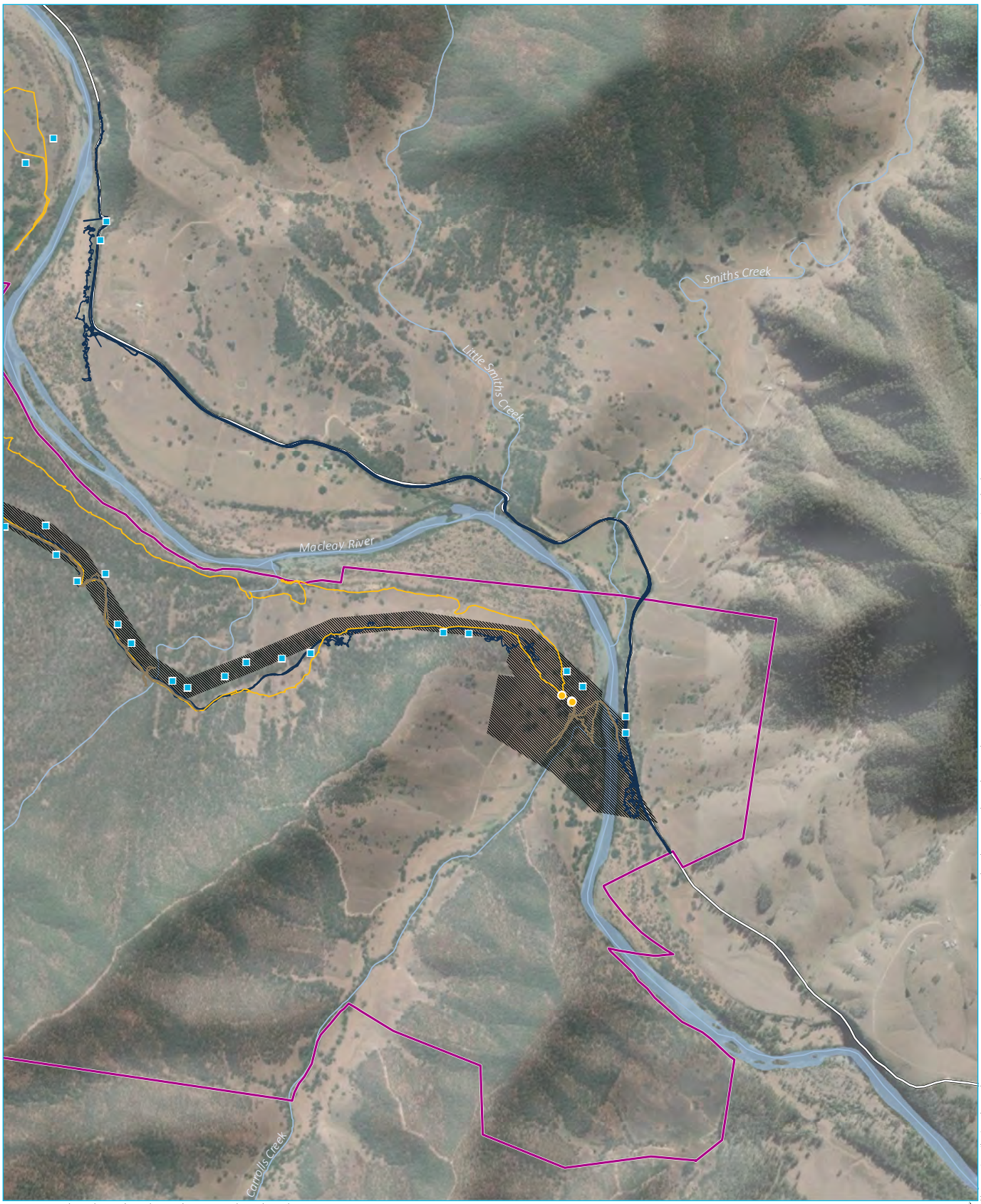

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0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted mammal survey point

- Camera
- Microbat acoustic
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Brush-tailed Rock-wallaby scat survey - August 2022
- Koala detection dog transect - August 2022
- Spotlighting - January 2023

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Targeted mammal surveys
Map 6 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM
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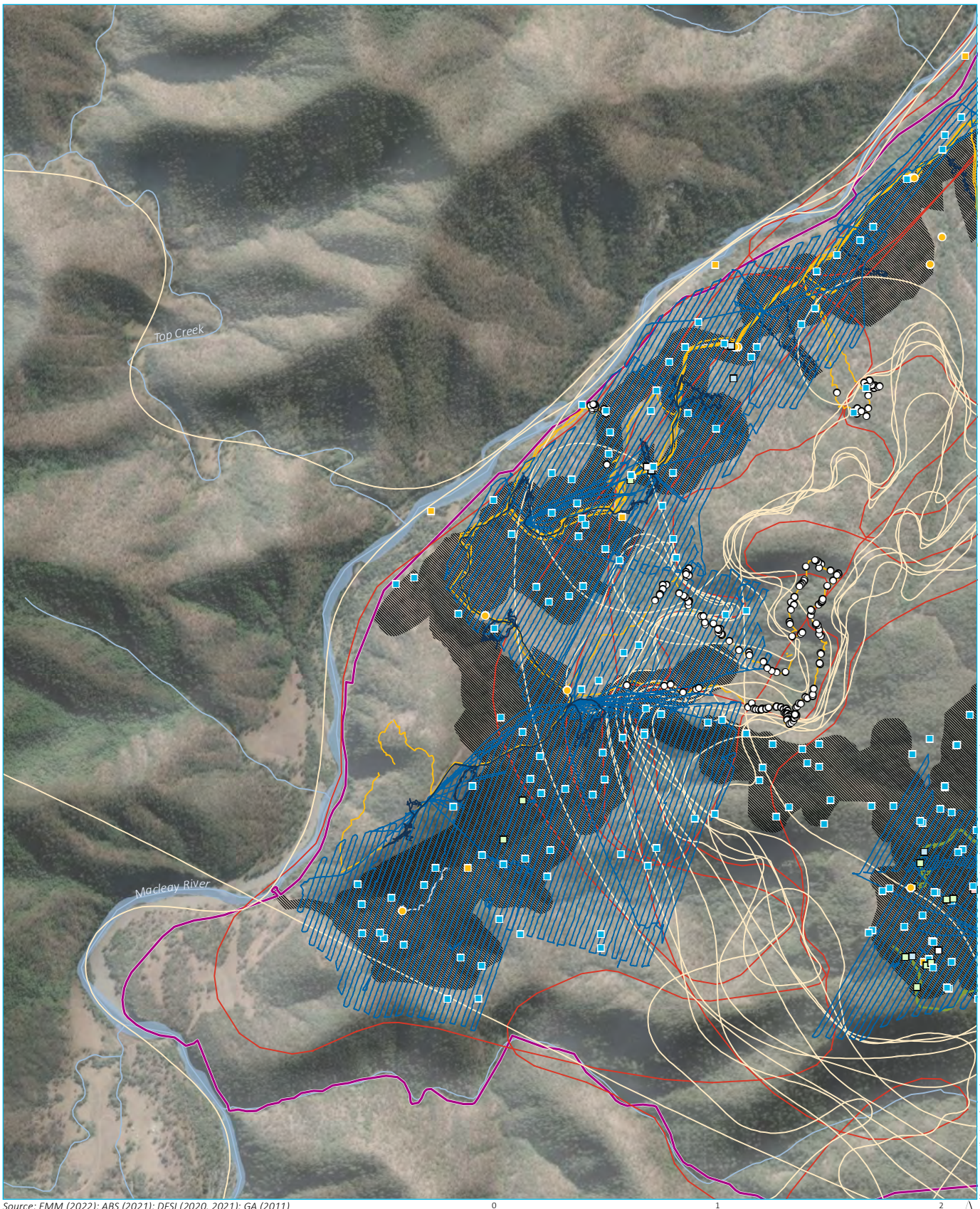

Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse

Targeted mammal survey point

- Camera
- Microbat acoustic
- Brush-tailed Rock-wallaby scat collection
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Aerial survey - October - November 2022
- Brush-tailed Rock-wallaby scat survey - August 2022
- Spotlighting - November 2021
- Spotlighting - March 2022
- Thermal drone transect - August 2021
- Koala detection dog transect - August 2022
- Aerial survey - August 2022

Targeted mammal surveys
Map 7 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM creating opportunities

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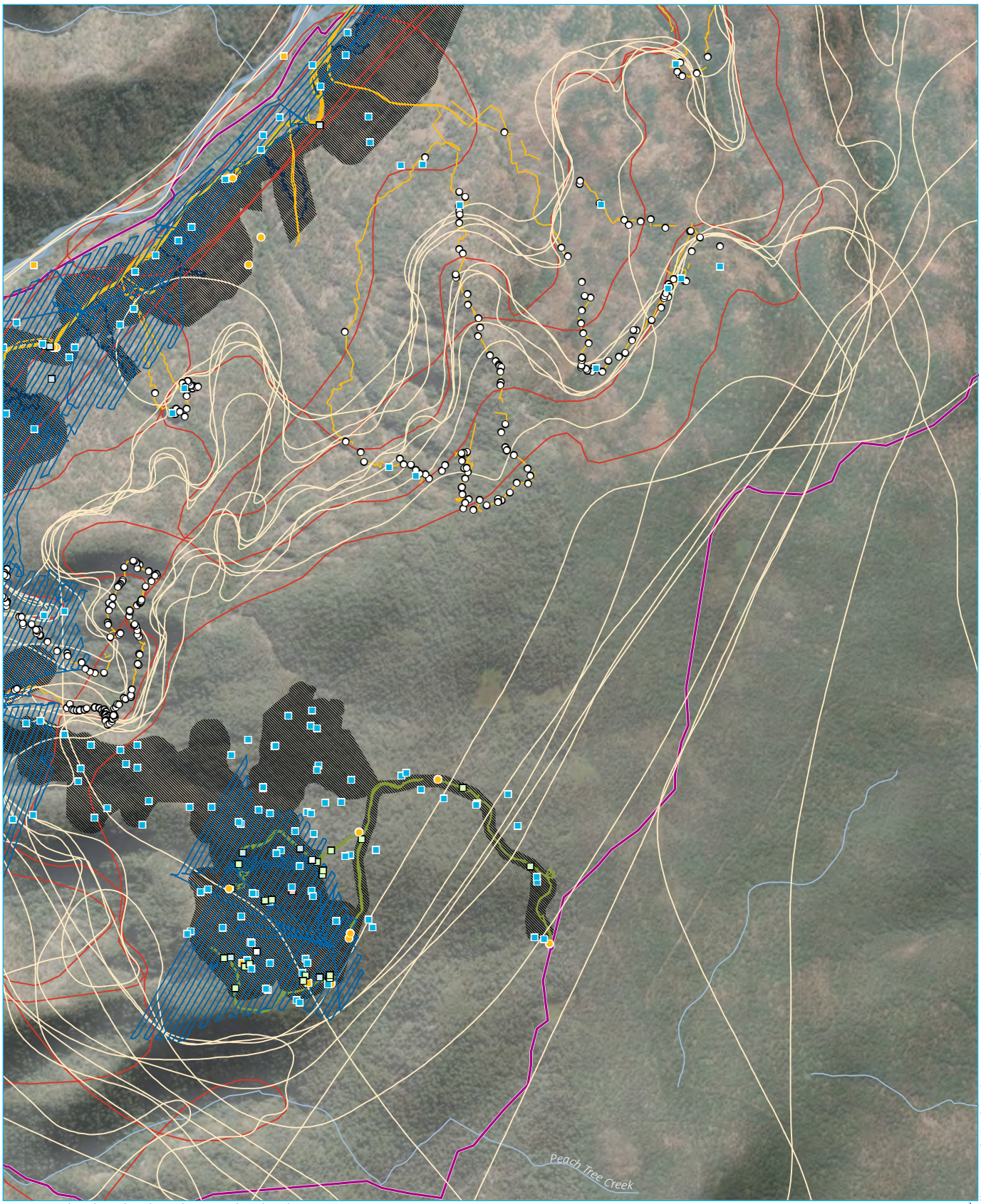

Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse

Targeted mammal survey point

- Camera
- Microbat acoustic
- Brush-tailed Rock-wallaby scat collection
- Arboreal mammal traps
- Hair trap
- Harp survey
- SAT survey

Survey transect

- Spotlighting

Targeted mammal survey transect

- Aerial survey - October - November 2022
- Brush-tailed Rock-wallaby scat survey - August 2022
- Spotlighting - November 2021
- Spotlighting - March 2022
- Thermal drone transect - August 2021
- Koala detection dog transect - August 2022
- Aerial survey - August 2022

Targeted mammal surveys
Map 8 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2a

EMM creating opportunities

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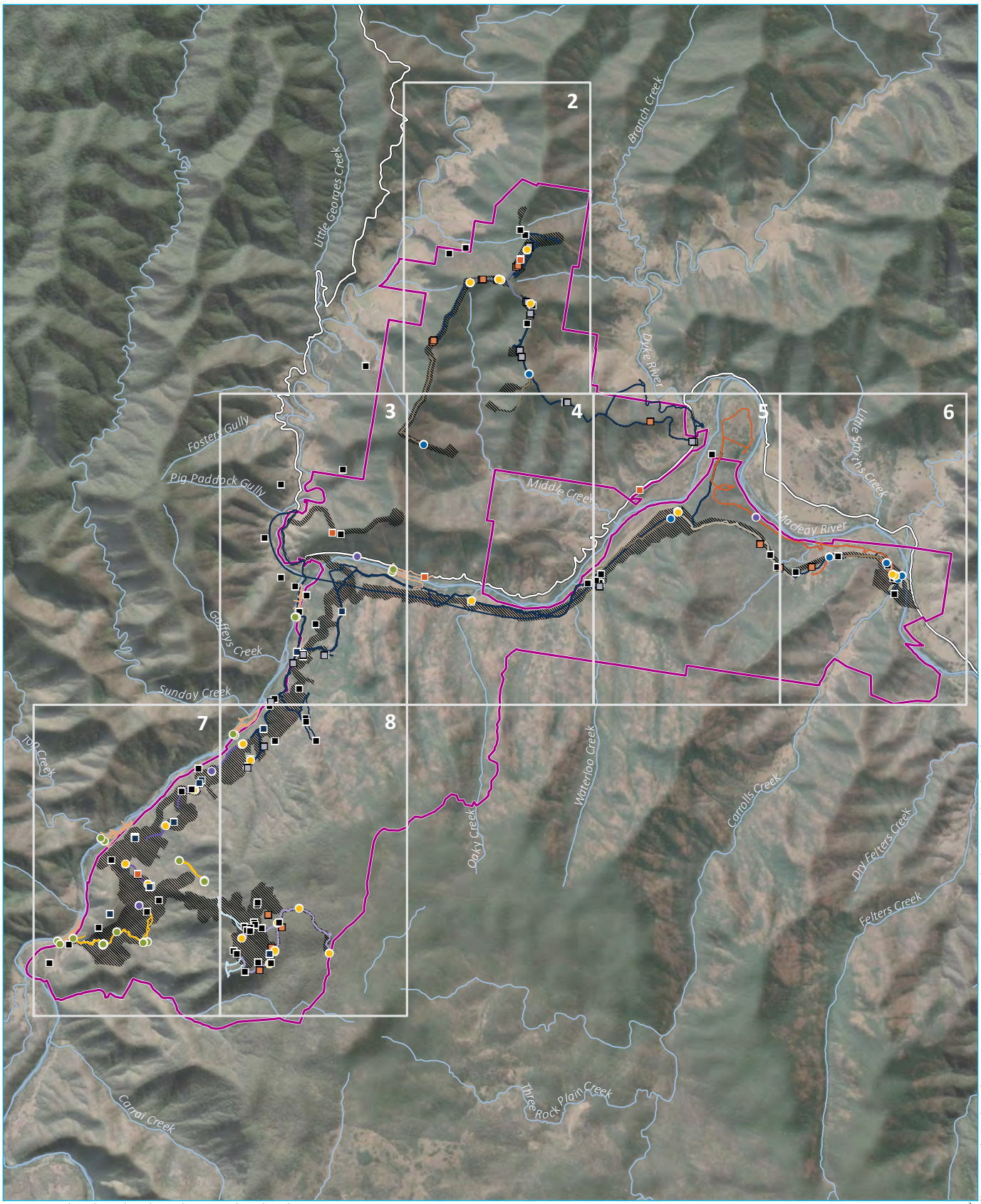

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey
- Funnel traps

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Bird survey - August 2022
- Frog survey - September 2021
- Frog survey - October 2021
- Frog survey - March 2022
- Frog survey - January 2023
- Spotlighting - March 2022
- Spotlighting - November 2021
- Bird transects - October 2021
- Bird survey - July 2022
- Spotlighting - December 2022
- Spotlighting - January 2023
- Bird flushing transects - January 2023

Other targeted fauna surveys
Map 1 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 6.2b

EMM creating opportunities

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey
- Funnel traps

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Bird survey - July 2022
- Spotlighting - December 2022
- Bird flushing transects - January 2023

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Other targeted fauna surveys
Map 2 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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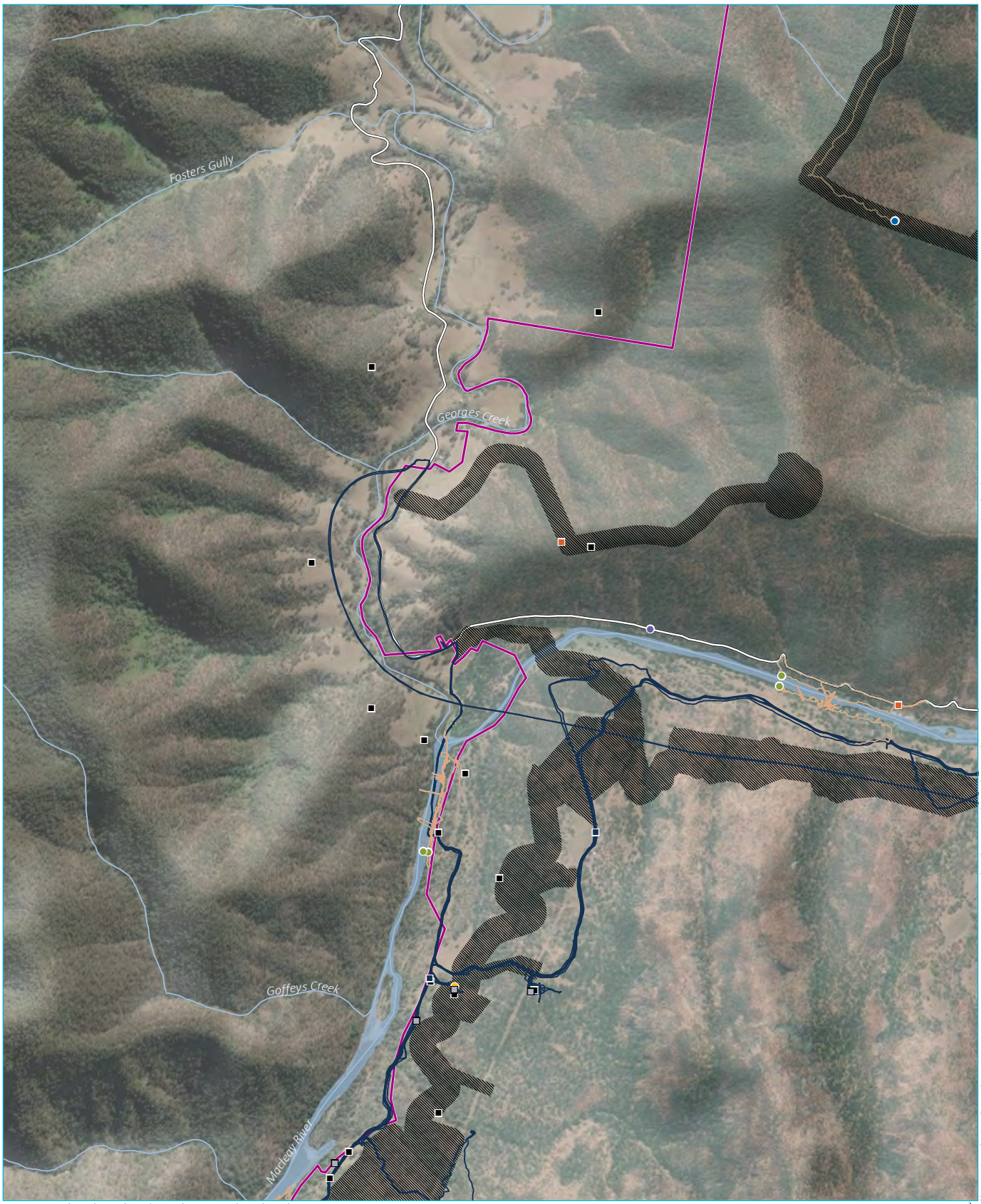
Figure 6.2b

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Frog survey - September 2021
- Frog survey - October 2021
- Bird survey - July 2022
- Bird flushing transects - January 2023

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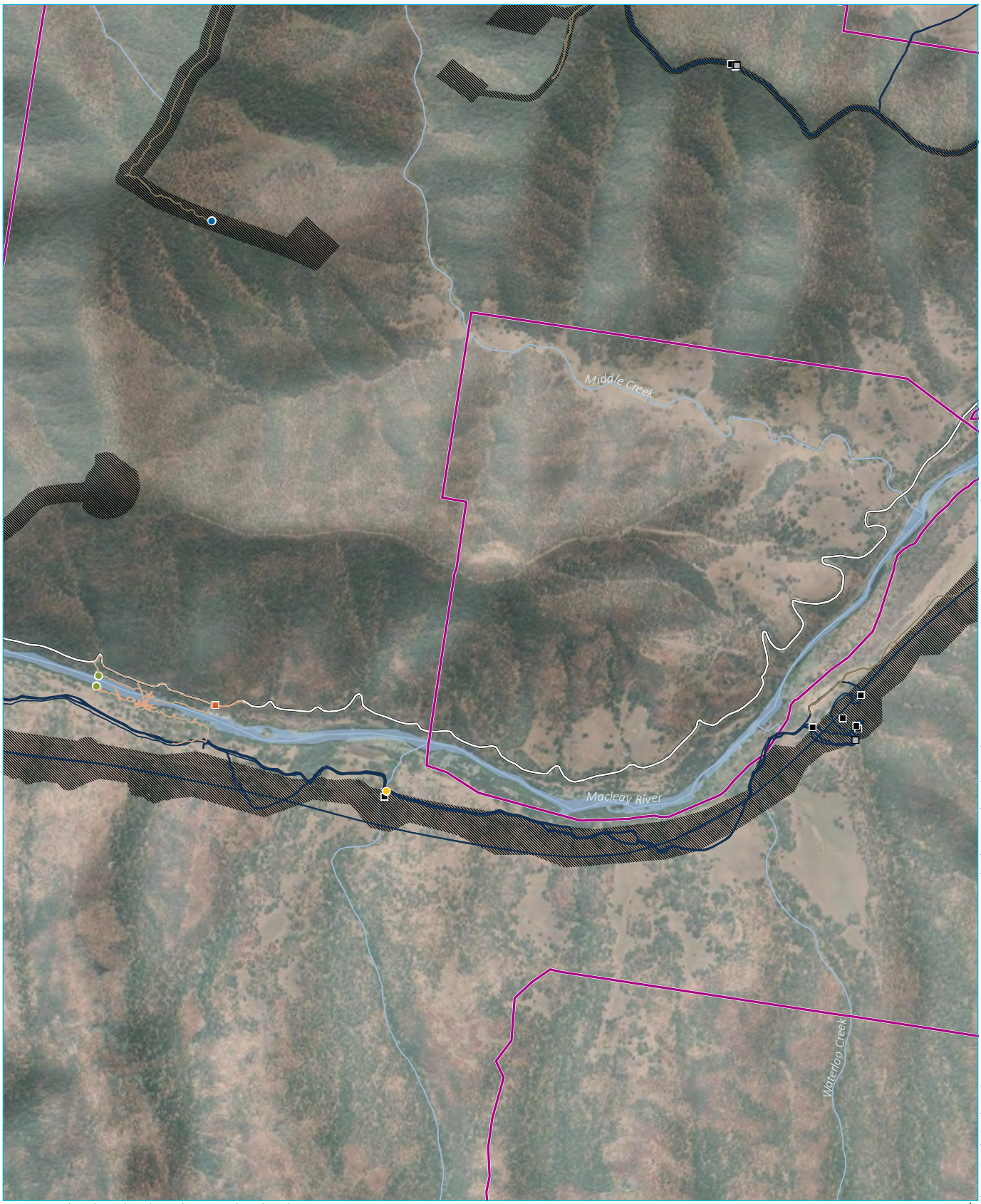
Other targeted fauna surveys
Map 3 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Frog survey - September 2021
- Frog survey - October 2021
- Bird survey - July 2022
- Bird flushing transects - January 2023

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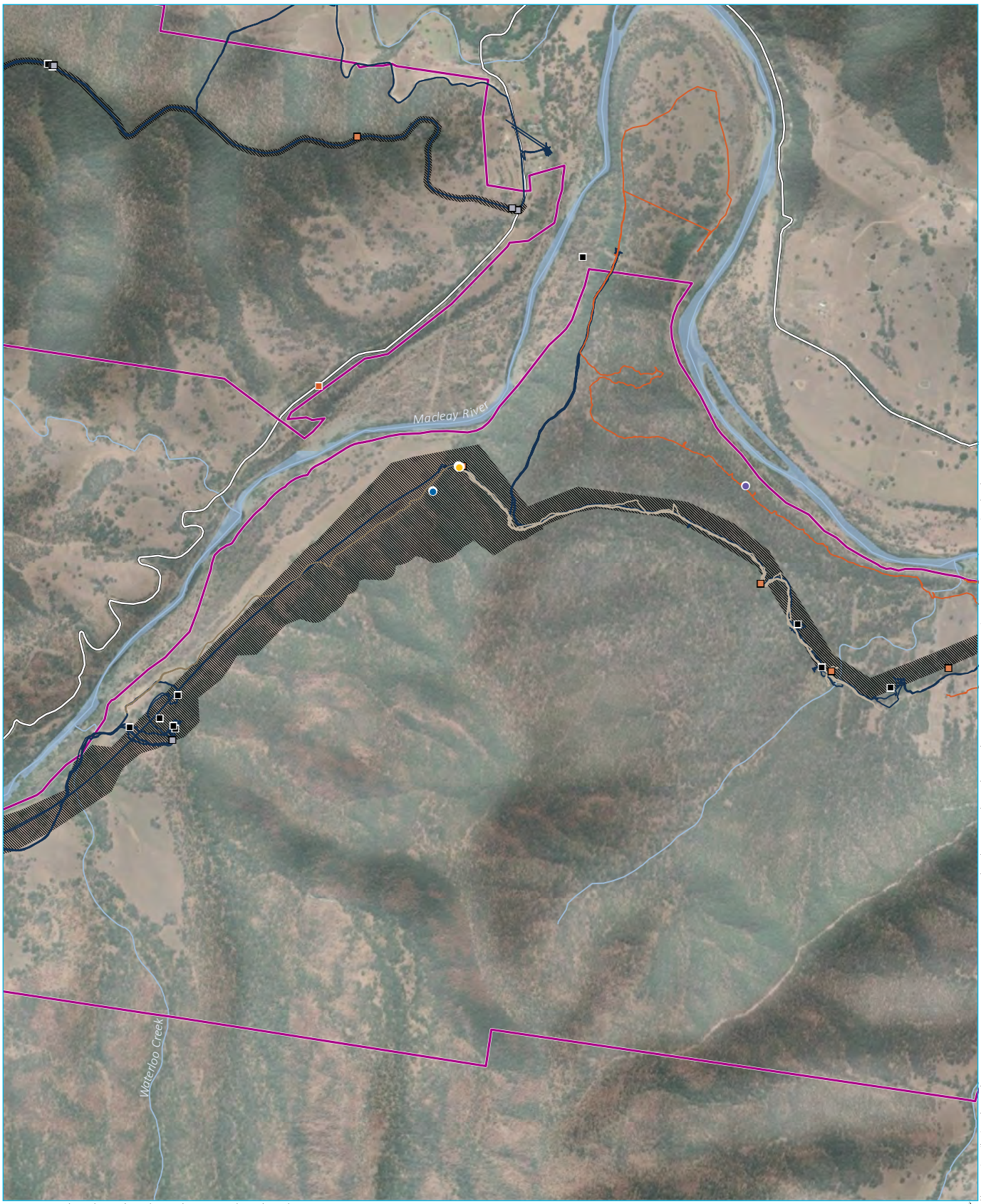
Other targeted fauna surveys
Map 4 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey
- Funnel traps

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Bird survey - August 2022
- Bird survey - July 2022
- Spotlighting - January 2023
- Bird flushing transects - January 2023

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Other targeted fauna surveys
Map 5 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse
- Major road

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey
- Funnel traps

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Bird survey - August 2022
- Bird survey - July 2022
- Spotlighting - January 2023
- Bird flushing transects - January 2023

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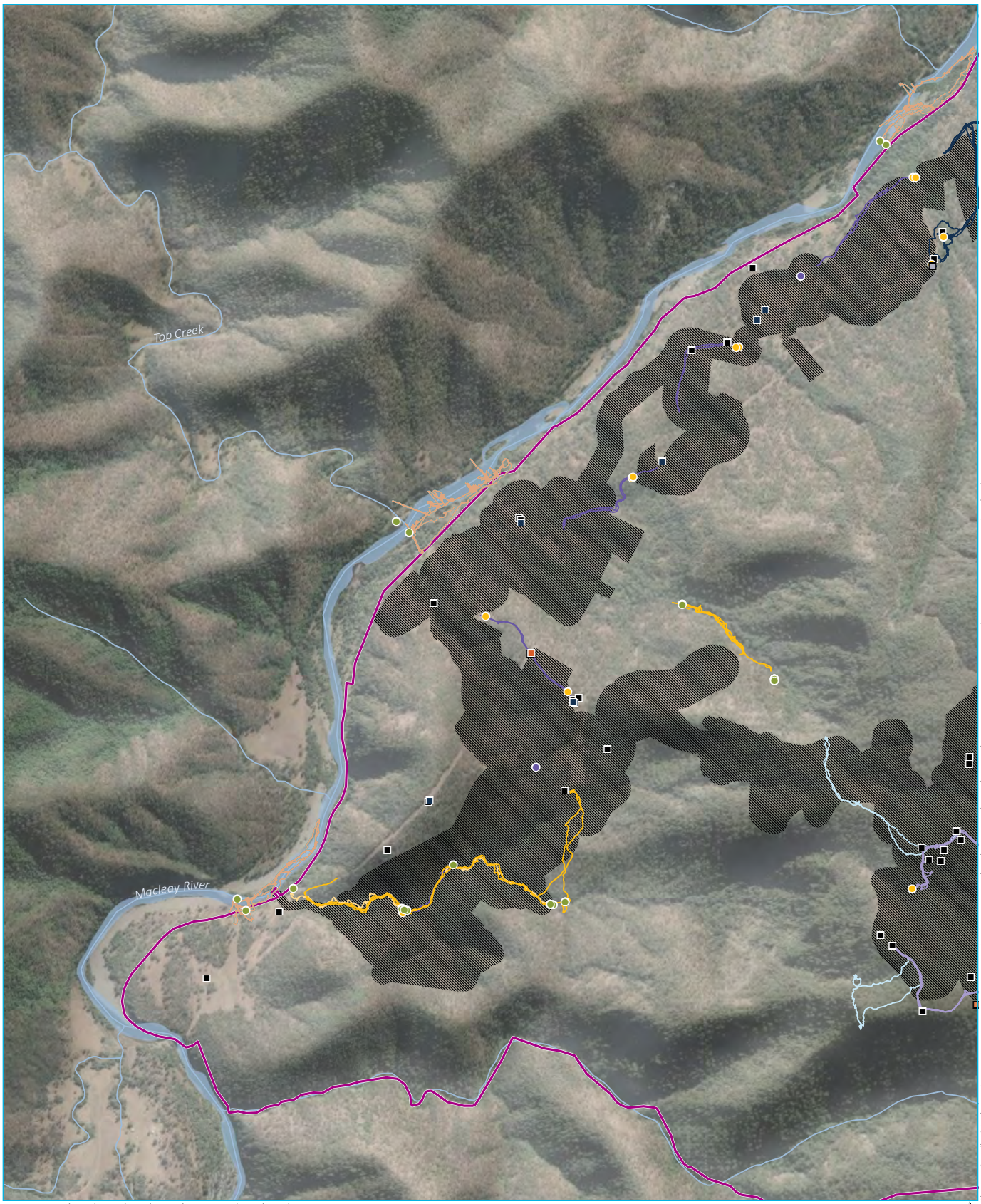
Other targeted fauna surveys
Map 6 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Named watercourse

Targeted fauna survey point

- Owl survey area
- Owl nest watch
- Bush Stone-curlew broadcast survey
- Bird area survey
- Funnel traps

Survey transect

- Bird transect
- Frog survey
- Spotlighting

Targeted fauna survey transect

- Frog survey - September 2021
- Frog survey - October 2021
- Frog survey - March 2022
- Frog survey - January 2023
- Spotlighting - March 2022
- Spotlighting - November 2021
- Bird transects - October 2021
- Bird survey - July 2022

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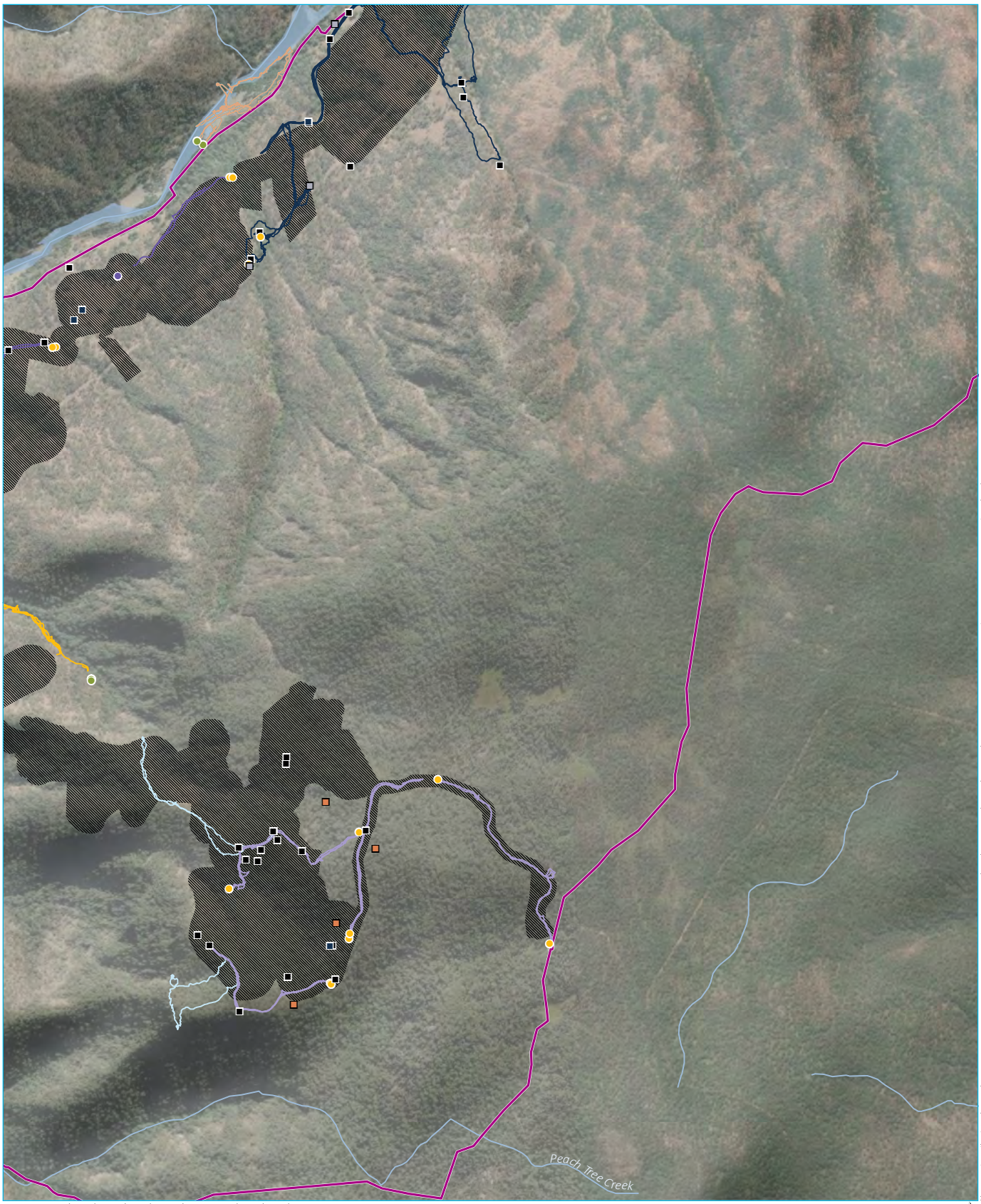
Other targeted fauna surveys
Map 7 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

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- Bird survey - July 2022

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Other targeted fauna surveys
Map 8 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.2b

EMM creating opportunities

6.3.4 Survey limitations

i Bushfire and drought influence

Surveys were initially undertaken by NGH in the generation area predominantly in 2020, less than a year after the 2019–2020 Australian bushfire season and at the end of a prolonged period of drought conditions in eastern Australia. These surveys included vegetation mapping, plots and some threatened flora and fauna survey effort. The majority of the Project area that includes the Generation site and access road was mapped as unburnt during the 2019/2020 bushfires. The transmission line, north of the Macleay River was burnt to varying degrees as mapped on the Fire Extent and Severity Mapping (FESM) (DPE, 2020) shown on Figure 6.3. The majority of the vegetation plots were undertaken within areas of unburnt or low – burnt understory with unburnt canopy to medium – partial canopy scorch areas. Some plots, mainly associated with PCT 1268, were undertaken two years after the bushfires along the transmission line in areas that showed strong recovery. It is likely that influences from La Niña have aided in the quick recovery of areas burnt during the 2019/2020 bushfires.

The FESM mapped some small areas of the transmission line as extreme – full canopy consumption, as such these areas require further assessment under Section 4.2.2 of the *Guideline for applying the Biodiversity Assessment Method at severely burnt sites* (DPIE, 2020d). Table 6.14 evaluates if native vegetation is considered severely burnt on site and if further assessment is required.

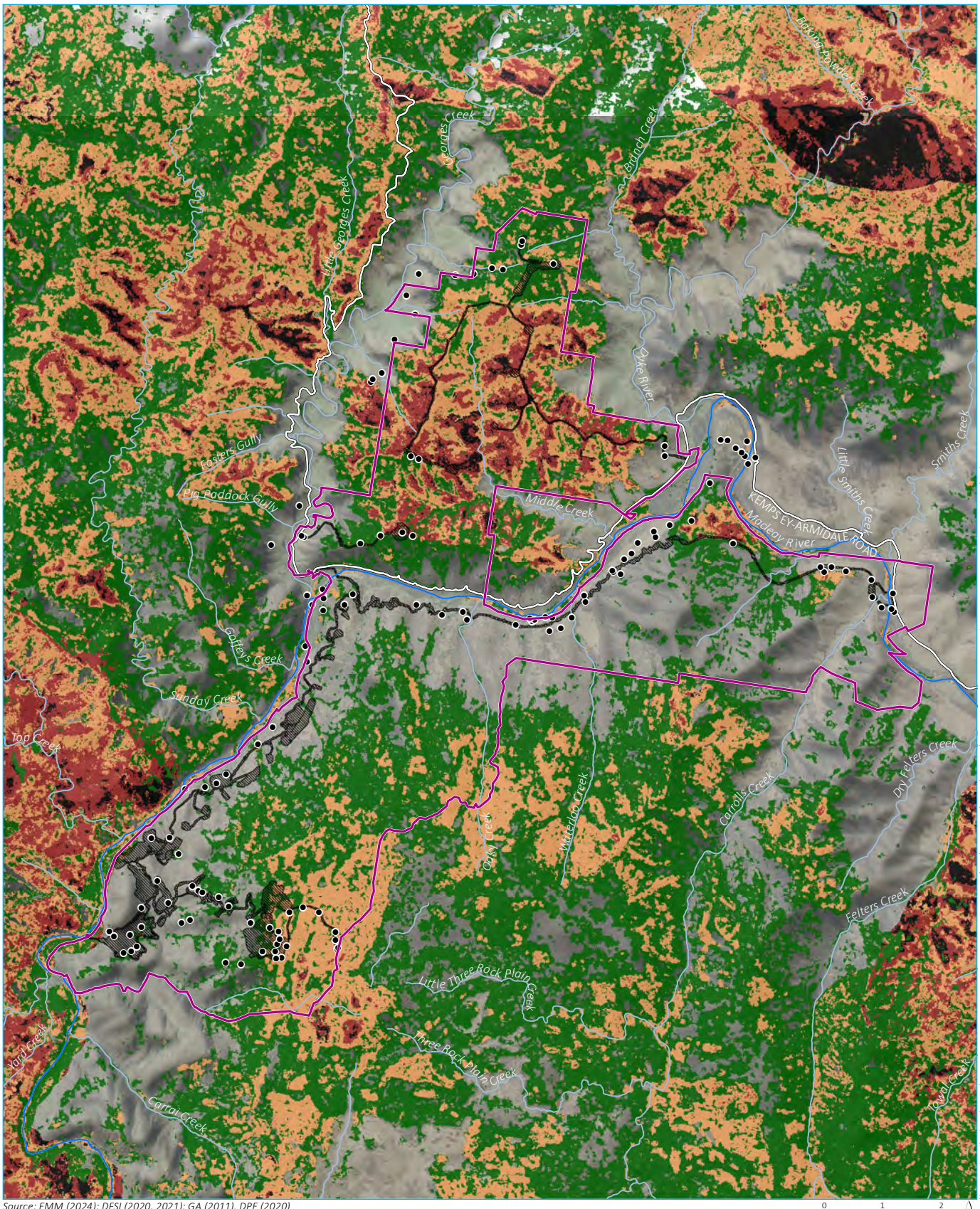
Table 6.14 Decision support criteria to help evaluate if native vegetation is severely burnt

Features	Descriptive characteristics for severely burnt vegetation	Site assessment of areas mapped as severely burnt
Species richness	The range of species present before the fire are burnt and/or cannot be identified. Dominant species cannot be easily identified until regeneration occurs.	Species richness considered to be representative of plot data recorded within unburnt – low burnt areas. With the exception of PCT 1268, where no unburnt sample site could be obtained in the Project area, plots were undertaken in 2022 in habitat representing the best examples of species richness.
Growth form: trees	Canopy trees are killed and/or canopy is consumed or largely consumed with most leaf material charred/scorched. Epicormic growth, if present, is not well developed (<1 m long).	Canopy trees present. Canopy trees have recovered and were easily identifiable. Some trees (Stringybarks) showed evidence of fire (burnt bark); other trees, like Spotted Gums which shed bark each year, did not show evidence of fire.
Growth form: shrubs, forbs, ferns and other	All understorey plants are consumed or largely consumed (some charred). Re-growth, if present, is immature (very few species have attained full height).	Understory present. Strong recovery of understory observed with species diversity and shrubs forbs, ferns etc at height expected for growth form.
Growth form: grasses and glass-like	Ground cover is consumed, or largely consumed. Evidence of ground scorch is present. Re-growth, if present, consists predominately of new resprouting growth (native vegetation).	Ground cover present; some small patches of scorch earth was observed, largely associated where large logs or trees (likely stags) were once present.
Logs	Logs (if expected to have been previously on site) are absent or largely consumed.	Logs were observed to be present.
Litter cover	Pre-fire surface litter (if expected) is consumed. Soil organic layer is consumed or largely consumed. New leaf may be occurring where the canopy was burnt but not scorched	Little cover was present.
Ash	White ash deposition and charred organic matter is present to several centimetres' depth.	Ash was absent, not recorded within the construction envelope.

Using the criteria above, it is not considered that areas mapped as severely burnt apply to the areas within the construction envelope. Therefore, impacts from the 2019/2020 bushfires are not considered to have an impact on the vegetation integrity compared with the pre-fire condition. As stated above, the majority of plots undertaken within the Project area was within areas mapped as unburnt and therefore not considered to have a major impact on representative vegetation integrity scores for each vegetation zone.

The combination of drought and fire in the years preceding the surveys for the Project is likely to have reduced the populations of some animal and plant species, making some species more difficult to detect.

The conclusions in this report are therefore conservative and based on consideration of the results of field surveys in conjunction with desktop assessment of the likelihood that other threatened species may utilise the Project area. Due to the possibly lower detectability of some species, a conservative approach was taken in the development of some species polygons, which extend well beyond where the species were recorded, into contiguous areas of similar habitat.



Source: EMM (2024); DFSI (2020, 2021); GA (2011), DPE (2020)

0 1 2 km

GDA 1994 MGA Zone 56

N

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Project

Disturbance footprint

BAM plot

Fire extent and

Unburnt

Low - burnt understory with unburnt canopy

Medium -partial canopy

High- full canopy scorch/partial consumption

Extreme - full canopy

Existing environment

Macleay River

Named

Major

NPWS

State forest

Fire Extent and Severity Mapping

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 6.3

EMM creating opportunities

ii La Niña and flooding influence

Surveys undertaken by EMM began in June 2020, only months before a La Niña weather event began. Survey works continued during the La Niña period until November 2022 with unprecedented rainfall across eastern Australia. These weather conditions impacted surveys in a number of ways.

Rainfall events impacted accessibility, both to the site due to rising water levels in the Macleay River and, once on site, due to increasing unsafe conditions (see below). Rainfall events turned usually dry gullies into flowing areas of water and turned steep rocky drainage lines and cliff areas into slippery and hazardous sections to traverse.

With the mountainous terrain of the locality, weather events were hard to predict and forecasts largely incorrect. In some instances, surveys were delayed or had to be cut short due to the large number of storm events.

Flash flooding events and huge downpours occurred during periods when dry conditions were forecast. Some surveys, such as trapping, was compromised due to rising river levels that could have impacted on animal welfare. As a result, some survey effort could not follow the recommended survey guidance or meet the required survey effort.

Storm events also delayed rescheduled surveys, and some missed the required seasonal survey periods. These impacts were managed by using alternative survey methodology to complete the works, where they could be reasonably applied.

iii Safe access

Impacts from La Niña regularly restricted access to site. Access to site via Kempsey/Armidale Road was impacted due to continued landslides with road closures occurring after some heavy rainfall events, and landslides closed the road from Kempsey, with limited access via Armidale. Road works in this area also restricted available windows to move between areas of the Project area; i.e. no movements could occur during road work hours. Access to the upper areas of the Project area via Carrai and Cochrane Road was considered dangerous after storm events, with fallen trees blocking access, landslides, closed roads and deep mud along the unsealed road preventing access. The bridges that crossed the Macleay River providing access to the Carrai would be underwater during flood events. Access via the back roads that avoided bridge crossings was also periodically closed due to issues with small creek crossings and landslides.

Access onto the lower sections of the Project area was via the Macleay River that could only be safely crossed below 1.2 m water level. Regularly high-water levels and multiple flooding events meant that the only access in was determined by this river height. Once on site, access into the project area was via one unsealed track that travelled from the crossing point at Georges Junction 6 km south to the main survey locations of the lower reservoir and associated ancillaries. This track was heavily impacted after storm events, with sections that would flood, be prone to landslides, have sections of the track that would wash away and boggy sections that could not be crossed until they dried out or shrunk.

To mitigate access issues, helicopters were used to access the Project area. Access via helicopters was limited to dry spells and times when fog was not present in the valley or around Armidale where they were based. Boats were also used to cross the Macleay River during higher flows. However, boat access was only suitable outside flood events, or when the river level was below 3 m, due to dangerous river conditions. Access onsite was largely by using all-terrain vehicles as continued storm events and wet conditions make the site track unsafe for heavy 4WD vehicles.

The Project area is largely steep and, in places, near vertical with escarpments, cliff faces, often with loose unstable soil and rock. To traverse to other sections of the project area requires various descents down mountain slopes into and out of gullies or across deep rocky creeks with thick vines and vegetation. The Project area had an elevation change of 840 m, with some of the survey areas requiring a daily hike of up to 500 m elevation with equipment to undertake surveys.

For flora survey transects walking of closely spaced and parallel flora survey transects was not always safe or feasible. In such areas, transects were more meandering with their path dictated by safe access. Due to the skeletal soil conditions and, in places, dense shrub cover, the habitat that could not be safely accessed was considered to be marginal as habitat for the targeted threatened plant species and unlikely to occur.

iv Covid-19 pandemic

Surveys were undertaken during the Covid-19 pandemic. The pandemic disrupted a number of field surveys, with either team members contracting the virus just before heading to site or having symptoms on site that caused surveys to be cancelled, and shared accommodation sterilised prior to other teams attending site. The evolving situation was managed as best as possible under the EMM Covid-19 policy; however, as state restrictions eased, the virus had a greater impact on survey teams, with some survey effort missing survey periods for threatened species due to staff being unable to attend site, the need for staff to demobilise and/or isolate.

6.3.5 Targeted survey results

i Targeted flora surveys

Six threatened flora species were recorded during the threatened flora surveys. Survey results summarised in Table 6.15 and species polygons are described in Table 6.21.

Table 6.15 Threatened flora results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Grevillea guthrieana	Guthrie's Grevillea	E	E	Species	Targeted threatened flora surveys.
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	V	V	Species	Targeted threatened flora surveys.
Lepidium peregrinum	Wandering Pepper Cress	E	E	Species	Targeted threatened flora surveys.
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	E	-	Species	Targeted threatened flora surveys.
Rhodamnia rubescens	Scrub Turpentine	CE	CE	Species	Targeted threatened flora surveys.
Tylophora woollsii[1]	Cryptic Forest Twiner	E	E	Species	Targeted threatened flora surveys.

Notes: 1. Unconfirmed by the herbarium and genetic analysis.

More detail on *Pultenaea rubescens* and Cryptic Forest Twiner is provided below as these species required more survey effort and analysis than the other recorded threatened flora species.

a Pultenaea rubescens

An unidentified *Pultenaea* sp., with characteristics of Parris' Bush-pea (*Pultenaea parrisiae*), was sent to the herbarium for identification in January 2022 (see Photograph 6.1). Identification could not be confirmed by the herbarium at this time, with the response from the herbarium that "this is particularly interesting. In many features it looks very close to *P.parrisiae* but it is a very long way from previous records. The few bracteoles present showed some variability, which would need to be studyed further. Russel Barrett at the NSW Herbarium is currently doing some work on *Pultenaea* and will likely be interested in this". At the time of survey, it was considered that the specimen could be Parris' Bush-pea (*Pultenaea parrisiae*) or an as yet undescribed Pultenaea spp. In July 2023 confirmation was received from the herbarium that the plants recorded on site were a new species for the genus. There is an existing phrase name for this taxon; *Pultenaea* sp. Werrikimbe NP. However, it is proposed to recognise this as a distinct species, *Pultenaea rubescens* (Barrett, in prep 2023).

Comprehensive and detailed surveys for this species were undertaken within the current and previous construction envelope (see Figure 6.1). Additional surveys outside of the project area were undertaken to better understand the occurrence and distribution of *Pultenaea rubescens.* The survey effort described below were conducted in areas outside of the project area within the Carrai State Conservation Area and Carrai National Park to provide context for the assessment of the Project's impact on the species:

- During 2022 (07/11/2022) surveys, one experienced botanist accompanied by a field assistant briefly visited the edges of a small subset of the swamps in the north-west of the Carrai Plateau, undertaking meandering transects, across the transition zone between open sedge swamp, through swamp edges co-dominated by sedges and low shrubs, out to the edge of the adjacent dry eucalypt forest.

- During 2023 (31/10/2023 to 02/11/2023) surveys, two experienced botanists walked the edges of a subset of the swamps on the Carrai Plateau in meandering transects, across the transition zone between open sedge swamp, through swamp edges co-dominated by sedges and low shrubs, out to the edge of the adjacent dry eucalypt forest.

- Each time that the species was encountered, plant numbers were estimated at data collection points, each approximately 25 square metres in area.

- It is estimated that roughly 20% of potential habitat on NPWS estate on the Carrai Plateau was surveyed in 2022 and 2023.

As summary of the survey result is provided below:

- 138 plants were recorded during surveys undertaken to assess the construction envelope area.

- Approximately 371 plants were recorded in November 2022 within and adjacent to the project area. Many of the observed plants had finished flowering and some plants were observed to be senescing at the time.

- Approximately 86 plants were recorded in October / November 2023 outside of the project area. Many of the observed plants had finished flowering and some plants were observed to be senescing at the time.

Pultenaea rubescens was typically recorded in swamp margins; i.e. the transition zone between nearly perpetually wet sedge-dominated middle of the swamps and the adjacent dry sclerophyll forest. The species appears to be absent, or at least scarce, in areas where the transition between swamp vegetation and dry forest is abrupt and in areas where transitional areas contain a dense layer of taller shrubs.

In habitat occupied by the species, the ground layer typically contains a mixture of graminoid plants from the families Cyperaceae (e.g. *Lepidosperma* sp., *Gahnia* sp.) and Restionaceae (e.g. *Empodisma minus*) with a variety of forbs such as *Gonocarpus micranthus*, *Hypericum japonicum* and *Asperula gunnii* and low wiry subshrubs including two undescribed species of *Hibbertia*, *Pultenaea dentata* and *Sphaerolobium minus*. A variety of erect shrubs such as *Epacris breviflora*, *Leptospermum* sp., *Callistemon pallidus*, *Pultenaea retusa* and a member of the *Prostanthera scutellarioides* species complex are also found in this habitat at low to moderate density. In some areas the species also occurs in moist areas of open eucalypt forest on poorly drained relatively flat areas, and moist areas adjacent to streams.

Detection of the species during 2023 surveys was difficult as almost all observed plants had finished flowering, suggesting that the peak flowering period occurred during mid-October or earlier. Lower densities of plants were seen at each data collection point and lower overall plant numbers were recorded in 2023 surveys compared to 2022 surveys despite the 2023 surveys covering a much larger area and detecting many more sites for the species. Possible causes for these lower counts include:

- the switch in climate from La Nina to the currently prevailing El Nino conditions
- the extra year of post-fire regrowth, noting that the species most closely related to *Pultenaea rubescens* is *Pultenaea parrisiae*, a species which grows in similar habitats and is described as a fire ephemeral by NSW DPE in that species' TBDC profile. In de Kok, Rogier & West, J. (2004), it is also noted that seedlings of *Pultenaea parrisiae* are abundant after fire.

Threats to the species observed during surveys in NPWS estate included:

- Grazing and trampling of swamp vegetation by escaped cattle in areas adjacent to private property with damaged fences.
- Extensive damage to swamp vegetation by feral pigs in localised areas, which was particularly prominent in areas also affected by cattle grazing and historical soil disturbance.

Based on data collected to date, *Pultenaea rubescens* is likely:

- to occur at scattered locations, where suitable habitat occurs (primarily swamp edges) across much of the Carrai Plateau
- to occur in groups ranging from a few individuals to larger groups of 50 or more plants.
- vary in population between years due to climate variability and time since fire.

The accuracy of estimates of the species' distribution and abundance is limited by factors including:

- Difficulty of detection of the species, in general and particularly at the time of surveys due to timing and prevailing climatic conditions.
- The relatively small proportion of potential habitat that was visited (around 15 – 20%). It is estimated that there is 7.07 km^2 of potential habitat within the Carrai Plateau IBRA sub region that has not been surveyed to date [2].

[2] This area was worked out using the Freshwater Wetlands Formation areas within the SVTM, within the Carrai Plateau IBRA sub region. Areas that were already checked as part of a survey effort and found not to have any individuals, were not included in this area.

Photograph 6.1 *Pultenaea rubescens* recorded in the project area

b Cryptic Forest Twiner

Additional surveys were undertaken for the Cryptic Forest Twiner. This species can only be identified when in flower from *Tylophora paniculata.* Repeat surveys in 2023 and 2024 failed to record this species in flower. As the Herbarium could not definitively identify our 2022 specimens to species level, surveys undertaken in 2024 also included collecting genetic material from six specimens. Samples were sent to the Sydney Botanical Gardens PlantClinic for genetic sequencing. Confirmed specimens were also collected for Cryptic Forest Twiner and *Tylophora paniculata* at reference populations and were also sent to PlantClinic for genetic sequencing for genetic analysis.

Genetic analysis undertaken on the possible Cryptic Forest Twiner plants showed that the plants sampled from the project area are genetically similar to the more common *Tylophora paniculata*, which is not listed as threatened. Based on the data analysis conducted to date, the species may not be clearly distinguishable based on commonly used plant genetic barcodes (the ribosomal DNA, internal transcribed spacer 1 and 2 (ITS), maturase K (matK) gene and the ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit (rbcL) gene regions). Using the precautionary principle, the records within the construction envelope remain as assumed to be Cryptic Forest Twiner.

This species was located in moist eucalypt forest, moist sites in dry eucalypt forest, and rainforest margins. The species polygon was therefore created based on these microhabitats.

ii Targeted fauna surveys

The results of targeted fauna surveys are summarised below for each group of species, including incidental records of non-targeted threatened species.

a Diurnal birds

Twelve threatened diurnal bird species were recorded during the diurnal bird survey. Survey results summarised in Table 6.16.

Table 6.16 Diurnal bird results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Artamus cyanopterus	Dusky Woodswallow	V	-	Ecosystem	Incidental
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Dual	Incidental Assumed presence at a potential nest site location that may have been in use earlier in the breeding season.
Climacteris picumnus	Brown Treecreeper	V	-	Ecosystem	Incidental
Daphoenositta chrysoptera	Varied Sittella	V	-	Ecosystem	Area searches and incidental
Glossopsitta pusilla	Little Lorikeet	V	-	Ecosystem	Incidental
Haliaeetus leucogaster	White-bellied Sea-eagle	V	-	Dual	Incidental
Hieraaetus morphnoides	Little Eagle	V	-	Dual	Incidental
Hirundapus caudacutus	White-throated Needletail	-	V	Ecosystem	Incidental
Petroica boodang	Scarlet Robin	V	-	Ecosystem	Incidental
Ptilinopus magnificus	Wompoo Fruit-dove	V	-	Ecosystem	Incidental
Pyrrholaemus sagittatus	Speckled Warbler	V	-	Ecosystem	Area searches and incidental
Stagonopleura guttata	Diamond Firetail	V	-	Ecosystem	Incidental

As no breeding habitat was recorded for the dual credit species in the construction envelope, no further assessment is required. Glossy Black-cockatoos were confirmed to be present on site. No confirmed evidence of breeding was identified for Glossy Black-cockatoo, however, one possible nest tree was observed to contain old bedding material derived from *Allocasuarina* sp. It is considered that this nest tree was likely used earlier on in the breeding season and as *Allocasuarina* sp. are this species feed tree, using the precautionary principle this nest tree has been treated as a confirmed nest tree for this species.

b Nocturnal birds

Two threatened nocturnal bird species were recorded during the nocturnal bird survey. Survey results summarised in Table 6.17.

Table 6.17 Nocturnal bird results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Ninox strenua	Powerful Owl	V	-	Species	Evidence of breeding survey and call playback.
Tyto novaehollandiae	Masked Owl	V	-	Species	Evidence of breeding surveys, hollow bearing tree surveys, call playback and nest surveys.,.

Powerful Owl was recorded on the outskirts of the project area within the Cunnawarra National Park and Lower Creek State Forest. One record occurred within the construction envelope, no nest trees were recorded.

An active nest tree was recorded for Masked Owl just outside of 100 m of the construction envelope along the area of the proposed transmission line, south of the Macleay River. A single individual was also recorded on repeat nights at Georges Junction, potential nest trees were watched for emergence. No indication of breeding was confirmed at this location, and it was considered to be a lone individual roosting in the mature trees, potentially the dense canopy of the fig trees along the Macleay River. A single individual was recorded on two separate nights at different locations along access tracks near the Upper Reservoir. Both sightings occurred at similar times (1-2 hours after sunset) during call playback for other owl species. The first sighting the individual perched up on a tree before moving on, the second sighting that occurred a week later was a brief moment as it flew overhead. Call playback could not acquire a response following nights in similar locations and suitable nest trees were watched for emergence and were confirmed to be occupied by Greater Gliders. It is therefore considered that the access road forms part of this individuals commuting path and foraging area, due to similar timing the individual was recorded (1-2 hours after sunset) it is highly unlikely that a nest tree occurs within the construction envelope. A single pass of an individual was recorded near the Lower Reservoir, repeat surveys and nest watches at this location failed to record this individual again. It is considered that it could be associated with the known nest tree located to the north of the Lower Reservoir location or a foraging / commuting individual from another location outside of the project area. Terrestrial mammals.

Four threatened terrestrial mammal species, two of which are candidate species, were recorded during the terrestrial mammal survey. Survey results summarised in Table 6.18.

Table 6.18 Terrestrial mammal results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Ecosystem	Remote camera
Petrogale penicillata	Brush-tailed Rock Wallaby	V	E	Species	Remote camera, targeted habitat, aerial surveys, and incidental surveys
Potorous tridactylus	Long-nosed Potoroo	V	V	Species	Remote camera
Pseudomys oralis	Hastings river mouse	E	E	Ecosystem	Remote camera, incidental

Due to rocky conditions, the initial surveys for the Common Planigale were undertaken using funnels traps, Elliot traps and standard remote cameras as opposed to pitfall traps. Previous comments received from BCS as part of the draft BDAR submission received in 30.05.2023 was a requirement to resurvey gaps for Common Planigale where guidance was not met as per the BAM Stage 1 operational manual. An expert report could not be obtained due to the only recognised expert no longer being available. Additional surveys were undertaken using camera traps used to identify Common Planigale used a modified magnification lens on camera traps to improve the identification for small mammals that could be used for Common Planigale as per Meek PD, Cook CR (2022).

The Hastings River Mouse was identified on camera traps from using key features such as fur colour (grey-brown on the back merging to off white or grey underneath), noticeable eye ring and where possible from camera images a bicoloured tail (same length as body). It was distinguished from similar looking species such as Bush Rat (*Rattus fuscipes*) which also have a noticeable eye ring and Black Rat (*Rattus rattus*) from difference in colour, tail type, and body shape. See Photograph 6.2 for an example photo of the Hastings River Mouse.

Photograph 6.2 Hastings River Mouse

Species polygons for species credit species are described in Table 6.22.

c Arboreal mammals

Five threatened arboreal mammal species, four of which are targeted candidate species, one ecosystem credit species were recorded during the surveys. Species polygons for candidate species are described in Table 6.22. Survey results are summarised in Table 6.19.

Table 6.19 Arboreal mammal results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Petaurus norfolcensis	Squirrel Glider	V	-	Species	Trapping and remote camera.
Petauroides volans	Greater Glider	-	V	Species	Spotlighting and remote camera.
Petauroides australis	Yellow-belled Glider	V	V	Ecosystem	Call playback and spotlighting
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Species	Remote camera.
Phascolarctos cinereus	Koala	E	E	Species	Koala detection dogs.

Species polygons are described in Table 6.22.

d Microchiropteran bats

Two threatened microchiropteran bat dual credit species, one species credit and two ecosystem credit species were recorded during the Microchiroptera surveys. Species polygons for the species credit species are described in Table 6.22. Survey results summarised in Table 6.20.

Large Bent-winged Bat and Little Bent-winged Bat were only recorded as foraging or commuting though the project area. Harp trapping didn't confirm any lactating females which would have indicated breeding within the project area. The absence of lactating females caught as part of the bat surveys indicated that no maternity roosts were considered within 1 - 2 km of the disturbance footprint. As such, these species only generate ecosystem species credits.

Eastern Cave Bat was recorded as a possible identification using passive acoustic detection surveys (see Appendix C) however, the species was not captured during harp trap surveys. Acoustic recordings marked as a possible record were identified as either Eastern Cave Bat, Eastern Forest Bat (*Vespadelus pumilus*) and/or the more common species Little Forest Bat (*V. vulturnus*), as these species share similar frequencies and overlapping distributions. It is acknowledged that the use of passive acoustic detection to determine this species in north east NSW is not practical (as discussed in (Pennay, Law, & Reinhold, 2004)).The Eastern Cave Bat calls characteristic frequency are between 49 to 52 kHz (n = 15). The species overlaps in frequency with the Chocolate Wattled Bat (*Chalinolobus morio*), Eastern Forest Bat and Little Forest Bat. The Eastern Cave Bat may be distinguished from Chocolate Wattled Bat by an up-sweeping tail present in most pulses. Furthermore, the species can be distinguished from Eastern Forest Bat only if the end frequency is lower than 51 kHz, or if the end frequency is higher than 54.5 (Pennay, Law, & Reinhold, 2004). Middle values cannot be identified to species, where these species are sympatric.

Twenty-eight harp trap nights were undertaken during the survey period for this species. Survey effort also included 100 passive acoustic detection surveys nights. Survey effort required for associated PCTs for the entire project area is 48 trap nights (using any survey method as per the guidelines), survey total effort undertaken was 128 trap nights. It should be noted that that the guidelines don't discuss the difficulties of positive identification using passive acoustic detection as per Pennay, Law & Reinhold (2004).

Results from the harp trapping surveys included captures from all similar species listed above that share frequency characteristics. Eastern Cave Bat was not captured as part of the harp surveys, as such it is considered highly likely that the possible identification using passive acoustic detection relates to *V. pumilus* and *V. vulturnus.* Eastern Cave Bat is therefore not considered further within this BDAR.

Table 6.20 Microchiropteran bat results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Ecosystem	Anabat and harp trapping
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Dual	Anabat and harp trapping
Miniopterus australis	Little Bent-winged Bat	V	-	Dual	Anabat and harp trapping
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Ecosystem	Anabat
Myotis macropus	Southern Myotis	V	-	Species	Anabat

Species polygons for species credit species are described in Table 6.22.

e Amphibians

None of the targeted amphibian species were detected during survey efforts.

f Reptiles

None of the targeted reptile species were detected during survey efforts.

6.4 Step 5: Determination of the area or count of species and species polygons

For species identified as present in Step 4, the following was undertaken:

- For flora species, the species polygon was developed based on the following:
  - Where flora species are assessed by count, the species polygon was created using a 30 m buffer around all recorded locations within the direct and indirect disturbance footprint. Where this buffer intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The number of individuals recorded within the disturbance footprint was entered into the BAMC.
  - Where flora species were assessed by area, the species polygon was created by:
    - identifying particular microhabitats or ecological niches (where relevant) and mapping the species polygon to these, or
    - including relevant vegetation zones associated with the record and any connected areas of the same vegetation zone.
  - Where this intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The area of the species polygon, including relevant areas of any vegetation zones, was entered into the BAMC.

- For fauna species, the species polygon was developed including relevant vegetation zones of associated PCTs, species records, and mapping of microhabitats or ecological niches. Where this intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The area of the species polygon, including relevant areas of any vegetation zones, was entered into the BAMC.

Table 6.21 and Table 6.22 provide descriptions of the species polygons prepared for the calculation of species credit requirements, based on the results of surveys and habitat in and adjacent to the disturbance footprint included in vegetation zones listed in Section 6.3.2. Figure 6.4 to Figure 6.18 show the species polygon for each species.

Table 6.21 Flora species polygon descriptions

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Grevillea guthrieana	Guthrie's Grevillea	Recorded along creek-lines and steep rocky sections near gullies throughout the Project area. This species was recorded within the following PCTs within the disturbance footprint; PCT 842, PCT 868 and PCT 979.	Guthrie's Grevillea is a count-based species. 580 individuals were recorded within the construction envelope with 378 individuals recorded within the disturbance footprint. A species polygon was created as per the process for count based species above. Figure 6.4 shows the species polygon for this species.
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	Recorded along creek lines and in high numbers in steep moist floors throughout the Project area. This species was recorded within the following PCTs within the disturbance footprint; PCT 762, PCT 842 and PCT 1215.	Tall Velvet Sea-berry is a count-based species. 2,477 individuals were recorded within the construction envelope with 405 individuals recorded within the disturbance footprint. A species polygon was created as per the process for count based species above. Figure 6.5 shows the species polygon for this species.
Lepidium peregrinum	Wandering Pepper Cress	Local occurrence of this species is from the flood plain area of the Macleay River. The majority of the individuals were recorded along the eastern bank of the Macleay, with a small number recorded along the northern bank. This species was recorded within the following PCTs within the disturbance footprint; PCT762, PCT842 and PCT1106	Wandering Pepper Cress is an area-based species. This species is not associated with any PCTs within the Project area. A species polygon was created for all recorded locations and including all vegetation zones associated with records of the species and any connected areas of the same vegetation zone. This includes associated connective vegetation zones where this species was recorded within PCT 1106 moderate, 762 exotic grassland and PCT 842 DNG moderate. Figure 6.6 shows the species polygon for this species.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Pultenaea rubescens (syn. *Pultenaea* sp. Werrikimbe NP)	Carrai Bush Pea (syn. Pultenaea sp. Werrikimbe NP)	This species was recorded in small patches of wet and heathy habitat and appears to be restricted to the Carrai Plateau in the locality. This species grows in clumps in microhabitats associated with flat and wet areas. Most records are located within or along edges of wet habitat and are associated with PCT 1287_High, except for two patches that were recorded in PCT 988_High that contained similar wet microhabitats. No individuals have been recorded within the direct and indirect disturbance footprint. The species occurs in similar microhabitat described for Parris' Bush-pea (*Pultenaea parrisiae*).	The species information in the TBDC is incomplete and the species is currently being described. As such there is no guidance on species polygon construction for *Pultenaea rubescens.* Species polygon was created using microhabitats as described for this species. This area was mapped out using GIS slope analysis and LiDAR imagery, including ground truthing of microhabitat. Microhabitat includes moist, poorly drained areas of forest and the edges of swampland within PCT 988 High and PCT 1287 High. Figure 6.7 shows the species polygon for this species.
Rhodamnia rubescens	Scrub Turpentine	Recorded on steep slopes in moist forest in the Project area. Individuals occurred as juvenile plants or as regrowth from the 2019 bushfires. All specimens were infected with myrtle rust. This species was recorded within the following PCTs within the disturbance footprint: • PCT 1215	Scrub Turpentine is a count-based species. 77 individuals were recorded within the Project area. No individuals were recorded within the disturbance footprint or construction envelope. This species was buffered by 30 m. The Project was redesigned to avoid any impact to this species and the 30 m buffer. As such, no species polygon was created, and this species no longer has an offset liability.
Tylophora woollsii	Cryptic Forest Twiner	This species is not associated with any PCTs within the project area. Microhabitat for this species is in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. This species was recorded within the following PCTs within the disturbance footprint; PCT 1215, PCT979 and PCT988.	Cryptic Forest Twiner is an area-based species. This species is not associated with any PCT mapped within the disturbance footprint. Suitable habitat was identified based on ground-truthed data recorded during surveys. These microhabitats were consistent with those described in the threatened species profile, namely, moist eucalypt forest, moist sites in dry eucalypt forest, and rainforest margins (OEH, 2020). Species polygon was created based on GIS slope analysis and LiDAR imagery, including ground truthing of microhabitat. Suitable habitat areas were included in the species polygon where the mapped microhabitat intersected the disturbance footprint. Figure 6.8 shows the species polygon for this species.

Table 6.22 Fauna species polygon description

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Calyptorhynchus lathami	Glossy Black-cockatoo	This species was incidentally recorded as non-breeding in multiple locations in the Project area. One potential nest site was recorded. The hollow contained nesting material, such as Allocasuarina leaves regarded highly likely to be used by this species. This species was recorded within the following PCTs within the disturbance footprint; PCT842, PCT868, PCT979 and PCT988.	Glossy Black-cockatoo is an area-based species. The TBDC specifies that a species polygon must be drawn around confirmed nest sites and should include a buffer radius of 200 m around each confirmed nest tree. One potential nest site was recorded. The hollow contained nesting material, such as Allocasuarina leaves regarded highly likely to be used by this species. This tree was buffered by 200 m to create the species polygon for this species.
Ninox strenua	Powerful Owl	Recorded as non-breeding within the Project area.	Powerful Owls are an area-based species. A species polygon must be drawn to include all vegetation zones; 1. within 800 m (being the approximate home range) from the location of a detected owl, and 2. containing a living or dead tree with a hollow >20cm diameter that occurs >4m above the ground. Figure 6.10 shows the species polygon for this species.
Tyto novaehollandiae	Masked Owl	An active Masked Owl nesting hollow was recorded outside of the survey footprint along the transmission line south of the Macleay River.	Masked Owls are an area-based species. A species polygon must be drawn to include all vegetation zones; 1. within 800 m (being the approximate home range) from the location of a detected owl, and 2. containing a living or dead tree with a hollow >20cm diameter that occurs >4m above the ground. Figure 6.11 shows the species polygon for this species.
Petrogale penicillata	Brush-tailed Rock-wallaby	The Brush-tailed Rock-wallaby was recorded throughout the Project area, with the majority of the records concentrated where cliffs, outcrops and rocky terrain were present. Most records were within the generation site with a sub-population using the rocky terrain for denning and refuge along the road proposed to connect the lower and upper reservoir.	Brush-tailed Rock-wallaby is an area-based species. The habitat constraint for this species is land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines. It is associated with PCTs 762, 842, 868, 979, 988, 1142, 1215, 1268 which have all been mapped within the project area. Brush-tailed Rock-wallaby denning and refuge (critical) habitat representing this habitat constraint was mapped across the project area. Vegetation zones of associated PCTs within the disturbance footprint were included within the species polygon where they occurred within 1 km of mapped habitat constraints. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.12 shows the species polygon for this species.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Potorous tridactylus	Long-nosed Potoroo	Long-nosed Potoroo was recorded at four locations above 750 m in elevation, within areas that contained dense understorey in PCT 868_High, and PCT 868_Dry and PCT 1215_High.	Long-nosed Potoroo is an area-based species. Long-nosed Potoroo is an area-based species. A species polygon was created for all recorded locations and including all vegetation zones associated with records of the species and any connected areas of the same vegetation zone. These included PCT 868 high and dry and PCT 1215 high. Figure 6.13 shows the species polygon for this species.
Petaurus norfolcensis	Squirrel Glider	Squirrel Glider was recorded throughout the Project area. The majority of the records were recorded within the generation site.	Squirrel Glider is an area-based species. All vegetation zones where species were recorded and where they intersect the disturbance footprint have been included in the species polygon. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.14 shows the species polygon for this species.
Petauroides volans	Southern Greater Glider	Greater Glider was recorded at higher elevations associated with areas containing old growth forest around the upper reservoir and transmission line. It was recorded in PCT 868_High, PCT 1215_High, PCT 979_High, PCT 988_High.	Greater Glider is an area-based species. All vegetation zones where species were recorded and where they intersect the disturbance footprint have been included in the species polygon. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.15 shows the species polygon for this species.
Phascogale tapoatafa	Brush-tailed Phascogale	Brush-tailed Phascogale was only recorded in the northern section of the Project area, throughout the Macleay Hastings IBRA sub-region and along the habitat where the Macleay's River runs west to east in the Macleay Gorges IBRA sub-region. It was recorded in PCT 842_High, PCT 868_High and PCT 1215_High.	Brush-tailed Phascogale is an area-based species. All associated vegetation zones where they intersect the disturbance footprint have been included in the species polygon. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.16 shows the species polygon for this species.
Phascolarctos cinereus	Koala	Evidence of the Koala was recorded to the north of Macleay River with old scats found near the river in the most eastern section of the access road and a recent observation of scratch marks in a Eucalypt near the northern extent of the Transmission Line. All areas of PCTs associated with the species contained Koala use trees as defined in the Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE, 2022b).	Koala is an area-based species. All associated vegetation zones where they intersect the disturbance footprint north of the Macleay River were included in the species. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.17 shows the species polygon for this species.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Myotis macropus	Southern Myotis	Southern Myotis was recorded along the Macleay River which is considered suitable habitat for this species.	Southern Myotis is an area-based species. All associated vegetation zones within 200 m of the Macleay River were included in the species polygon. Vegetation zones representing DNG and exotic grassland are not included in the species polygon assessment for this species. Figure 6.18 shows the species polygon for this species.

Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 250 500 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Disturbance footprint
- Indirect impact area
- Guthrie's Grevillea species polygon (30 m buffer around sighting)
- Guthrie's Grevillea species sighting

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Guthrie's Grevillea species polygon

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Figure 6.4

EMM creating opportunities

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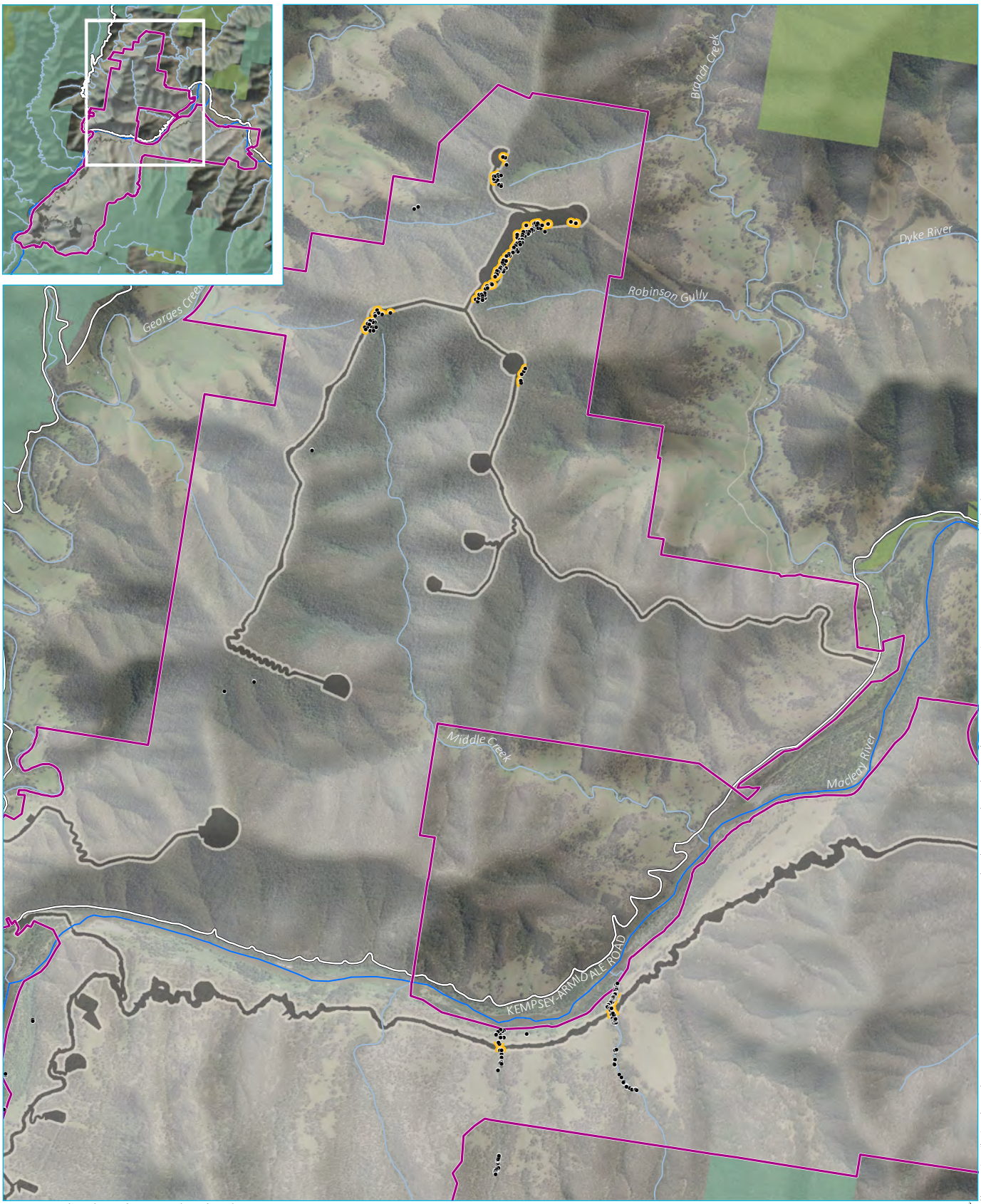

Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Disturbance footprint
- Indirect impact area
- Tall Velvet Sea-berry species polygon (30 m buffer around sighting)
- Tall Velvet Sea-berry species sighting

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Tall Velvet Sea-berry species polygon

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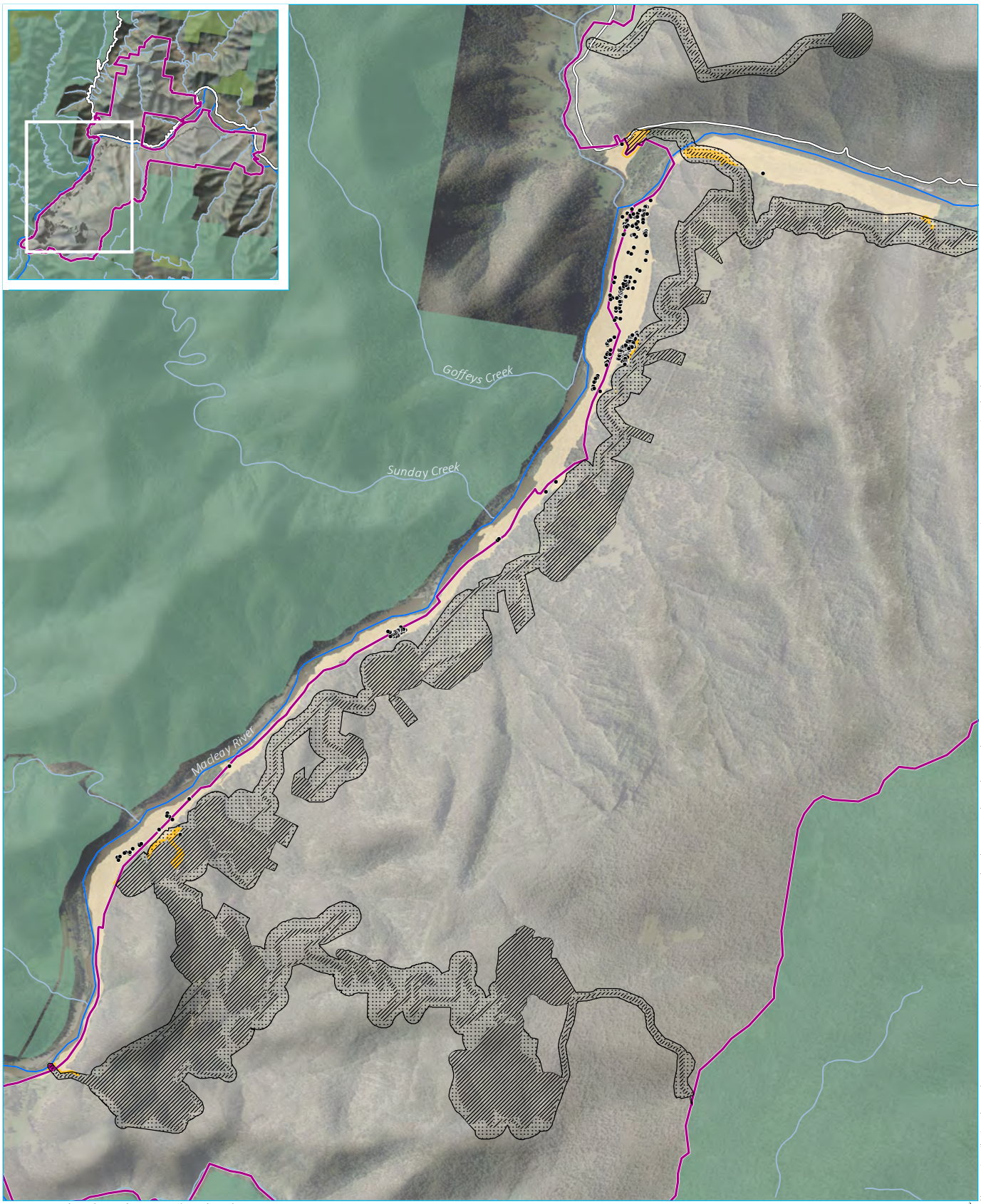
Figure 6.5

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Design disturbance
- Wandering Pepper Cress species sighting

Wandering Pepper Cress species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Wandering Pepper Cress species polygon

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Biodiversity development assessment report
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Figure 6.6

EMM creating opportunities

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Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

KEY

Project area
Construction envelope
Design disturbance
Pultenaea rubescens species polygon
Direct and indirect impact area
Non-impacted area

Existing environment
Macleay River
Named watercourse
Major road
NPWS reserve
State forest

Pultenaea rubescens species polygon

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Biodiversity development assessment report
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Figure 6.7

EMM creating opportunities

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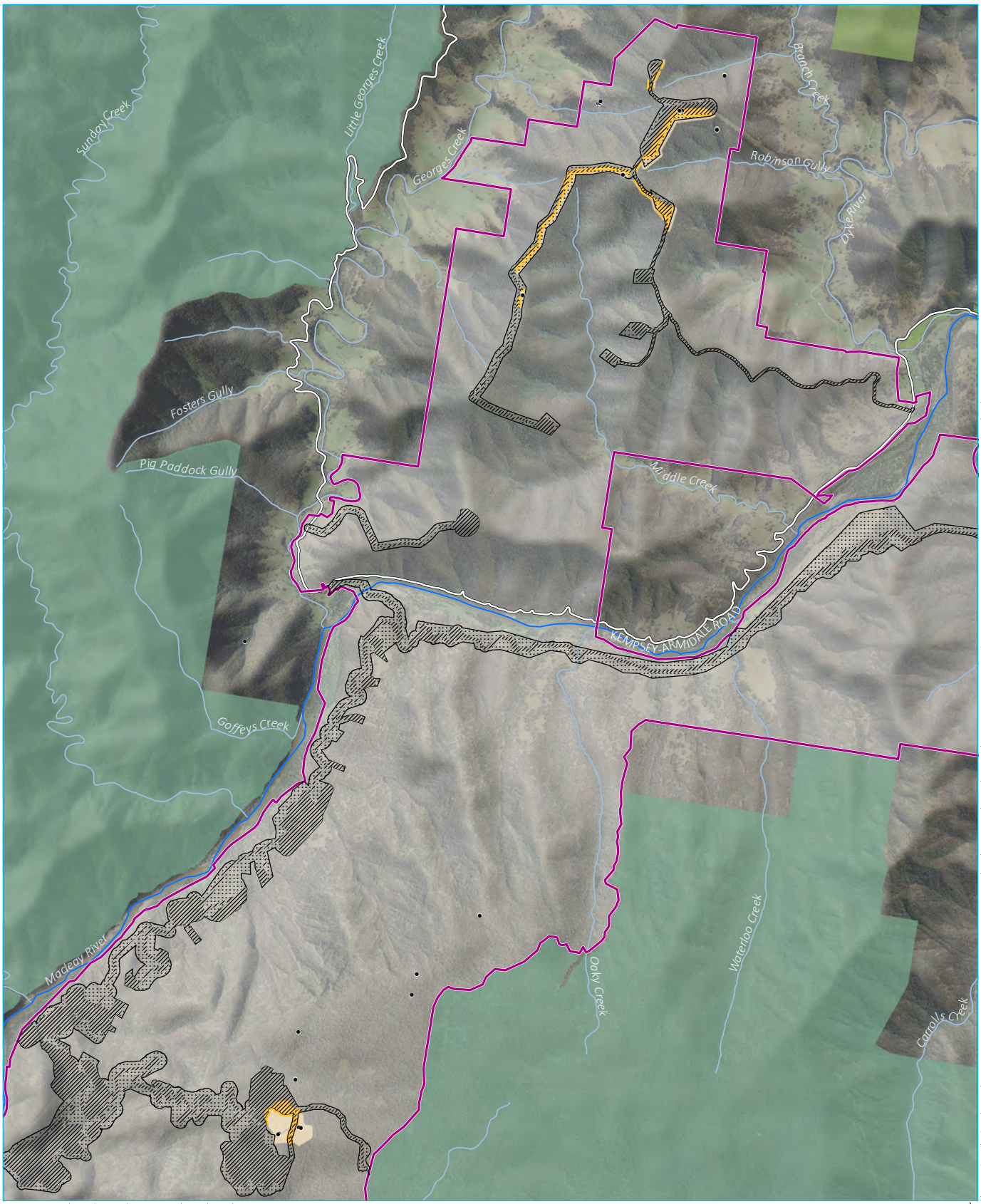

Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Cryptic Forest Twiner species polygon species sighting

Cryptic Forest Twiner species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Cryptic Forest Twiner species polygon

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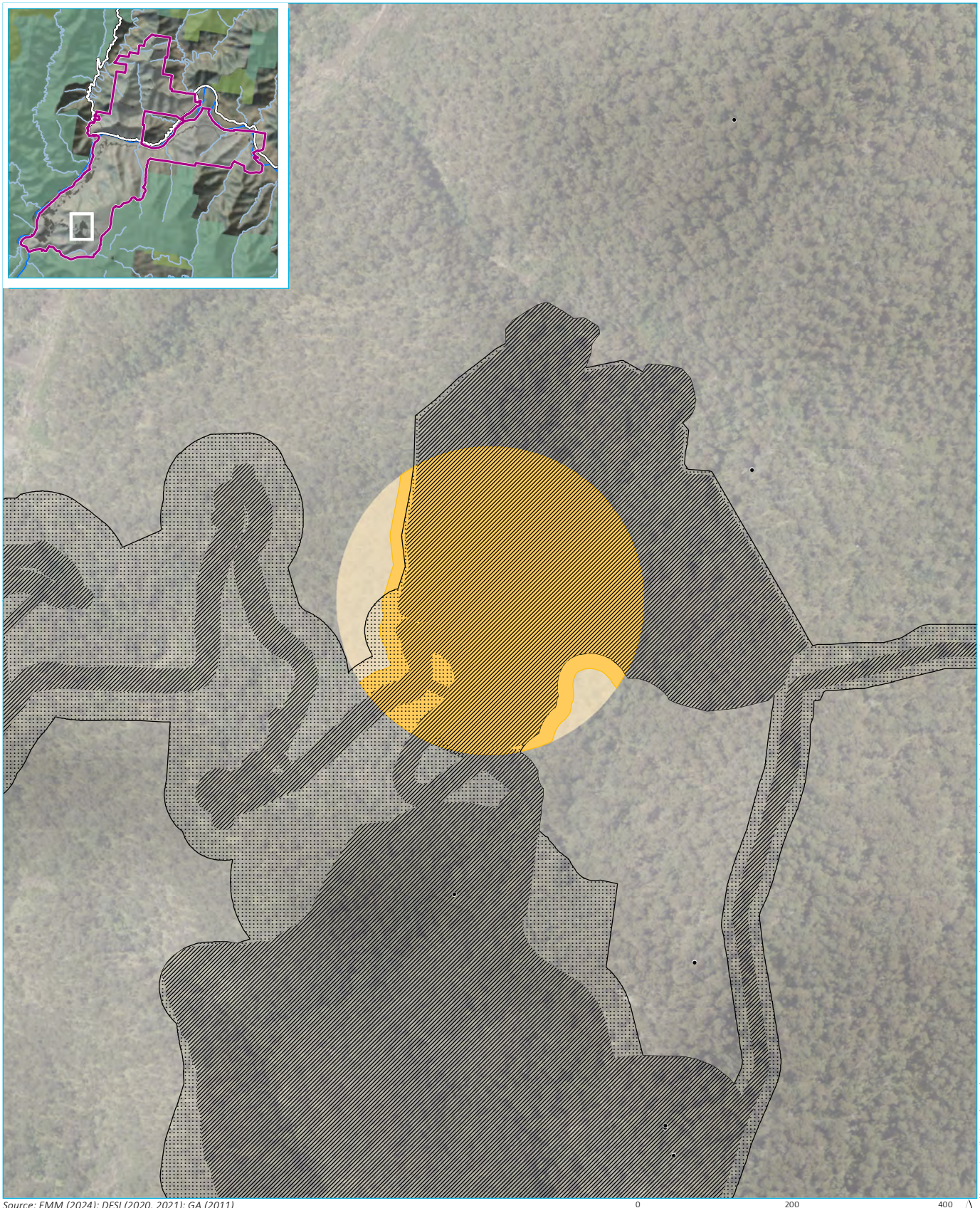
Figure 6.8

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 200 400 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Design disturbance
- Glossy Black-Cockatoo species polygon species sighting

Glossy Black Cockatoo species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Glossy Black Cockatoo species polygon

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Figure 6.9

EMM creating opportunities

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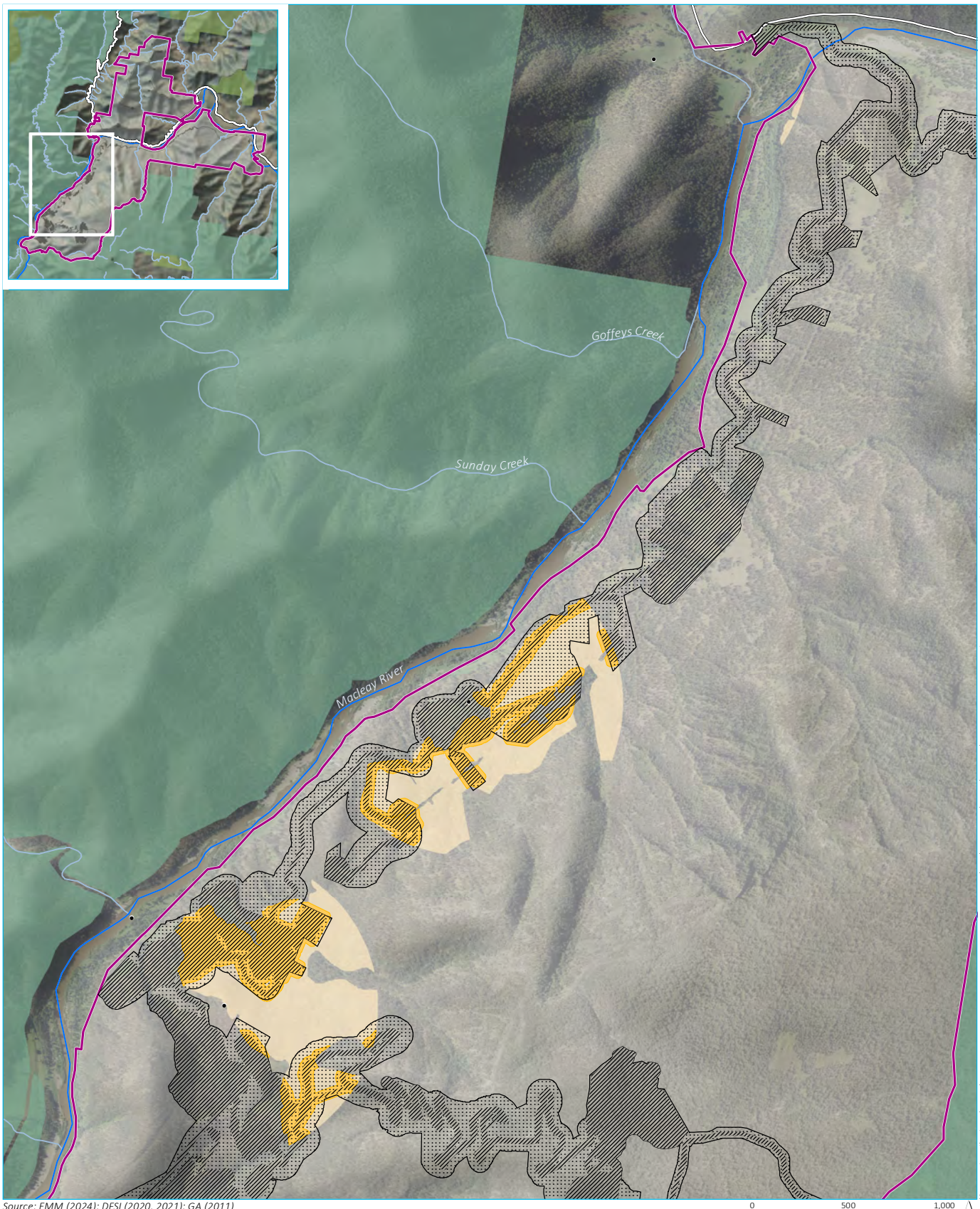

Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Design disturbance
- Powerful Owl species sighting

Powerful Owl species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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Powerful Owl species polygon

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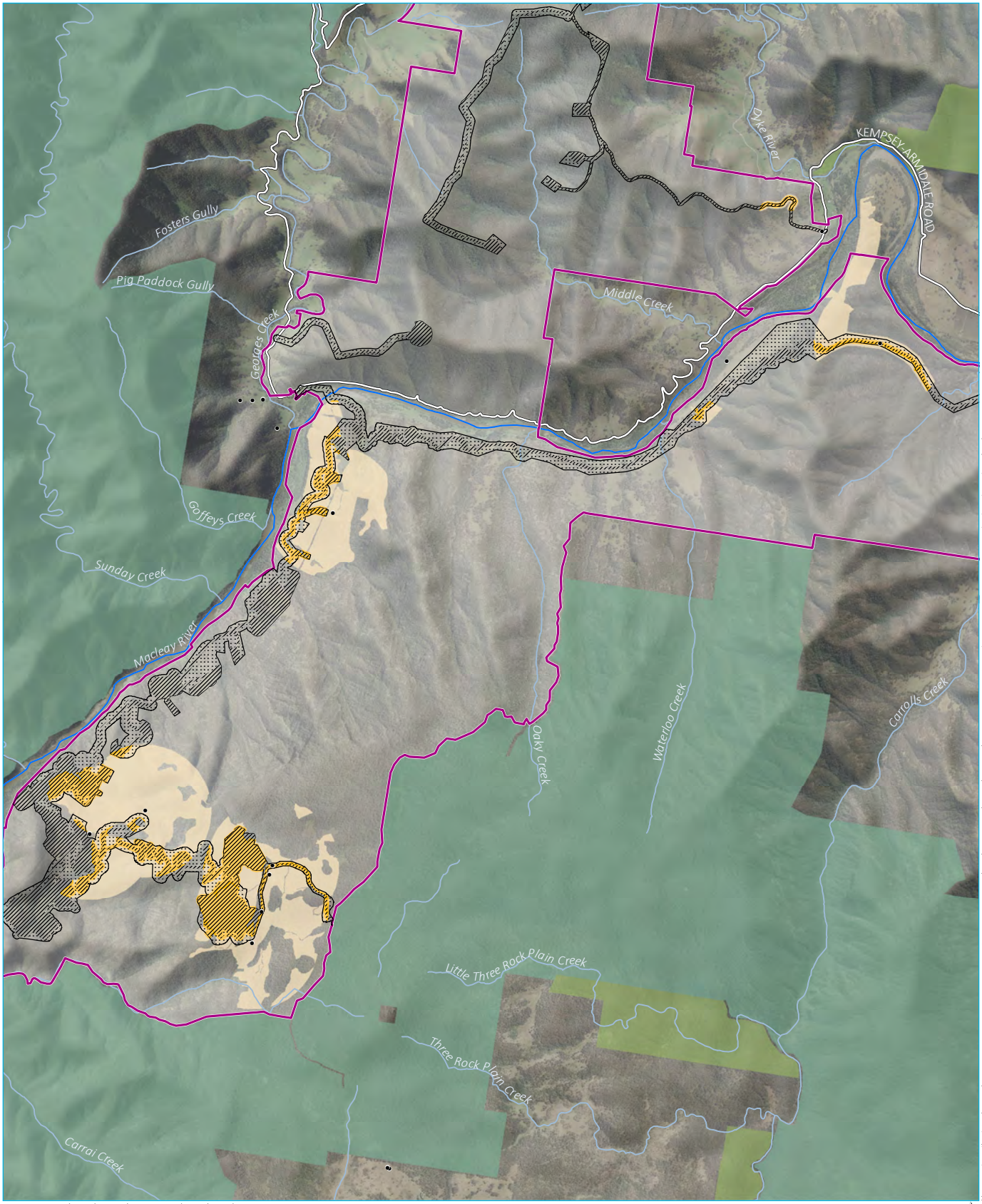
Figure 6.10

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m
GDA 1994 MGA Zone 56

N

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KEY

Project area
Construction envelope
Design disturbance
Masked Owl species sighting
Masked Owl species polygon
Direct and indirect impact area
Non-impacted area

Existing environment
Macleay River
Named watercourse
Major road
NPWS reserve
State forest

Masked Owl species polygon

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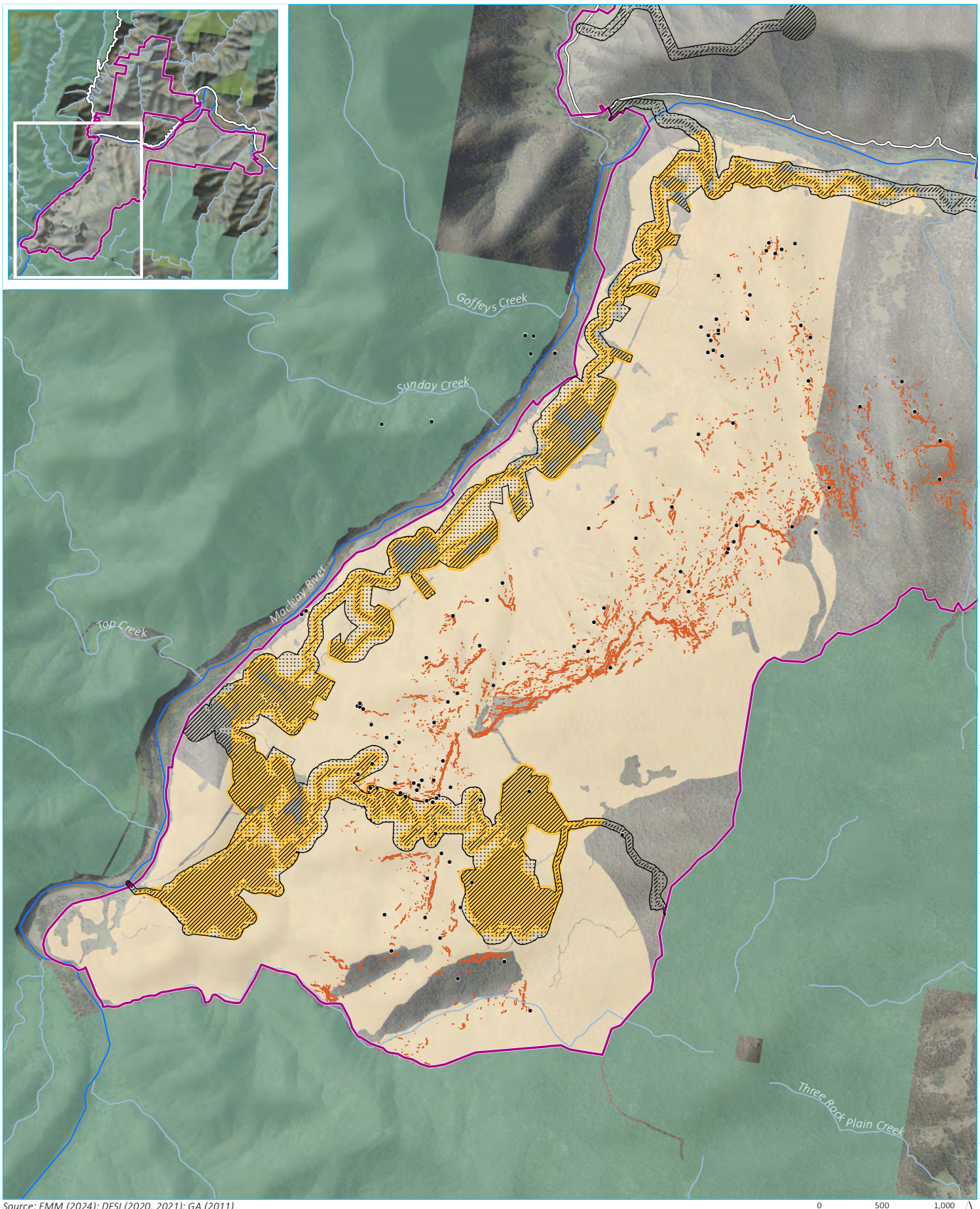
Figure 6.11

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Brush-tailed Rock-wallaby species sighting
- Denning and refuge (critical) habitat

Brush-tailed Rock-wallaby species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Brush-tailed Rock-wallaby species polygon

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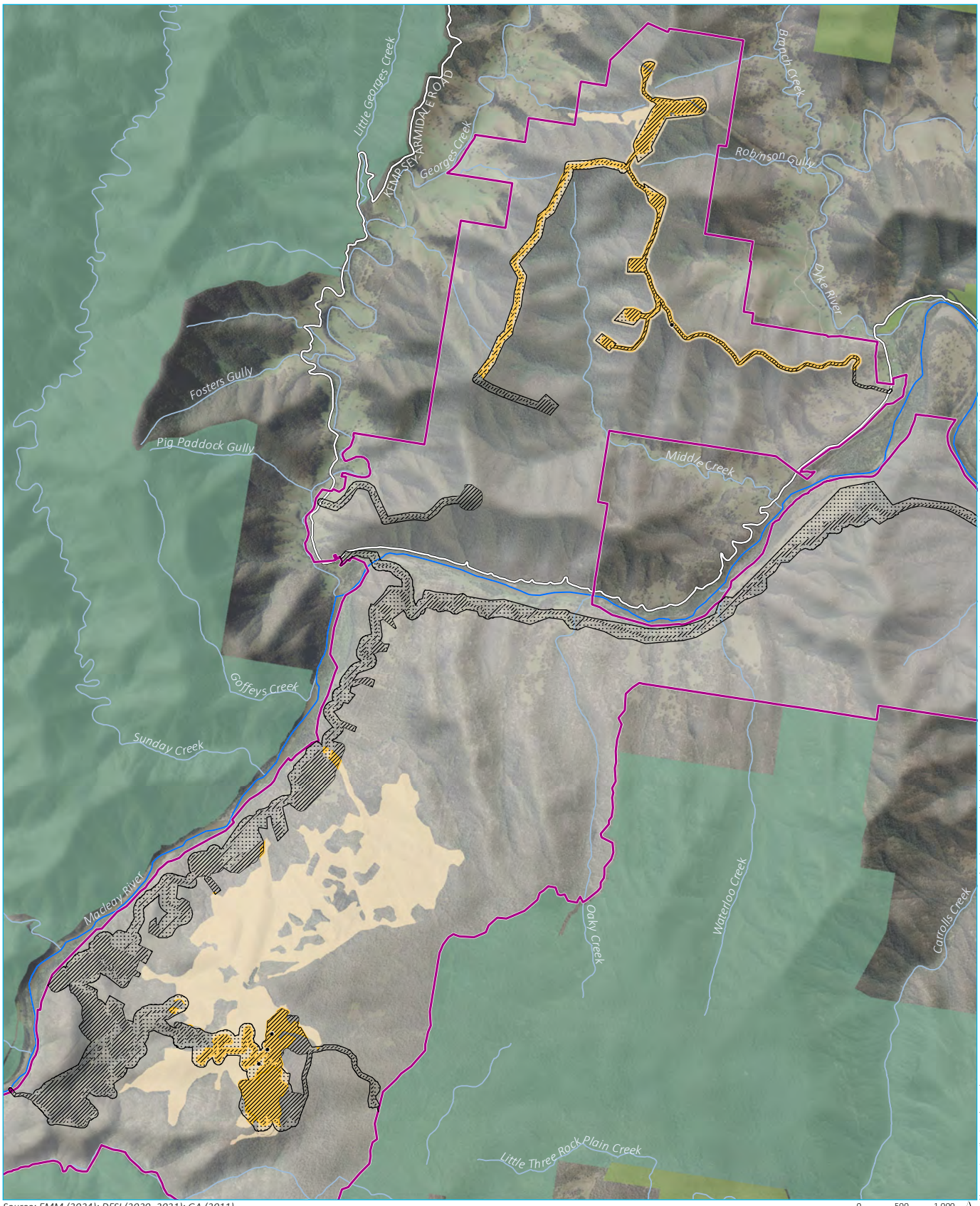
Figure 6.12

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m
GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Long-nosed Potoroo species sighting

Long-nosed Potoroo species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Long-nosed Potoroo species polygon

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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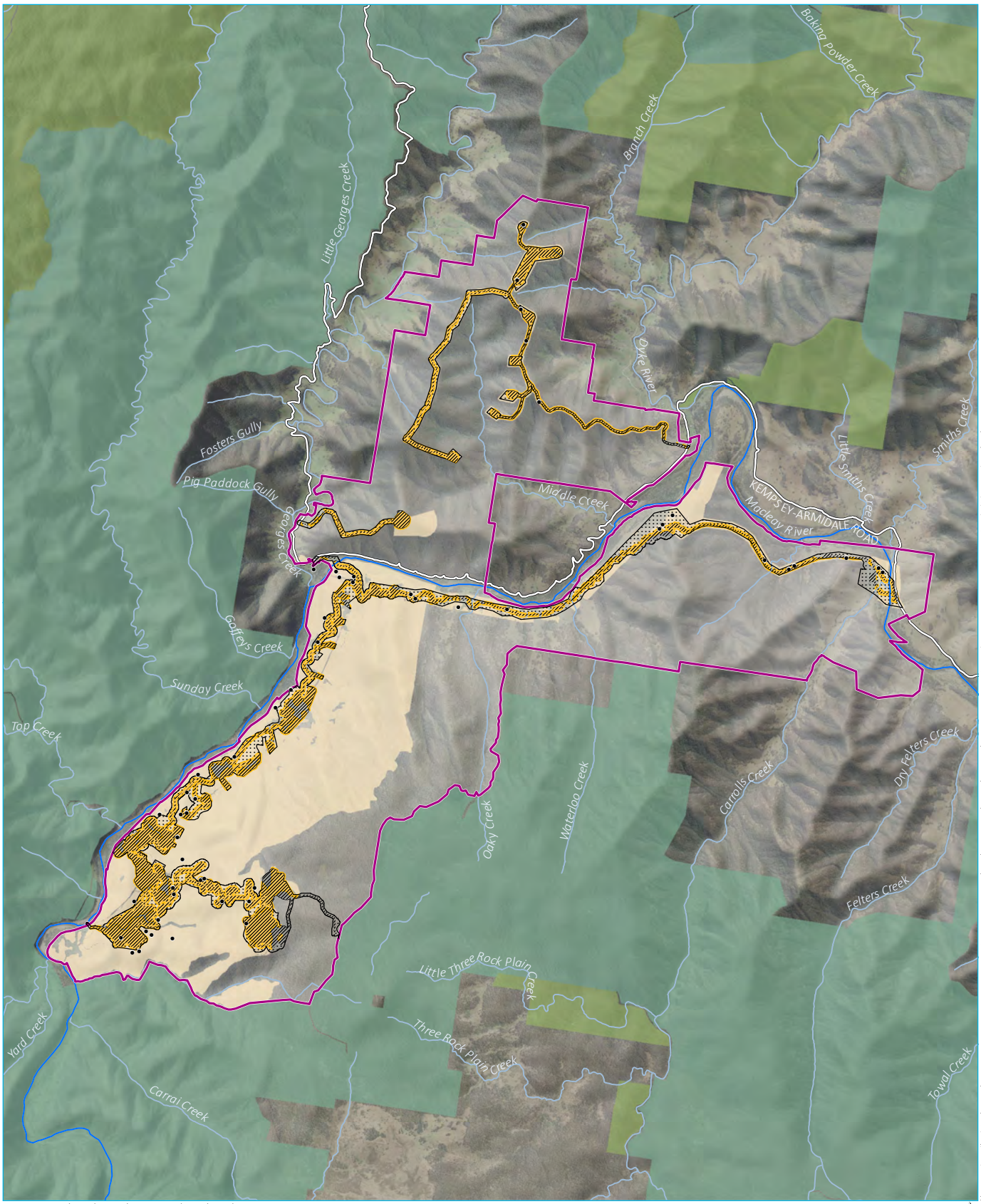
Figure 6.13

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Squirrel Glider species sighting

Squirrel Glider species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Squirrel Glider species polygon

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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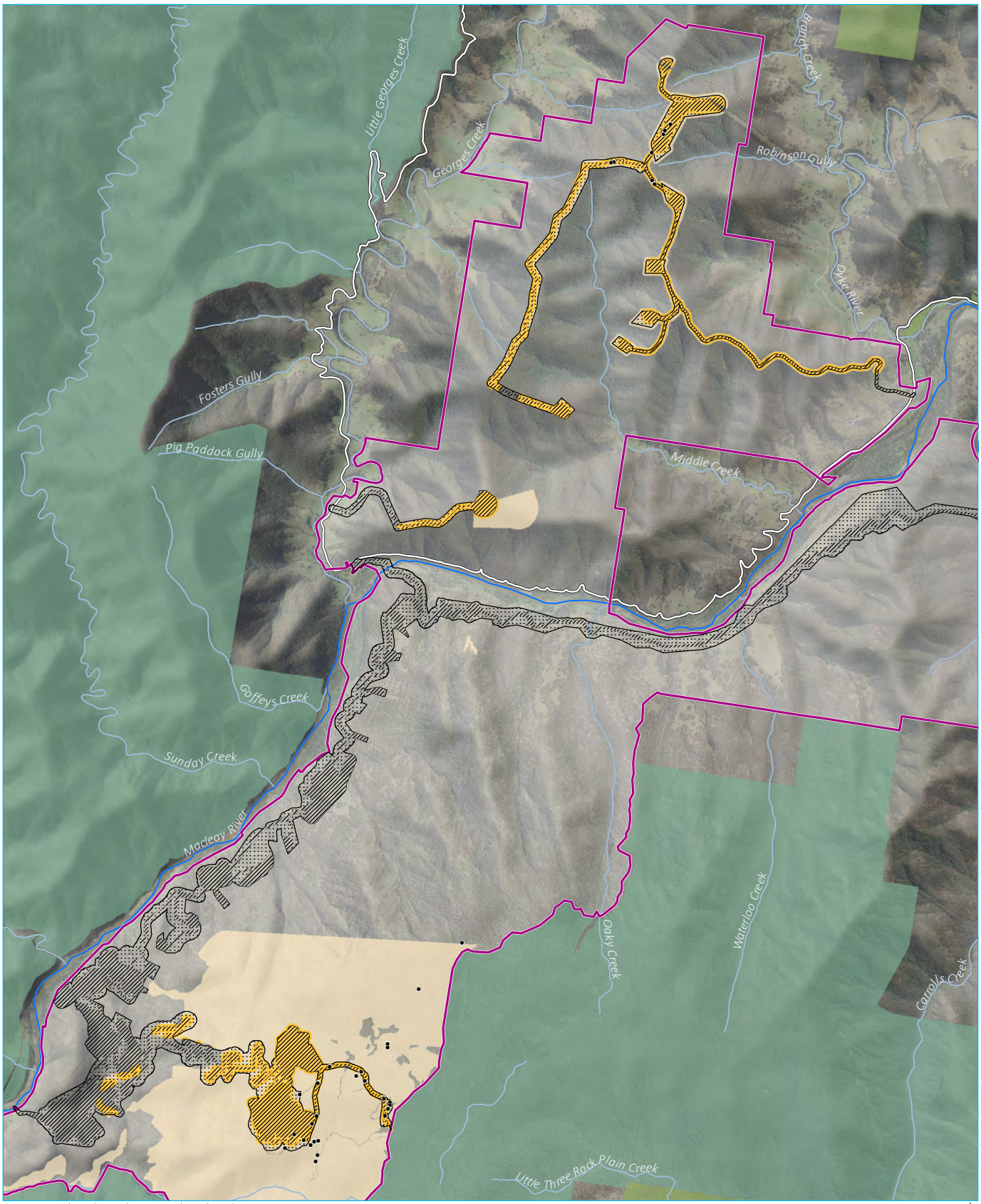
Figure 6.14

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m
GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Greater glider species sighting

Greater glider species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Greater glider species polygon

Oven Mountain Pumped Hydro Energy Storage Project
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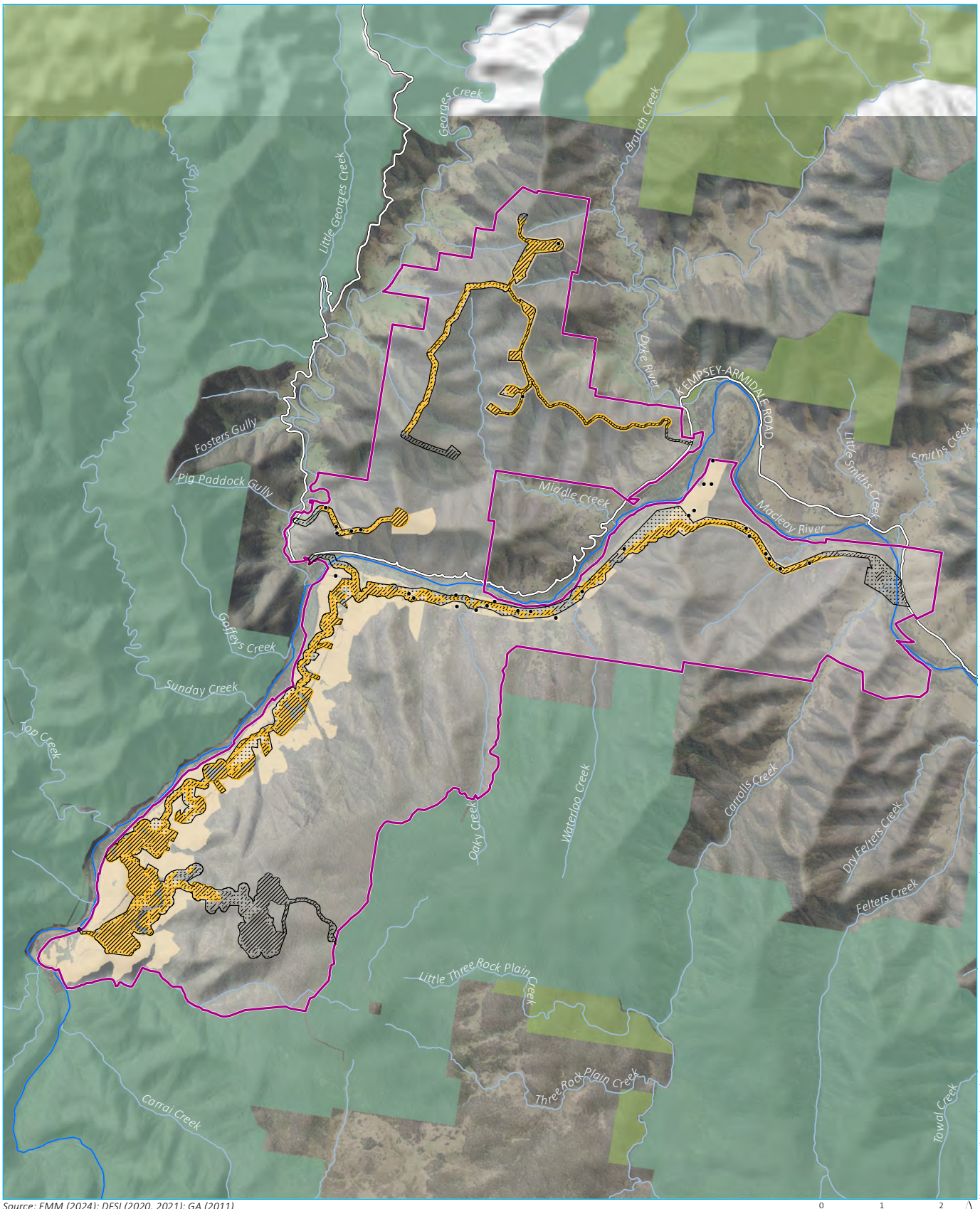
Figure 6.15

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Brush-tailed Phascogale species sighting

Brush-tailed Phascogale species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Brush-tailed Phascogale species polygon

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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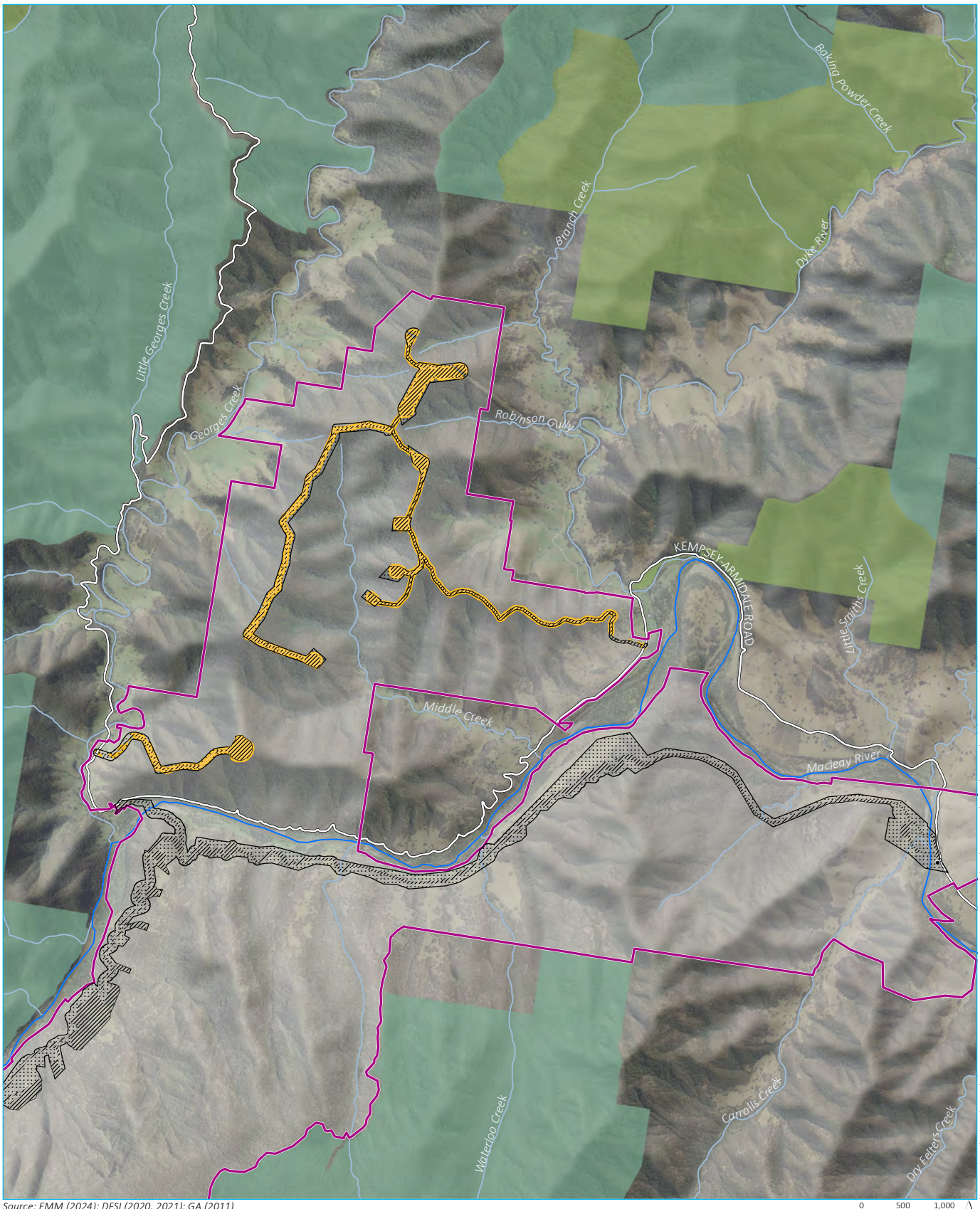
Figure 6.16

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 500 1,000 m
GDA 1994 MGA Zone 56

N

\\emm.local\xdrive\2021\J210465 - OMPS EIS - Generation Component\GIS\02_Maps_RTS_BDAR\BDAR007_SpeciesPolygon_20240815_01_Koala.mxd 19/08/2024

Project
Construction
Design
• Koala species

Koala species polygon
Direct and indirect impact
Non-impacted

Existing environment
Macleay River
Named
Major road
NPWS
State

Koala species polygon

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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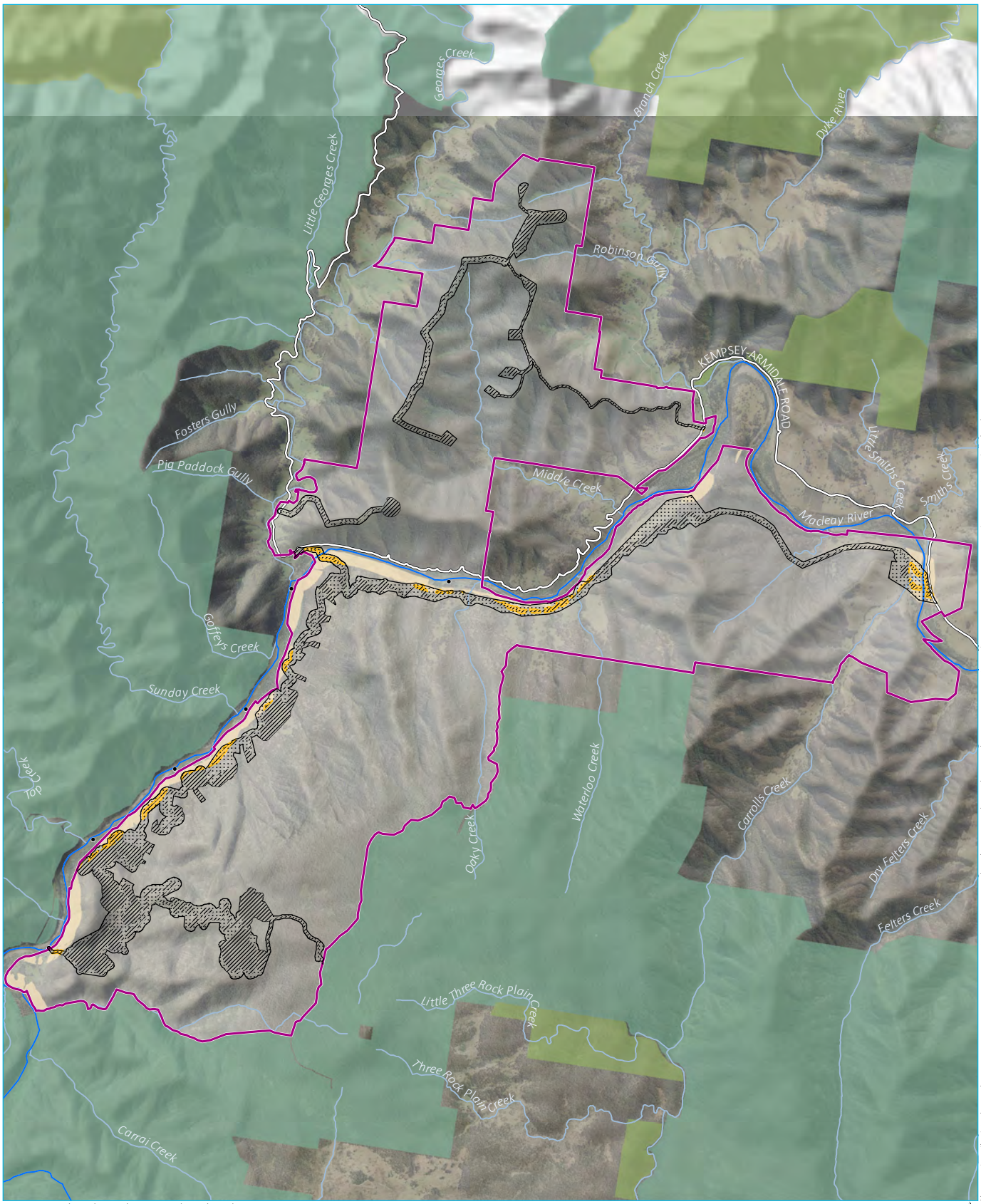
Figure 6.17

EMM
creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Construction envelope
- Design disturbance
- Southern Myotis species sighting

Southern Myotis species polygon

- Direct and indirect impact area
- Non-impacted area

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

Southern Myotis species polygon

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Figure 6.18

EMM creating opportunities

6.5 Step 6: Determination of the habitat condition within the species polygon for species assessed by area

The habitat condition within species polygons was determined by using the vegetation integrity score for each vegetation zone that is wholly or partially within the species polygon. The count of individuals or area of each vegetation zone entered into the BAMC is summarised in Table 6.23.

Table 6.23 The habitat condition within species polygons

Scientific name	Common name	Vegetation zones in species polygon	Extent of impact in species polygon (ha)/count
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 High	37
Grevillea guthrieana	Guthrie's Grevillea	PCT 868 High	93
Grevillea guthrieana	Guthrie's Grevillea	PCT 979 High	248
Grevillea guthrieana	Guthrie's Grevillea	PCT 979 High (indirect)	2
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 High (indirect)	91
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 DNG Moderate (indirect)	1
Grevillea guthrieana	Guthrie's Grevillea	PCT 868 High (indirect)	108
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 1215 DNG Moderate	11
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 1215 High	379
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 842 High	15
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 1215 DNG Moderate (indirect)	1
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 1215 High (indirect)	1110
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 762 Moderate (indirect)	1
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 842 High (indirect)	29
Lepidium peregrinum	Wandering Pepper Cress	PCT 762 EG	0.92 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 DNG Moderate	0.85 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 High	0.07 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate	0.72 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 High (indirect)	0.39 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate (indirect)	1.06 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 DNG Moderate (indirect)	0.33 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 EG (indirect)	0.22 ha
Lepidium peregrinum	Wandering Pepper Cress	PCT 762 EG (indirect)	0.62 ha
Pultenaea rubescens	*Pultenaea rubescens*	PCT 868 High (indirect)	0.06 ha
Pultenaea rubescens	*Pultenaea rubescens*	PCT 1287 High (indirect)	0.13 ha
Pultenaea rubescens	*Pultenaea rubescens*	PCT 988 High (indirect)	0.16 ha

Scientific name	Common name	Vegetation zones in species polygon	Extent of impact in species polygon (ha)/count
Tylophora woollsii	Cryptic Forest Twiner	PCT 979 High	1.4 ha
Tylophora woollsii	Cryptic Forest Twiner	PCT 988 High	2 ha
Tylophora woollsii	Cryptic Forest Twiner	PCT 1215 High	9.3 ha
Tylophora woollsii	Cryptic Forest Twiner	PCT 979 High (indirect)	0.42 ha
Tylophora woollsii	Cryptic Forest Twiner	PCT 988 (indirect)	1.9
Tylophora woollsii	Cryptic Forest Twiner	PCT 1215 High (indirect)	9.3 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 988 High	1.6 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 868 Dry	0.61 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 868 High	7.43 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 988 High (indirect)	0.37 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 868 Dry (indirect)	0.5 ha
Calyptorhynchus lathami	Glossy Black-cockatoo	PCT 868 High (indirect)	0.44 ha
Ninox strenua	Powerful Owl	PCT 842 High	36.39 ha
Ninox strenua	Powerful Owl	PCT 842 High (indirect)	20.05 ha
Tyto novaehollandiae	Masked Owl	PCT 842 High	41.53
Tyto novaehollandiae	Masked Owl	PCT 842 High (indirect)	28.08
Tyto novaehollandiae	Masked Owl	PCT 762 Moderate (indirect)	0.11 ha
Tyto novaehollandiae	Masked Owl	PCT 762 Moderate	0.04 ha
Tyto novaehollandiae	Masked Owl	PCT 1215 High	5.6 ha
Tyto novaehollandiae	Masked Owl	PCT 1215 High (indirect)	8.9 ha
Tyto novaehollandiae	Masked Owl	PCT 868 Dry	2.1 ha
Tyto novaehollandiae	Masked Owl	PCT 868 Dry (indirect)	2.3 ha
Tyto novaehollandiae	Masked Owl	PCT 868 High	41.7
Tyto novaehollandiae	Masked Owl	PCT 868 High (indirect)	8.9
Tyto novaehollandiae	Masked Owl	PCT 979 High	6.2 ha
Tyto novaehollandiae	Masked Owl	PCT 979 High (indirect)	1.1 ha
Tyto novaehollandiae	Masked Owl	PCT High 988	8.2 ha
Tyto novaehollandiae	Masked Owl	PCT High 988 (indirect)	6.2 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 842 High	148.37 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 868 Dry	6.77 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 868 High	48.50 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 842 High (indirect)	78.36 ha

Scientific name	Common name	Vegetation zones in species polygon	Extent of impact in species polygon (ha)/count
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 868 Dry (indirect)	6.1 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 868 High (indirect)	13.57 ha
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 1142 Moderate (indirect)	0.46
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 1142 Moderate	5
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 979 High	8.7
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 979 High (indirect)	1.6
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 988 High	8.7
Petrogale penicillata	Brush-tailed Rock-wallaby	PCT 988 High (indirect)	4.8
Potorous tridactylus	Long-nosed Potoroo	PCT 868 Dry	3.5 ha
Potorous tridactylus	Long-nosed Potoroo	PCT 868 High	43.7 ha
Potorous tridactylus	Long-nosed Potoroo	PCT 1215 High	41.4 ha
Potorous tridactylus	Long-nosed Potoroo	PCT 868 Dry (indirect)	3.3 ha
Potorous tridactylus	Long-nosed Potoroo	PCT 868 High (indirect)	11.4 ha
Potorous tridactylus	Long-nosed Potoroo	PCT 1215 High (indirect)	46.7 ha
Petaurus norfolcensis	Squirrel Glider	PCT 762 Poor	0.31 ha
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate	0.53 ha
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor	1.63ha
Petaurus norfolcensis	Squirrel Glider	PCT 842 High	167.12 ha
Petaurus norfolcensis	Squirrel Glider	PCT 868 Dry	6.6 ha
Petaurus norfolcensis	Squirrel Glider	PCT 868 High	57.85 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1106 ModerateRF	0.89 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High	0.17 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate	3.87 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1215 High	51.51 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1268 High	1.1 ha
Petaurus norfolcensis	Squirrel Glider	PCT 762 Poor (indirect)	0.31 ha
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate (indirect)	0.17 ha
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor (indirect)	2.90 ha
Petaurus norfolcensis	Squirrel Glider	PCT 842 High (indirect)	94.1 ha
Petaurus norfolcensis	Squirrel Glider	PCT 868 Dry (indirect)	6.1 ha
Petaurus norfolcensis	Squirrel Glider	PCT 868 High (indirect)	20.36 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High (indirect)	0.77 ha

Scientific name	Common name	Vegetation zones in species polygon	Extent of impact in species polygon (ha)/count
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate (indirect)	3.83 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1106 (indirect) ModerateRF	0.26 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1215 High (indirect)	60.32 ha
Petaurus norfolcensis	Squirrel Glider	PCT 1268 High (indirect)	0.96 ha
Petauroides volans	Greater Glider	PCT 868 Dry	6.6 ha
Petauroides volans	Greater Glider	PCT 868 High	59.61 ha
Petauroides volans	Greater Glider	PCT 79 High	7.3 ha
Petauroides volans	Greater Glider	PCT 979 High (indirect)	1.6 ha
Petauroides volans	Greater Glider	PCT 988 High	10.3 ha
Petauroides volans	Greater Glider	PCT 988 High (indirect)	8.3 ha
Petauroides volans	Greater Glider	PCT 1142 Moderate	0.21 ha
Petauroides volans	Greater Glider	PCT 1215 High	41.4 ha
Petauroides volans	Greater Glider	PCT 868 Dry (indirect)	6.1 ha
Petauroides volans	Greater Glider	PCT 868 High (indirect)	20 ha
Petauroides volans	Greater Glider	PCT 842 High (indirect)	0.01 ha
Petauroides volans	Greater Glider	PCT 1215 High (indirect)	47.22 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High	168.8 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 868 High	8.14 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 1215 High	50.81 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High (indirect)	95.3 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 868 High (indirect)	4.52 ha
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 1215 High (indirect)	57.75 ha
Phascolarctos cinereus	Koala	PCT 842 Poor	0.59 ha
Phascolarctos cinereus	Koala	PCT 842 High	1.7 ha
Phascolarctos cinereus	Koala	PCT 868 High	12.90 ha
Phascolarctos cinereus	Koala	PCT 1215 High	41.44 ha
Phascolarctos cinereus	Koala	PCT 1268 High	1.06 ha
Phascolarctos cinereus	Koala	PCT 762 Poor (indirect)	0.01 ha
Phascolarctos cinereus	Koala	PCT 842 Poor (indirect)	1.3 ha
Phascolarctos cinereus	Koala	PCT 842 High (indirect)	2.33 ha
Phascolarctos cinereus	Koala	PCT 868 High (indirect)	7.5 ha
Phascolarctos cinereus	Koala	PCT 1215 High (indirect)	47.22 ha

Scientific name	Common name	Vegetation zones in species polygon	Extent of impact in species polygon (ha)/count
Phascolarctos cinereus	Koala	PCT 1268 High (indirect)	0.96 ha
Myotis macropus	Southern Myotis	PCT 762 Poor	0.23 ha
Myotis macropus	Southern Myotis	PCT 762 Poor (indirect)	0.15 ha
Myotis macropus	Southern Myotis	PCT 762 Moderate	0.1 ha
Myotis macropus	Southern Myotis	PCT 762 Moderate (indirect)	0.17 ha
Myotis macropus	Southern Myotis	PCT 842 Poor	0.82 ha
Myotis macropus	Southern Myotis	PCT 842 Poor (indirect)	1.22 ha
Myotis macropus	Southern Myotis	PCT 842 High	9.46 ha
Myotis macropus	Southern Myotis	PCT 1106 High	0.42 ha
Myotis macropus	Southern Myotis	PCT 1106 High (indirect)	1.19 ha
Myotis macropus	Southern Myotis	PCT 1106 Moderate	2.28 ha
Myotis macropus	Southern Myotis	PCT 1106 Moderate (indirect)	3.69 ha
Myotis macropus	Southern Myotis	PCT 1106 Moderate RF	0.86 ha
Myotis macropus	Southern Myotis	PCT 1106 Moderate RF (indirect)	0.85 ha
Myotis macropus	Southern Myotis	PCT 842 High (indirect)	11.71 ha

7 Groundwater dependent ecosystems

Division 6 of the *Water Management Act 2000* (WM Act) requires consideration of aquifer interference activities. The NSW Aquifer Interference Policy (AIP) (DPI, 2012) requires an assessment of potential impacts on groundwater users, including groundwater dependent ecosystems.

A groundwater-dependent ecosystem (GDE) risk assessment has been completed in accordance with the NSW Government *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov P, Kuginis L, Williams J.P., 2012). This assessment has been undertaken in the Groundwater Dependent Ecosystems assessment (EMM, 2023), and results are summarised below.

In accordance with the minimal impact criteria presented in the aquifer interference policy (DPI, 2012), water table drawdown has been assessed within 40 m of the identified terrestrial GDEs. The updates as part of the project design in the response to submissions stage now predict that water table drawdown is predicted to occur during the construction period only to the two obligate GDEs (PCT 1287). Drawdown is not predicted (within the minimum drawdown threshold) during operation. No ongoing drawdown is predicted within 40 m of facultative/opportunistic GDEs between the lower reservoir and Macleay River.

Terrestrial GDEs with a facultative and opportunistic dependence on groundwater predominantly depend on rainfall infiltration and adjacent surface watercourses to meet their water requirements, accessing groundwater opportunistically and seasonally when the water table is sufficiently close to the rooting depth of the particular PCT. Given the flow in the respective adjacent watercourse is likely to be sustained by rainfall runoff and releases from the upper reservoir during construction and operation, facultative/opportunistic GDEs are at low risk of potential impacts. It is noted that the drawdown predictions should be viewed as worst case based on conservative hydraulic conductivity values in the model and unmitigated tunnel and underground power station construction methods.

Stage 2 – Impact assessment

8 Impact assessment

This chapter identifies the potential impacts of the Project on the biodiversity values. Measures taken to date to avoid and minimise impacts are summarised and recommendations to assist in the design development that further avoids and minimises impacts are provided.

8.1 Potential direct and indirect impacts

8.1.1 Direct impacts

Without any measures implemented to avoid and minimise impacts in the disturbance footprint, the Project would have resulted in the following direct impacts on biodiversity:

- Loss of 7.43 ha of threatened ecological communities.
- Loss of 325 *Grevillea guthrieana* individuals, listed as Endangered under the BC Act and EPBC Act.
- Loss of over 384 Wandering Pepper Cress individuals, listed as Endangered under the BC Act and EPBC Act and a SAII entity.
- Loss of 143 *Pultenaea rubescens* individuals, a new species that is eligible to be listed as Endangered under as an emergency listing as set out in Division 4 of the BC Act 2016 (Barrett, in prep 2023).
- Loss of 13 Scrub Turpentine individuals, listed as Critically Endangered under the BC Act and EPBC Act and a SAII entity.
- Loss of four Cryptic Forest Twiner individuals, listed as Endangered under the BC Act and EPBC Act.
- Loss of 1.1 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat, listed as Endangered under the BC Act and Vulnerable under the EPBC Act and a SAII entity for impacts on refuge habitat.
- Loss and degradation of threatened species habitats including hollow bearing trees, rocky areas, cliffs, and creeks.

8.1.2 Loss of native vegetation

The Project will involve clearing and inundation of land and will therefore result in loss of native vegetation in affected areas. A total area of approximately 363 ha of native vegetation of varying condition would be directly impacted (Table 8.1).

Table 8.1 Vegetation zone and impact summary

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint (ha)
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate	0.5
762	Cabbage Gum open forest or woodland on flats of the North Coast	DNG Moderate	0.2
762	Cabbage Gum open forest or woodland on flats of the North Coast	Poor	0.3
762	Cabbage Gum open forest or woodland on flats of the North Coast	Exotic Grassland (EG)	1.6

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint (ha)
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	168.9
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	DNG Moderate	37.1
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Poor	1.6
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	EG	3.7
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	61.4
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry	6.8
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	High	7.3
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	10.5
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High	0.5
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion (associated with a TEC)	Moderate	2.3
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion (associated with a TEC)	Moderate RF	0.9
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5.0
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	High	52.1
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	DNG Moderate	1.2
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	High	1.1
1287	Upland heath swamps of the New England Tableland Bioregion	High	0
Total			**363 ha**

The majority of native vegetation in the disturbance footprint would generate an ecosystem credit offset requirement as described in Section 11.2.1. Areas that are habitat for species-credit species would also generate species credits as described in Section 11.2.2.

8.1.3 Indirect impacts

Section 8.2 of BAM (DPIE, 2020a) requires the assessment of indirect impacts on native vegetation, threatened ecological communities and threatened species habitats.

Delineation of a project into different management zones allows for direct impacts (i.e. total loss of native vegetation and fauna habitat in a given area) and indirect impacts (e.g. decreasing condition in retained native vegetation and fauna habitats adjacent to direct impacts) to be quantified. The following section describes how the indirect impacts have been defined for the Project. Mitigation measures have been provided in Section 8.3.2 to manage these indirect impacts.

The indirect impacts are likely to include:

- edge effect on areas of retained native vegetation
- disturbance to native animals in adjacent habitat, particularly during construction
- interruption of animal movement
- vehicle strike and powerline collision impacts on animal populations
- increase in predatory and pest animal species, resulting in increased predation and competition and a consequent reduction in populations
- impacts from *Phytophthora cinnamomi*
- impacts to water quality during construction
- impacts from stormwater and surface water runoff
- impacts from change of fire regime.

i Edge effects

Edge effects are zones of changed environmental conditions occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different plant species (including weeds), supress the growth of other plant species, promote invasion by animals (native and introduced) that specialise in edge habitats, or change the behaviour of resident animals (Moenting, AE & Morris DW, 2006). Edge zones can be subject to higher levels of predation by introduced mammal and native bird predators. The distance of edge effects influence can vary, with edge effects in roads having been recorded as extending greater than 1 km (Forman, RT, 2000) and as little as 20 m away (Bali, R, 2000), (Bali, R, 2005), (EMM, 2019).

Areas adjacent to the disturbance footprint were inspected during vegetation mapping, BAM plots and fauna surveys to determine the characteristics of vegetation and habitat present and their susceptibility to potential edge effects. The Project area has historically been logged in areas accessible by machinery and land use activity from grazing along the lower section of the generation site and access has already resulted in edge effects from existing access roads and clearing activities.

The upper reservoir and transmission line areas are not currently subject to edge effects. In these areas, construction of the Project has the potential to disperse weeds species into areas where they do not currently occur. The landscape surrounding these areas is dominated by areas of relatively intact forest and is unlikely to be a source of substantial weed introduction to retained areas around the reservoirs. The most likely causes of weed dispersal associated with the activity would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery.

Immediately adjacent to the areas of direct impact, native vegetation may be affected by changes to microclimatic conditions such as sunlight levels, average windspeed and soil moisture availability. Given that affected vegetation consists of dry sclerophyll forest and woodland, it is not likely to be substantially affected by such changes. Construction activities may also result in temporarily increased dust levels, covering adjacent vegetation and inhibiting growth.

These changes may result in minor degradation of native vegetation through weed invasion, changes to native plant species composition and diversity and habitat suitability for animal species.

ii Disturbance to native animals in adjacent habitat

In addition to permanent edge-effects, there may be temporary impacts from noise, vibration and artificial lighting during the construction period.

Possible effects of noise on native animals include permanent hearing impairment in the case of extremely loud noise, interference with communication between animals and disruption to normal activities such as foraging (Hoskin, CJ & Goosem, MW, 2010).

Construction activities would result in increased levels of noise and vibration, particularly as a result of blasting activities during construction of the reservoirs walls and access roads, and as a result of general construction activities. Blast overpressure and ground vibration levels from the Project are predicted to comply with relevant Environmental Protection Authority (EPA) guidelines. The volumes of maximum instantaneous charge required to meet compliance are not expected to result in any significant constraints to blasting. Notwithstanding, active management and monitoring of blast overpressure and vibration would be in accordance with current best practice to mitigate any issues while maintaining blasting requirements.

Noise levels are expected to be transient during construction. Operational noise is expected to be minimal and restricted to immediately surrounding operational elements.

It is considered that such species like Brush-tailed Rock-wallaby are able to tolerate certain levels of disturbance and impacts from roads that are located in close proximity to refuge habitat. NPWS North Coast Branch undertake regular monitoring of Brush-tailed Rock-wallabies in Oxley Wild Rivers National Park. A known colony is located adjacent to a publicly accessible road along Green Gully Trail. Conversations with Piers Thomas (as per comms. November 2022), is that no impacts have been observed within the colony that has disturbance from public use of the road (noise and disturbance), higher risk from predators / feral herbivores and regular maintenance works (noise) that occurs along the road. Location of road and refuge habitat shown below in Table 8.2.

Table 8.2 Brush-tailed Rock-wallaby colony along Green Gully Trail

Colony habitat location to road	Brush-tailed Rock-wallaby records (AoLA 2024)
	

Lighting for night works also has the potential to result in light spill into adjacent habitat areas, and disturbance to fauna species during construction of the Project.

Noise, vibration and artificial lighting may lead to some animals temporarily ceasing to utilise habitat adjacent to the disturbance footprint during the construction of the Project or may impair their normal activities, but is unlikely to cause a significant impact on any species. Usage is predicted to return to pre-construction levels during operation due to minimal ongoing impacts.

iii Interruption of animal movement

Removal of native vegetation and associated habitat and inundation of land has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow (Bennett, AF, 1990) (Keller, I & Largiadèr, C, 2003) (Dixo, M et al., 2009). Clearing can result in the inability of species to move between patches of suitable habitat or a reduced level of movement. Species most vulnerable to fragmentation include relatively sedentary species with low mobility. Species least vulnerable to barrier effects tend to be those that are highly mobile (e.g. birds), although even these species can vary in their response to fragmentation. Ultimately, fragmentation can increase the vulnerability of flora and fauna populations to stochastic events and extinction (Bennett, AF, 1990) (Smith, J & Hellmann, J, 2002) (Fischer B, & Lindenmayer, D, 2007).

Under present conditions, animals may move between the extensive areas of habitat within the Project area with the Macleay River contributing the largest constraint of movement for smaller animals less capable of swimming across the river. It is considered that animals may be able to cross the Macleay River during dry spells and lower rainfall years.

The reservoirs will impede movement directly across these two waterbodies; however, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the proposed reservoirs. Birds, bats frogs and some reptiles are likely to be able to continue to cross the reservoirs during operation but may be less likely to do so due to reduced cover and higher risk of predation.

The access and powerline route elements of the Project would result in increases in the distance between patches of animal habitat through the removal of trees. In the lower portion of the Project area, the clearing in these areas would consist of narrow strips of land, in areas mostly along existing tracks and is considered unlikely to significant modify the ability of threatened species to move through the landscape between areas of habitat. In the upper portion of the Project area, where large areas of intact vegetation occur, access tracks have a greater capacity to interrupt animal movement for small, less mobile species that will not cross small open gaps.

The likely impact of interruption of movement on threatened species is discussed further in Section 8.2.2.

iv Vehicle strike and powerline collision impacts on animal populations

a Vehicle strike impacts

There will be increased vehicle traffic on publicly accessible roads adjacent to the Project area during the construction phase. All current access tracks in the disturbance footprint will be upgraded with new roads created. Unmitigated, this has the potential to result in increased mortality of animals due to vehicle strike in these areas. Rare or low-density populations are most at risk of significant impacts if this impact is not managed appropriately (Hoskin, CJ & Goosem, MW, 2010). Despite some level of impact being possible, the majority of impacts will be limited to common or abundant species. The potential for increased traffic during construction to result in increased mortality of native animals would be minimised by the construction traffic driving rules in high risk sections of road at night when most native animal species are active.

b Powerline collision impacts

The Project includes a new 15 km long corridor containing 132 and 330 kilovolt (kV) overhead powerlines. Overhead powerlines may be hazardous for medium to large species of birds, flying-foxes and arboreal mammals. If an animal simultaneously contacts two electrical wires (conductors or phases) or a single-phase and a ground wire, it may be electrocuted. Birds may also be injured through collision with conductors.

Indirect impacts, such as bird collision, could impact the following threatened species recorded within the Project area:

- White-bellied Sea-Eagle
- Little Eagle
- Square-tailed kite.

The transmission line route is proposed to generally follow the existing line south of the Macleay River where possible, so this potential impact is already present in this section of the Project. The transmission line connecting the existing Line 965 to south of the Macleay River will be a new feature within the landscape that may cause mortality to the species discussed above.

v Increase in predatory and pest animal species

Increased human activity and creation of new roads also has the potential to attract feral animals if unmitigated. Of key concern is an increase in feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) activity and consequent impacts on native animals. Predation by feral Cats and Red Foxes are listed as key threatening processes under the BC Act and EPBC Act ((NPWS, 2001), (DEWHA, 2008), (DoE, 2015)) with impacts from Foxes and feral Cats also listed as a threat to the Brush-tailed Rock-wallaby TBDC (DPIE, 2020a). Introduced predators are also considered a threat to the Long-nosed Potoroo and Hastings River Mouse.

vi Impacts from *Phytophthora cinnamomi*

Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under the BC Act and EPBC Act. *P. cinnamomi* can lead to death of trees and shrubs, resulting in devastation of native ecosystems. Infection of susceptible communities with *P. cinnamomi* leads to

- changes in the structure and composition of the native plant communities
- a significant reduction in primary productivity and functionality; and
- habitat loss and degradation for dependent flora and fauna (DoE, 2014c).

Impacts from *P. cinnamomi* has been identified as a key threat to the *Pultenaea rubescens (Pultenaea parrisiae* subsp. *parrisiae), Grevillea guthrieana* and Hastings River Mouse.

vii Impacts on water quality during construction

Construction activities have the potential to result in impacts to water quality in watercourses located downstream of construction area in the following ways:

- Release of poor-quality water to watercourses. In particular, any sediment laden water that could arise following mobilisation of soils/sediments during inclement weather over disturbed soils and sediments in areas where vegetation has been cleared and/or soil and construction material has been stockpiled. If untreated surface water was released to watercourses it could be detrimental to aquatic habitat and biota.

- Reduction in watercourse bank stability following any nearby construction and any clearing of riparian vegetation could also result in bank erosion and input of sediments into watercourses.
- Accidental release of chemicals and fuels (e.g. oils, hydraulic fluids and fuel from construction equipment) could result in the input of hydrocarbon and metal contaminants into watercourses. The accidental release into watercourses of any pesticides, herbicides and sewage could also affect aquatic biota.
- Disturbance of riparian vegetation could have indirect impacts on aquatic habitat quality and influence abundance, distribution and health of aquatic biota.

The likely impact of alteration of flow regimes and associated impacts on water quality is discussed further in Section 8.2.3.

viii Impacts from stormwater and surface water runoff

Water quality impacts resulting from construction phase discharges are summarised as follows:

- Annual pollutant loads in the Macleay River adjacent to the Project area are predicted to generally increase by less than 1%. The largest increase in pollutant loads occurs for aluminium which is predicted to increase by up to 3% in a typical rainfall year.
- No impacts to water quality are predicted to occur for approximately 330 days per year (90% of the time). When water quality impacts do occur, they generally result in less than a 10% increase to existing water quality objectives (WQO) values. Negligible impacts are predicted during typical discharge conditions.
- Water quality impacts that result in more than a 10% increase to existing/WQO values are expected to occur infrequently. All water quality impacts are predicted to be short term with impacts only occurring during and immediately following rainfall, when discharges are occurring.
- The modelled water quality in the Macleay River is predicted to be similar to the baseline water quality observed in minor watercourses and the Macleay River adjacent to the Project area. This indicates that while pollutant concentrations in the Macleay River may be elevated compared to the WQOs, the concentrations are predicted to be within water quality ranges that occur naturally within the catchment.
- The capture, treatment and reuse of stormwater runoff, process water, and wastewater are key management measures that are proposed to mitigate water quality impacts during construction of the Project.

It is important to note that the water balance and quality modelling completed to inform this DIA represents a worst-case scenario where all disturbance areas are occurring at once. In practice, construction will be staged so that disturbance areas are progressively rehabilitated to reduce the total area that could impact water quality at any one point in time.

Large rain events may increase impacts such as sediment deposition in more sensitive areas that support such species as Wandering Pepper Cress and TECs associated with low lying areas such as along the flood plain of the Macleay River. Mitigation measures to control stormwater and surface runoff are listed in Table 2.1, which include drainage pits, levees and detention basins including water treatment plants.

Due to the natural process that occur along the flood plain, such as flood events during large periods of rain, these species and TEC are naturally impacted by sediment deposition. It is therefore considered that the Project will not significantly increase impacts to these sensitive areas.

ix Impacts from change of fire regime

The Project may have the potential to indirectly impact on fire regimes on the Carrai, which would have implications for *Pultenaea rubescens*. While the details on the ecology of *Pultenaea rubescens* are not known, several of its close relatives (*P. parrisiae, P. palacea*) are obligate seeders and are killed by fire (Ferrer-Paris JR and Keith DA, 2022). Obligate seeders are completely dependent on seed for regeneration. Assuming that *Pultenaea rubescens* is an obligate seeder, this means that *Pultenaea rubescens* requires a period of time without fire, so that it can replenish its soil seed bank, so that declines do not occur. As well as this species likely being susceptible to too frequent fire, it is likely susceptible to less frequent fire, as the germination of *Pultenaea* is often triggered by soil heating in the passage of a fire (Auld TD and O'Connell MA, 1991).

8.1.4 Calculating the credit obligation for direct and indirect impacts

For all areas of direct impact, being all areas within the disturbance footprint, the future vegetation integrity score was set to zero to account complete loss of vegetation within these areas.

As a result of various design changes to the disturbance footprint, there has been a significant reduction in direct impacts to native vegetation and threatened species. However, it is acknowledged that indirect impacts may arise out of the Project, subsequently resulting in a reduction in the condition of retained areas of native vegetation (see Section 8.1.3i). These indirect impacts have been assessed in accordance with Section 2.4.1 of the BAM (DPIE, 2020a) and credits have been calculated.

It is assumed that edge effects arising from the Project will impact all vegetation within 20 m of the disturbance footprint. This assessment was based on an assessment of data collected as a part of the biodiversity monitoring program for Snowy 2.0 Exploratory Works (EMM, 2019) which showed a statistically significant difference in weed cover from 10 m to 50 m, but not from 10 m to 20 m or from 20 m to 50 m.

To account for direct and indirect impact, vegetation zones were split into management zones based on whether they occurred within the direct impact footprint or the indirect impact footprint. Changes in vegetation integrity score (future vegetation integrity score) for indirect impacts were calculated based on the following:

- the structure (cover) scores for ‘grass’, ‘forbs’, ‘ferns’ and ‘other’ growth forms were reduced by 10%, leaving scores for all other growth forms at the current score
- functional score for litter cover was reduced by 5%.

8.2 Prescribed impacts

Consideration has been given to prescribed impacts on threatened species and communities recorded or assumed to be present within the disturbance footprint, as per Chapter 6 of the BAM (DPIE, 2020a). The prescribed impacts relevant to the Project are documented in Table 8.3, and prescribed impacts are assessed in Table 8.4 to Table 8.6.

Table 8.3 Prescribed biodiversity impacts relevant to the Project

Prescribed impacts	Relevance to the Project
Karst, caves, crevices, cliffs, rocks and other geological features of significance.	No karst (eroded limestone landscape) features are found in the construction envelope. The Project is located within the Macleay Gorges which forms an extensive area of 167,000 ha, which contains cliff and gorges. Cliffs, from high to small that could contain cave features are found in and adjacent to the construction envelope. Assessed in Table 8.4.

Prescribed impacts	Relevance to the Project
Human-made structures.	The Project does not include the removal of human made structures. Therefore, this prescribed impact is not relevant to the Project.
Non-native vegetation.	Non-native vegetation is restricted within the disturbance footprint, and largely associated with grazing land. None of the threatened species likely to occupy the disturbance footprint are likely to be reliant on non-native vegetation for roosting, breeding or frequent foraging. The loss of this habitat would have a negligible impact on threatened species.
Impacts on areas connecting threatened species habitat, such as movement corridors.	The Project will impact on the connectivity of habitat within the Project area due to removal of vegetation and inundation of land. Assessed in Table 8.5.
Impacts that affect water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or upsidence from underground mining).	The construction and operation of the Project will result in changes to the flow of waterways downstream from the lower reservoir. Assessed in Table 8.6.
Impacts on threatened and protected animals from turbine strikes from a wind farm.	Not relevant to the Project as it is not a wind farm.
Impacts on threatened species or fauna that are part of a TEC from vehicle strikes.	The Project will involve the creation of roads, widening tracks and temporary increase in local traffic movements. Several threatened species have been identified within the construction envelope that are likely to be susceptible to impacts from vehicle strikes. Assessed in Table 8.7.

8.2.1 Impact on habitat associated with karst, caves, crevices, cliffs, rocks and other geological features of significance

Impacts on habitat associated with crevices, cliffs and rocks on threatened entities are assessed in Table 8.4. The relevant threatened entities were generated from the candidate species and predicted species lists associated with karsts, caves, crevices, cliffs, rocks and other geological features of significance.

Table 8.4 Impact on habitats of threatened species or ecological communities associated with karst, caves, crevices, cliffs, rocks and other geological features of significance

Associated features of the disturbance footprint	Nature, extent and duration of impact	Relevant threatened entities	Consequences of impacts on threatened entities
No karst (eroded limestone landscape) features are found in the construction envelope. No cave features suitable to support roosting bats are found in the construction envelope. The Project is located within the Macleay Gorges which forms an extensive area of 167,000 ha, which contains cliff and gorges. Cliffs, from high to small that could contain cave features are found outside of the construction envelope.	Long-term decrease in the area of large rock outcrops accessible to terrestrial animals by approximately 0.00594 ha. Possible short-term (construction phase) decrease in the availability of rocky habitat adjacent to the disturbance footprint due to noise and vibration associated with earthworks deterring occupation by sensitive animal species.	Little Bent-winged Bat (R, D) Large Bent-winged Bat (R, D)	These species are unlikely to use the features in the disturbance footprint, or within 1–2 km, for breeding as no lactating females were recorded as part of the microbat survey effort; caves may be used for roosting habitat. Bent-wing bats require deep caves with very specific and stable humidity and temperature conditions for breeding (Dwyer, P D & Hamilton-Smith, E, 1965). The Project will cause a small, permanent reduction in the availability of potential roosting habitat that may be intermittently used by the species for roosting. Similar habitat in adjacent areas (up to around 100 m away) may become temporary unsuitable as roosting habitat during construction, due to noise and vibration impacts, but would be available to the species post construction. This habitat is not considered limiting in the locality due to the extensive areas of cliffs. There is a small risk of mortality of a low number of individuals of these species during construction. Mitigation measures, including staged removal of habitat and pre-clearing surveys, have been identified to minimise this risk. The Project's impact on these features is unlikely to substantially affect populations of either species.
		Brush-tailed Rock-wallaby (R, S)	This species was recorded throughout the project area using both cliff and rocky habitats within and adjacent to the development footprint and is known to utilise these rocky features for refuge and breeding sites. The Project will cause permanent reduction in the availability of refuge and breeding habitat. Similar habitat in adjacent areas (up to around 100 m away) may become temporary unsuitable during construction but would be available to the species post construction. For this assessment, it is assumed that the displaced colony will have a moderate risk of mortality of a small number of individuals of the species during construction. Mitigation measures have been identified to minimise this risk.
		Spotted-tail Quoll (R, ES)	This species was recorded within the disturbance footprint and is likely to utilise these rocky features for den and breeding sites. The Project will cause permanent reduction in the availability of potential den and breeding habitat. Similar habitat in adjacent areas (up to around 100 m away) may become temporary unsuitable during construction but would be available to the species post construction. There is a low to negligible risk of mortality of a small number of individuals of the species during construction. Mitigation measures have been identified to minimise this risk.

Notes: R = Recorded in the disturbance footprint.

D = Dual credit (ecosystem-credit and species-credit) species.

S = Species-credit species

ES = Ecosystem credit species

8.2.2 Impact on areas connecting threatened species habitat such as movement corridors

Impacts on areas connecting threatened species habitat such as movement corridors are assessed in Table 8.5. The relevant threatened entities were generated by looking at the candidate species list that are susceptible to habitat fragmentation and isolation. (AS, 2009) (DPIE, 2020a).

Table 8.5 Impacts on areas connecting threatened species habitat such as movement corridors

Associated features of the disturbance footprint	Nature, extent and duration of impact	Relevant threatened entities	Consequences of impacts on threatened entities
Generation site	The construction of the upper and lower reservoirs and associated infrastructure and access roads will involve removal of native vegetation. Habitats will however remain directly connected via large areas of continuous forest and woodland encircling the inundation areas. Significant areas of infrastructure within the Generation Site will be rehabilitated following construction, reducing impacts to connectivity longer term.	**Arboreal mammals**: • Koala (R, S) • Yellow-bellied Glider (R, ES) • Squirrel Glider (R, S) • Greater Glider (R, S) • Brush-tailed Phascogale (R, S) • Long-nosed Potoroo (R, S). **Terrestrial mammals** • Spotted-tailed Quoll (R, ES) • Brush-tailed Rock-wallaby (R, S) • Hastings River Mouse (R, ES). **Microbats**: • Little Bent-winged Bat (R, D) • Large Bent-winged Bat (R, D) • Southern Myotis (R, S)	Under present conditions, these threatened animals may move between the extensive areas of habitat across the Project area. During the operation of the Project, the threatened arboreal and terrestrial mammals present in the disturbance footprint for the reservoirs and associated infrastructure and inundation area will no longer be able to easily cross these areas due to the associated clearing of vegetation and expanse of open water. Threatened small woodland and forest birds, owls and microbats are likely to continue to cross during operation but may be less likely to do so due to reduced cover and higher risk of predation. The movement of raptors is unlikely to be substantially affected. The infrastructure created for the construction phase will be rehabilitated on completion of the works and animal movements through these areas would slowly return. The Project is unlikely, however, to prevent long-term movement of any threatened species of animals from one side of the reservoirs to the other as habitat would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas. The narrow bands of clearing required for the access roads (up to 20 m but typically around 10 m) are unlikely to interfere with animal movement since these species are capable of traversing narrow tracts of cleared land between forested areas. The increases or creation of canopy separation in movement paths of threatened species along the transmission line (130 m where clearance is required) may reduce the frequency of plant dispersal and animal movements for small, less mobile species; large, mobile species are unlikely to be impacted. Clearance areas for the transmission line is limited to that of the areas around the towers and any sag clearance requirements. Therefore, the entire line will not be cleared allowing threatened animals to move around either side of the tower clearance locations. It is unlikely, however, to significantly impact the ability of threatened species to move through the landscape between areas of habitat as the affected species are all able to move around the breaks in suitable habitat.
Access Road	The Project will involve removal of native vegetation and trimming of trees along part of an existing track and clearing of intact vegetation for the creation of the EAR. These impacts will be permanent as roads will be maintained during operation.		
Transmission Line	The Project will involve removal and trimming of trees along part of an existing track and clearing of intact vegetation for the creation of new access road, overhead powerline tower / pole locations and clearance for overhead wires. Connectivity will be maintained through retention of native vegetation within spanned valleys and partial clearing within the easement. These impacts will be permanent as roads and the transmission line will be maintained during operation.		

Notes: R = Recorded in the disturbance footprint.

D = Dual credit (ecosystem-credit and species-credit) species.

S = Species-credit species

ES = Ecosystem credit species

8.2.3 Impact on water quality, water bodies and hydrological processes that sustain threatened species

The Project will result in water table drawdown during construction that may have effects on terrestrial groundwater dependent ecosystems (GDEs), and groundwater available for baseflow to rivers and creeks. The minimal impact criteria presented in the aquifer interference policy (DPI, 2012), water table drawdown has been assessed within 40 m of the identified terrestrial GDEs. The updates as part of the project design in the response to submissions stage now predict that water table drawdown is predicted to occur during the construction period only to the two obligate GDEs (PCT 1287). Drawdown is not predicted (within the minimum drawdown threshold) during operation. No ongoing drawdown is predicted within 40 m of facultative/opportunistic GDEs between the lower reservoir and Macleay River.

i Streamflow impacts

Impacts to the streamflow regime of the Macleay River are only anticipated to occur when extracting water for construction and operational purposes. The largest impact to streamflow will occur when extracting water for the initial fill of the Project dams and reservoirs. The following streamflow impacts are anticipated (EMM, 2022f):

- The maximum annual water take for construction and the one-off initial storage fill (7,250 megalitres per year (ML/year)) represents 1% of the average annual streamflow volume adjacent to the Project area.
- The maximum annual top-up volume of 130 ML/year represents 0.01% of the average annual streamflow volume in the Macleay River adjacent to the Project area.
- Extraction for the initial storage fill and operational top-up will occur at a rate of up to 86.4 ML/day which results in a maximum streamflow reduction of 12.6% at the extraction point for short periods (several hours) of time just after extraction commences and just before extraction ceases. On average, an extraction rate of 86.4 ML/day results in a 6.1% reduction to streamflow based on the historical streamflow record.
- Extraction for initial storage fill and operational top-up is predicted to result in a maximum water level reduction of 0.05 m (or 5% of stream depth).
- Extraction at lower pump-rates (e.g. 2.8 ML/day) for general construction purposes is predicted to result in less than a 3% impact on the streamflow regime for 90% of Macleay River flow conditions adjacent to the Project area.
- Impacts to streamflow regime are predicted to decrease:

- with increasing streamflow as the extraction volume makes up a smaller percentage of overall streamflow
- moving downstream of the extraction location as additional catchment area contributes flow to the Macleay River.

- The initial storage fill is a one-off take and will occur for a relatively short period of time (i.e. 3–12 months) during construction while operational top-up is predicted to generally occur for one or two weeks per year at low pump rates. Hence, any residual impacts associated with water extraction will be short-term.

Impacts resulting from Project related discharges and the reduction in contributing catchment area due to impounding Fingerboard Crossing Creek are negligible given the relative size of the Macleay River catchment (7,596 km^2) upstream of the Project and relative magnitude of associated streamflow volumes (three to four orders of magnitude greater).

The streamflow regime in Fingerboard Crossing Creek will unavoidably be impacted as a result of the Project. Streamflow immediately downstream (i.e. at the toe of the dam wall) of the upper dam and reservoir is predicted to cease during operations. The impact to streamflow volumes gradually reduces moving further downstream with only a 13% reduction in streamflow at the lower dam and reservoir location.

ii Water quality impacts

A conceptual water balance and quality model (WBQM) was developed to estimate the quantity and quality of discharges during construction of the Project (EMM, 2022f). Water quality impacts resulting from construction phase discharges are summarised as follows:

- Annual pollutant loads in the Macleay River adjacent to the Project area are predicted to generally increase by less than 1%. The largest increase in pollutant loads occurs for aluminium which is predicted to increase by up to 3% in a typical rainfall year.
- No impacts to water quality are predicted to occur for approximately 330 days per year (90% of the time). When water quality impacts do occur, they generally result in less than a 10% increase to existing/WQO values. Negligible impacts are predicted during typical discharge conditions.
- Water quality impacts that result in more than a 10% increase to existing/WQO values are expected to occur infrequently. All water quality impacts are predicted to be short term with impacts only occurring during and immediately following rainfall, when discharges are occurring.
- The modelled water quality in the Macleay River is predicted to be similar to the baseline water quality observed in minor watercourses and the Macleay River adjacent to the Project area. This indicates that while pollutant concentrations in the Macleay River may be elevated compared to the WQOs, the concentrations are predicted to be within water quality ranges that occur naturally within the catchment.

It is important to note that the water balance and quality modelling completed to inform the surface water impact assessment represents a worst-case scenario where all disturbance areas are occurring at once. In practice, construction will be staged so that disturbance areas are progressively rehabilitated to reduce the total area that could impact water quality at any one point in time.

The Project will be operated so that inflows to the system in excess of the available storage capacity will be released from the lower dam and reservoir to the downstream portion of Fingerboard Crossing Creek and the Macleay River. Discharges may also be required from a low-level outlet at the base of the Lower dam and reservoir to facilitate emergency dewatering.

Discharges from the Lower dam and reservoir are expected to have similar water quality to the Macleay River (which is the source of water for initial storage fill and operational top-up) and Fingerboard Crossing Creek (which is impounded by the Project). Any residual risk to water quality will be managed through operational procedures. Hence, no downstream water quality impacts are anticipated due to Project discharges during operations.

iii Impacts during drought

In years of drought, the lower reservoir includes a 75 ML drought contingency volume. The pumped hydro system must contain a minimum of about 5,800 ML of available water within the upper and lower dams and reservoirs to operate at full generation capacity. This includes 320 ML of dead storage and 75 ML of drought reserve which is intended to provide additional security of supply during dry periods when operational top-up from the Macleay River would not be possible.

A water supply system is proposed to supply water for potable water use, general construction water demand, initial fill of Project reservoirs and periodic operational top-up as necessary. The water supply system will extract water from the Macleay River via pump and pipeline.

The following mitigation measures are proposed when extracting water at higher rates for initial storage fill and operational top-up:

- extraction will only occur during high-flow (greater than 50th percentile) conditions
- extraction will not occur during extended dry periods or drought
- no extraction will occur during the first seven days of the first high-flow event following extended dry periods or drought to allow the river to recharge.

Water extracted at lower pump rates (up to 2.8 megalitre per day (ML/day)) for general construction purposes will be subject to the conditions and rules outlined in the relevant water sharing plan (WSP). Therefore, it is not considered that any likely impacts would occur to threatened species as a result of the operational top up as water would only be extracted during periods of high flow.

Table 8.6 Impacts on water quality, water bodies and hydrological processes

Associated features within the Project area	Relevant threatened entities	Consequences of impacts
Diversity and abundance of fish (including invertebrates) as prey	**Microbats**: • Southern Myotis (R, S)	Possibly slightly reduced prey availability for non-threatened water bird species and mammal species that feed on fish such as egrets, herons and cormorants and Rakali/Water-rat.
Instream habitat value		Slight reduction in the quality and availability of in-stream habitat for a variety of non-threatened semi-aquatic frogs, birds, reptiles and mammals during drought conditions.
In-stream drought refugia		Slight reduction in the suitability or availability of in-stream refugia for a variety of non-threatened semi-aquatic frogs, birds, reptiles and mammals.
Riparian forest and woodland		Possibly slightly reduced condition of riparian vegetation communities that provide habitat for a variety of non-threatened species.
Riparian drought refugia		Slight reduction in the condition of riparian vegetation and its ability to act as a heat and water stress refuge for terrestrial animals such as bats, birds and arboreal mammals.
Drinking water for terrestrial animals		Slight reduction in the availability of in-stream refugia as sources of drinking water for terrestrial animals, including non-threatened and threatened species of birds and mammals during drought conditions.
Instream habitat value		Slight reduction in the quality and availability of in-stream habitat for a variety of non-threatened semi-aquatic frogs, birds, reptiles and mammals during drought conditions.
Movement and dispersal opportunities		Possible beneficial impact on movement and dispersal opportunities for semi-aquatic frogs, reptiles and mammals due to more frequent larger flow events. During lower flow (Base-flow) conditions, the Project may slightly reduce the dispersal ability within the stream channels.

Notes: R = Recorded in the disturbance footprint.

D = Dual credit (ecosystem-credit and species-credit) species.

S = Species-credit species

8.2.4 Impacts on threatened species or fauna that are part of a TEC from vehicle strikes.

Impacts on threatened species or fauna that are part of a TEC from vehicle strikes are assessed in Table 8.7. The relevant threatened entities were generated from the candidate species and predicted species that are susceptible to vehicle strike.

Table 8.7 Impacts on threatened species or fauna that are part of a TEC from vehicle strikes

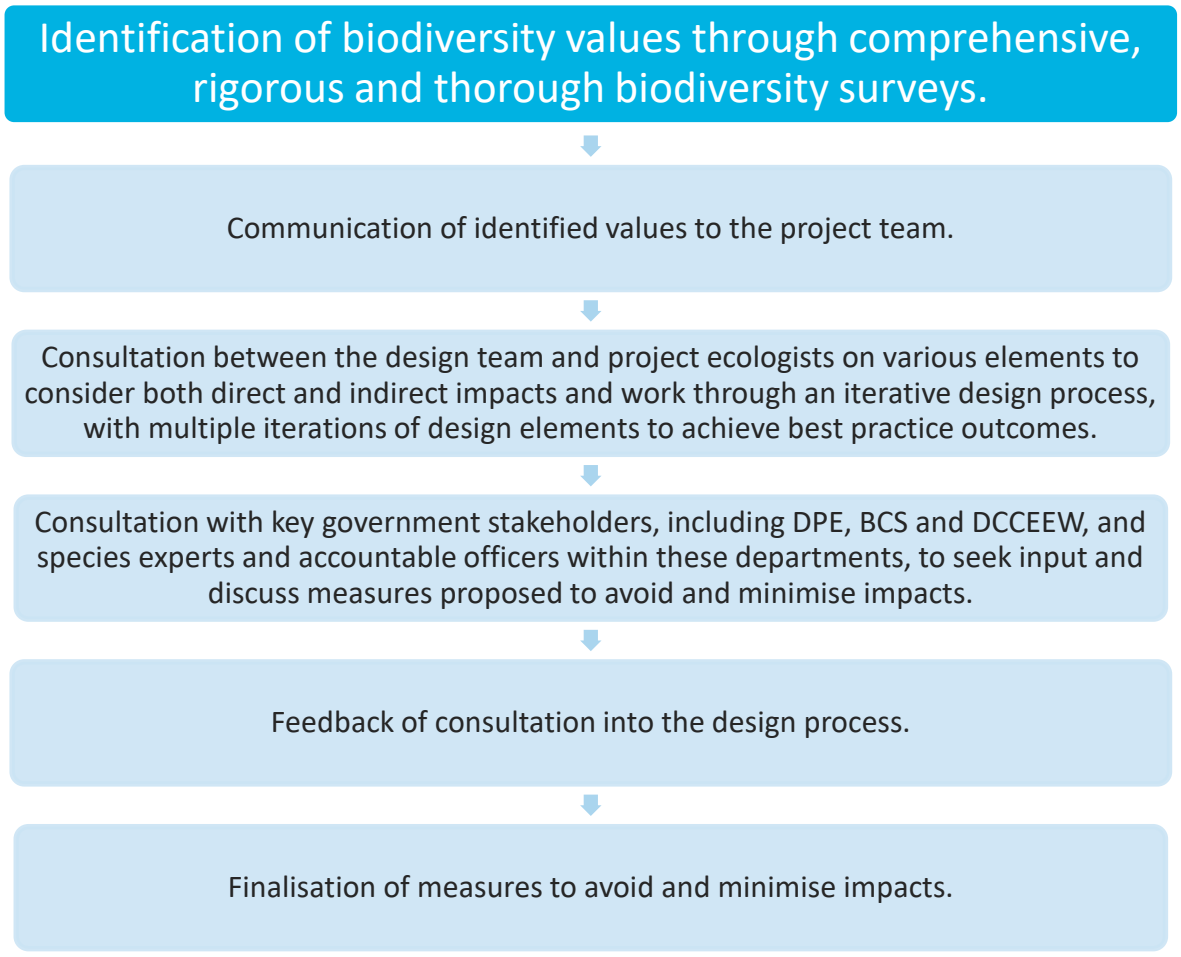
Associated features of the disturbance footprint	Nature, extent and duration of impact	Relevant threatened entities	Consequences of impacts on threatened entities
Newly created access roads. Public roads (Kempsey/Armidale Road).	Increased incidence of vehicle strikes on publicly accessible roads during construction due to increased traffic. New potential impacts of vehicle strikes on newly created access roads with the greater risk during construction due to increased traffic, with a lowered risk during operation as traffic would decreases post construction.	**Arboreal mammals**: • Koala (R, S) • Yellow-bellied Glider (R, ES) • Squirrel Glider (R, S) • Greater Glider (R, S) • Brush-tailed Phascogale (R, S) • Long-nosed Potoroo (R, S). **Terrestrial mammals** • Spotted-tailed Quoll (R, ES) • Brush-tailed Rock-wallaby (R, S) • Hastings River Mouse (R, ES). **Microbats**: • Little Bent-winged Bat (R, D) • Large Bent-winged Bat (R, D) Southern Myotis (R, S)	There will be increased vehicle traffic on publicly accessible roads adjacent to the Project area during the construction phase. All current access tracks in the disturbance footprint will be upgraded with new roads created. Unmitigated, this has the potential to result in increased mortality of animals due to vehicle strike in these areas. Rare or low-density populations are most at risk of significant impacts if this impact is not managed appropriately (Hoskin, CJ & Goosem, MW, 2010). Despite some level of impact being possible, the majority of impacts will be limited to common or abundant species. The potential for increased traffic during construction to result in increased mortality of native animals would be minimised by the construction traffic driving rules in high-risk sections of road at night when most native animal species are active.

8.3 Avoidance and minimisation

The hierarchy of avoid and minimise has been used in the design of the Project, fine-tuning of the proposed investigation locations.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys, where feasible. The Project has undergone significant steps to avoid and minimise impacts to ensure impacts are avoided and minimised to the greatest extent possible, within the design and other limitations of the Project. This has been achieved through the following process:

- Identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys.
- Communication of identified values to the project team.
- Consultation between the design team and project ecologists on various elements to consider both direct and indirect impacts and work through an iterative design process, with multiple iterations of design elements to achieve best practice outcomes.
- Consultation with key government stakeholders, including DPE, BCS and DCCEEW, and species experts and accountable officers within these departments, to seek input and discuss measures proposed to avoid and minimise impacts.
- Feedback of consultation into the design process.
- Finalisation of measures to avoid and minimise impacts.



Measures undertaken to avoid and minimise impacts that have arisen during the process outlined above are summarised below.

8.3.1 Avoidance in design

The consideration of options and development of the Project was informed by iterative environmental constraint assessment comprising both desktop and field survey, with the aim to reasonably avoid and minimise significant impacts to the environment, including biodiversity values. This resulted in changes including those to the lower and upper reservoir access roads, powerline routes, dam types, spoil emplacement and ancillary facilities and inform the proposed operating rules of the Project.

Additional avoidance measures undertaken during the response to submission stage included the following:

- Refinement of the access road between the lower and upper reservoir (Upper Dam Access Road) to avoid Actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat.
- Upper reservoir spoil emplacement, this has been relocated to avoid habitat for *Pultenaea rubescens*.

i Dam type considerations for spoil emplacement

Several alternate design options and locations for the dam types were considered through the conceptual design phase. The dam types and locations that were selected as the preferred options were selected on a merit-based approach balanced against the overall development constraints, including minimising impacts to the immediate and surrounding environment.

A Concrete Face Rockfill Dam (CFRD) was selected as the preferred option as this design type has the potential to enhance the utilisation of spoil generated on site, and proves to be more robust to managing ground risk, i.e. geotechnical and geological risk. Although a CFRD has a slightly larger permanent disturbance footprint it reduces the need for an onsite quarry and the result is a significantly reduced spoil emplacement area.

A CFRD design brings about benefits in the recycling and re-using of large amounts of spoil generated/excavated from dam foundations, reservoir excavations and tunnelling activities.

ii Conceptual spoil location selection

At the commencement of the Project feasibility design (circa Sept 2021), provisional spoil emplacement areas were located at the upper and lower construction areas. Two potential spoil emplacement locations were identified in the upper reservoir area that complemented selection of dam types, and that minimised other impacts that would be caused by hauling spoil material over longer distances. These footprints were provided to EMM for ecology surveys to be undertaken and, more specifically, to inform the construction envelope. These initial upper spoil areas are shown in Figure 8.1.

iii Upper Reservoir spoil design refinement

During targeted flora surveys for *Pultenaea rubescens*, which were completed around November 2022, the findings indicated that additional individuals have been recorded near the southern end of the southern-upper Spoil Emplacement Area. Once this population was mapped, it was found that, at the time, the Project disturbance footprint intersected with a few individuals. As part of the Design Integration and Assessment (DIAA) process, avoidance of this area was considered the preferred option and, in consultation with EMM ecologists, a setback buffer of 30 m was implemented.

As a result of this re-design work, the construction office pad and communications tower Pad were relocated, and the disturbance area for the southern-upper Spoil Emplacement Area had to be re-designed to avoid these individuals. Design adjustments were also made to the emergency access Road.

During the response to submission stage, the spoil design was further refined to remove all direct impacts to suitable habitat (microhabitat), including a 30 m buffer around the microhabitat.

iv Spoil emplacement areas – design considerations

During March/April 2022 survey findings indicated that the northern-most upper spoil emplacement area impacted a large population of Guthrie's Grevillea (*Grevillea guthrieana*). As part of the DIAA process, which is outlined in the submitted EIS in 2023, this area was removed from consideration as a spoil emplacement area. To avoid impacts to *Pultenaea rubescens,* this area had to be re-included to meet the requirements of the spoil emplacement as part of the design updates during the response to submission stage. The upper spoil emplacement area was redesigned to avoid all direct impacts to habitat suitable to support *Pultenaea rubescens.* The spoil emplacement location was also designed to occur 30 m from this suitable habitat. Changes in design has moved this location further north from this area.

Shading impacts as a result of the location and height of the soil pile has been predicted using GIS software modelling. The shading modelling shows that this area is already impacted by natural shading, while the upper soil emplacement area will increase the area of shading around the area, it will not create new shading to the habitat supporting *Pultenaea rubescens.*

v Avoidance Cryptic Forest Twiner

The upper reservoir construction office pad and communications tower pad were also relocated to avoid the record of Cryptic Forest Twiner (*Tylophora woollsii*). A concept design to provide for the estimated spoil volumes was undertaken, based on geotechnical information available at the time.

vi Access route via Georges Junction

One of the access options considered for the Project was initially proposed via a bridge that crossed at the southern section of Georges Junction. The largest count of 384, 24% of the population recorded within the project area Wandering Pepper Cress (*Lepidium peregrinum*) was recorded within the construction envelope proximate to this crossing location during flora surveys in November 2021.

A temporary bridge is required at Georges Junction as part of the early works stage. The location of this bridge was selected to avoid the large area of suitable habitat for Wandering Pepper Cress. Wandering Pepper Cress was observed to occur in areas that contained sandy alluvium soils that lacked rocky substrates. The temporary bridge avoids preferred habitat for this species, occurring in an area of rocky substrates in which this species was observed to be absent. The location for the temporary bridge crossing is a large area containing rocky substrates as the dominate feature. Therefore, this location is considered to lack suitable microhabitat for this species.

Input to the design was to move the proposed access road higher upslope away from the areas where this species was recorded. This also led to the design team to look for alternative access routes to the site. This area was avoided with the current access route crossing the Macleay River further east from Georges Junction that avoids Wandering Pepper Cress (*Lepidium peregrinum*) habitat. This has resulted in impacts to just two of the 1,577 plants recorded (0.12% of the population).

vii Other aspects of avoidance in design

As discussed above, the design of the Project has been through several iterations with biodiversity values being a key consideration in the design of project elements. The access roads and spoil pile locations were relocated, where practicable, to avoid areas known to contain threatened species. The access road connecting the lower reservoir to the upper reservoir was realigned to avoid the largest population of Guthrie's Grevillea. Associated ancillary infrastructure sites and spoil locations have also been moved away from sensitive areas containing threatened species locations and habitat. During the response to submissions the access road between the lower and upper reservoirs was redesigned. This removed direct impacts to 1.1 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat which supported the largest colony that was recorded within the project area, refer to Figure 8.7.

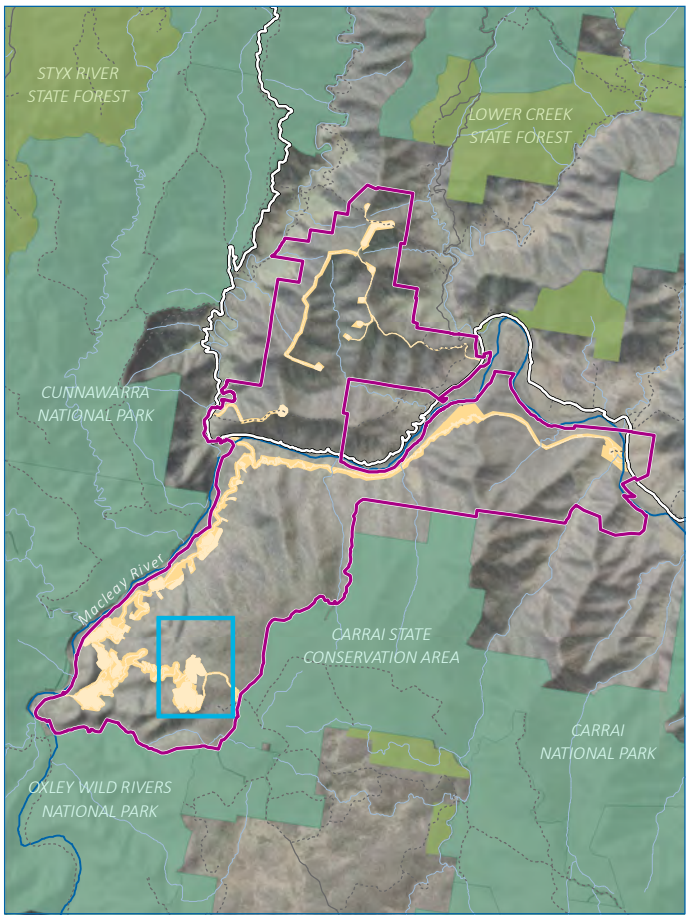
Table 8.8 outlines key examples of locations where the access road and ancillary sites were chosen to avoid threatened flora species and habitat to support threatened fauna species.

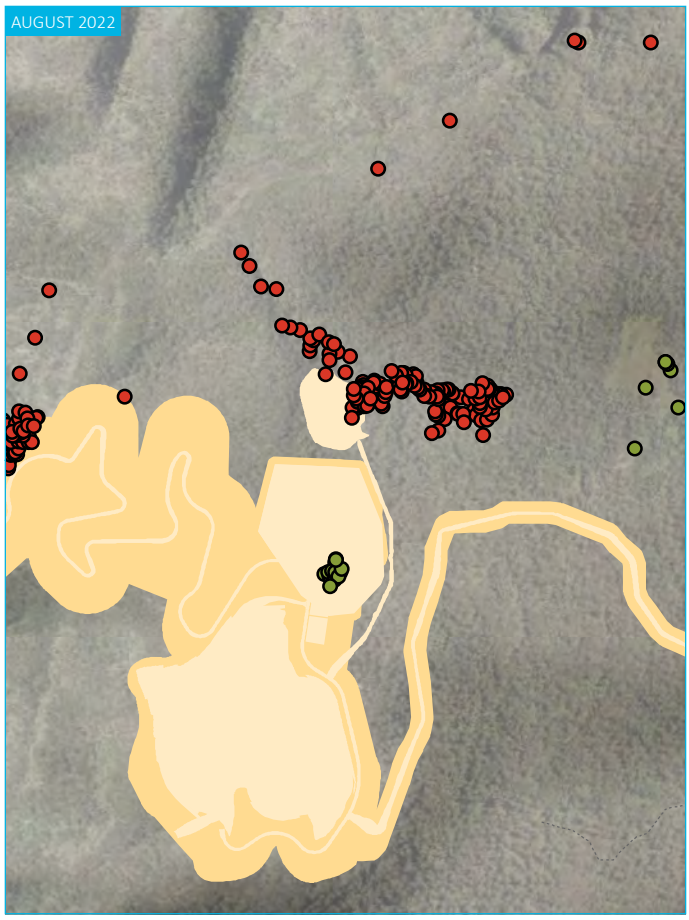
Table 8.8 Examples of avoidance measures through the design process

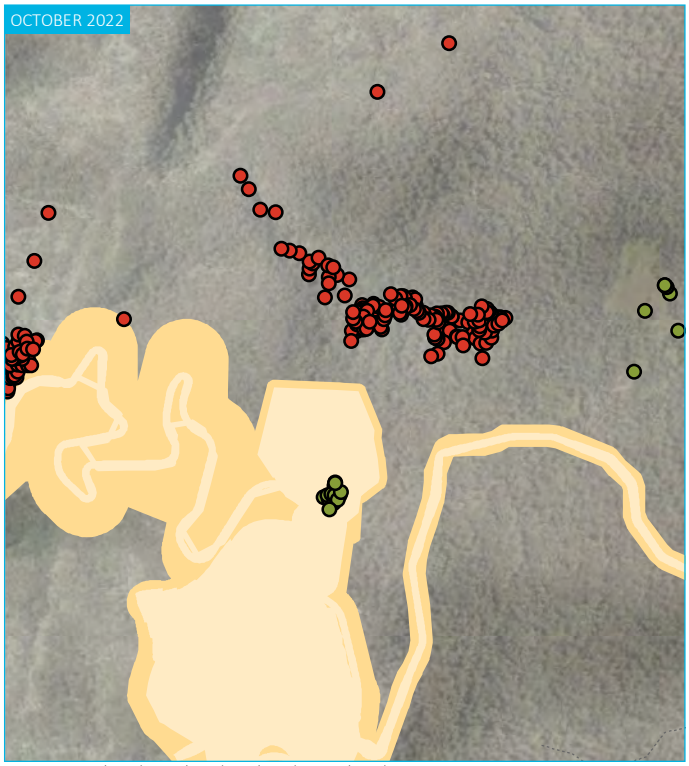
Impacted species	Avoidance measures
Flora	
Grevillea guthrieana	The following changes in disturbance footprint occurred for this species (see Figure 8.2 below): • The access road connecting the lower reservoir to the upper reservoir was realigned to avoid the largest population of this species recorded within the Project area. The design modification resulted in the retention of approximately 523 plants where 197 plants have been excluded from the construction envelope. • Transmission line towers/poles were located to avoid this species along the transmission line avoiding 98 plants.
Wandering Pepper Cress	The following changes in disturbance footprint occurred for this species (see Figure 8.3 below): • The disturbance footprint was moved outside of the floodplain area where this species was recorded to occur or identified as having habitat that supports this species where possible. This design modification will result in retention of over 384 plants.
Pultenaea rubescens	The following changes in disturbance footprint occurred for this species (see Figure 8.4 below): • Spoil locations and the emergency access road in the upper reservoir were modified to avoid impacts to *Pultenaea rubescens* following targeted surveys. This design modification will result in avoidance of removal of approximately 143 plants, including a 30 m buffer of habitat surrounding the 143 plants, avoiding direct impacts to all individuals and microhabitat recorded within the construction envelope. • Shading impacts as a result of the location and height of the soil pile are shown in Figure 8.4.
Scrub Turpentine	The following changes in disturbance footprint occurred for this species (see Figure 8.5 below): • Clearance for the transmission line was altered to avoid direct impacts to approximately 13 plants, avoiding direct impacts to all individuals recorded within the construction envelope.
Cryptic Forest Twiner	The following changes in disturbance footprint occurred for this species (see Figure 8.6 below): • Access/haul road at the upper reservoir was relocated to avoid impacts to four plants that were recorded in the construction envelope, avoiding direct impacts to all individuals recorded within the construction envelope.

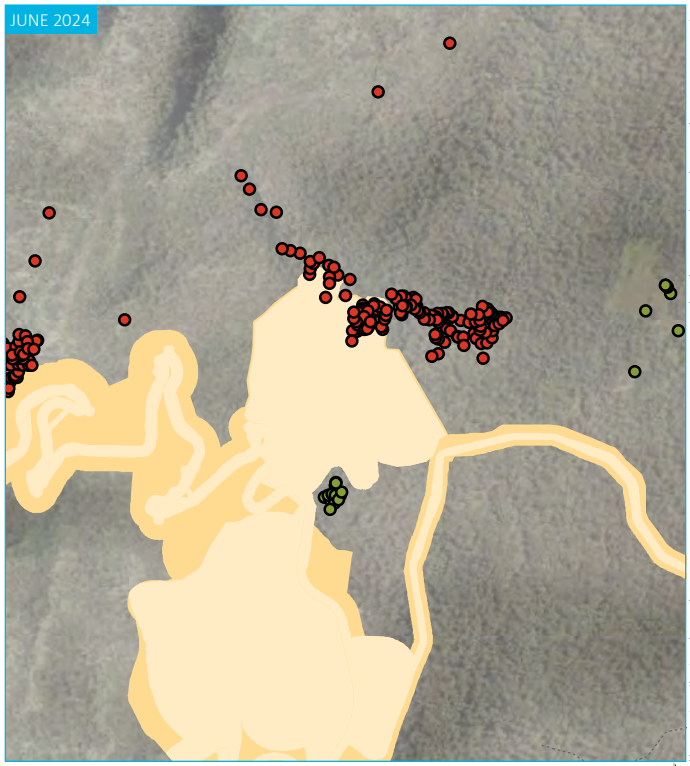
Impacted species	Avoidance measures
Fauna	
Brush-tailed Rock-wallaby	The following changes in disturbance footprint occurred for this species (see Figure 8.7 below): • The access road proposed to connect the lower reservoir to the upper reservoir was redesigned early in the Project's development when the presence of the Brush-tailed Rock-wallaby was confirmed within the Project area. Initial avoidance included use of LiDAR data to identify areas of habitat, such as cliff lines, rocky escarpments, and features that could support refuge areas for Brush-tailed Rock-wallabies, to avoid impacts to these areas as much as possible. Targeted surveys identified areas of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat within the project area. This process identified that the original concept design of the road, which was located further north, would directly impact on substantial areas of areas of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat. This change avoided 1.1 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat. • Further measures were undertaken to minimise impacts on actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat during the response to submission stage. The access road between the lower and upper reservoirs was redesigned. This removed impacts to an additional 0.002 ha actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat where a colony containing a minimal number of 11 was recorded within the project area. While this could not be completely avoided due to the large area of suitable habitat that separates the two reservoirs, impacts to this habitat was reduced as much as possible to incorporate the road design. • The northern-most upper spoil emplacement area, which was considered in the August 2022 design, would have impacted on additional foraging habitat for the Brush-tailed Rock Wallaby. The removal of this area has resulted in a reduction in impacts to foraging habitat for the species of 3.0 ha.

These examples of avoidance, and the overall changes to the design, have resulted in avoidance of a wider array of species and native vegetation.









Source: EMM (2024); DFSI (2020); GA (2011); SMEC (2022)

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GDA 1994 MGA Zone 56

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KEY

Project area

Disturbance footprint

Construction envelope

Threatened species sighting

Pultenaea rubescens

Guthrie's Grevillea

Existing environment

Macleay River

Kempsey-Armidale Road

Vehicular track

Existing transmission line

Design iterations of Spoil Emplacement

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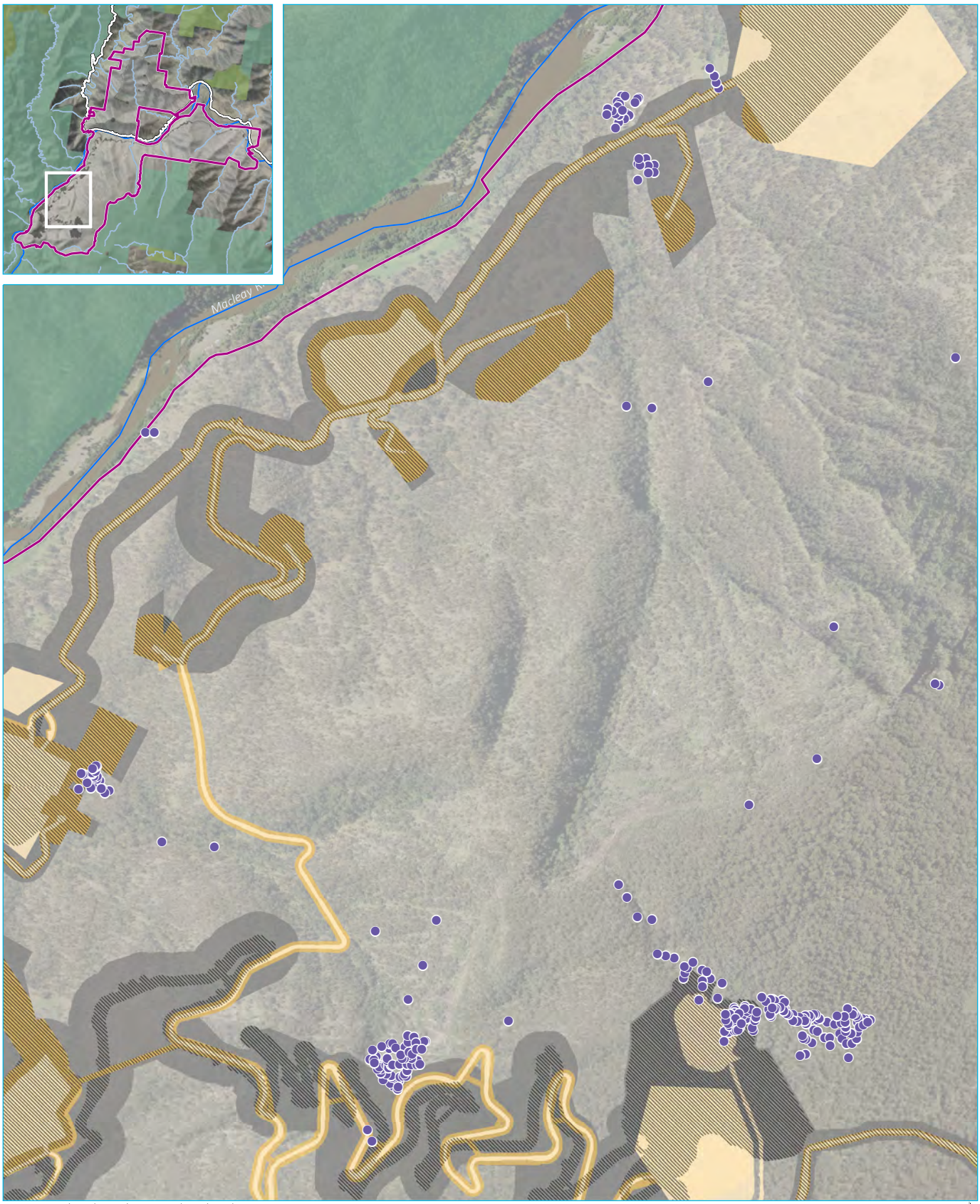
Figure 8.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 250 500 m

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KEY

- Project area
- Current disturbance footprint
- Design disturbance (Nov 2020)
- Design disturbance (Aug 2022)
- Construction envelope
- Guthrie's Grevillea sighting

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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Avoidance in design example: Guthrie's Grevillea

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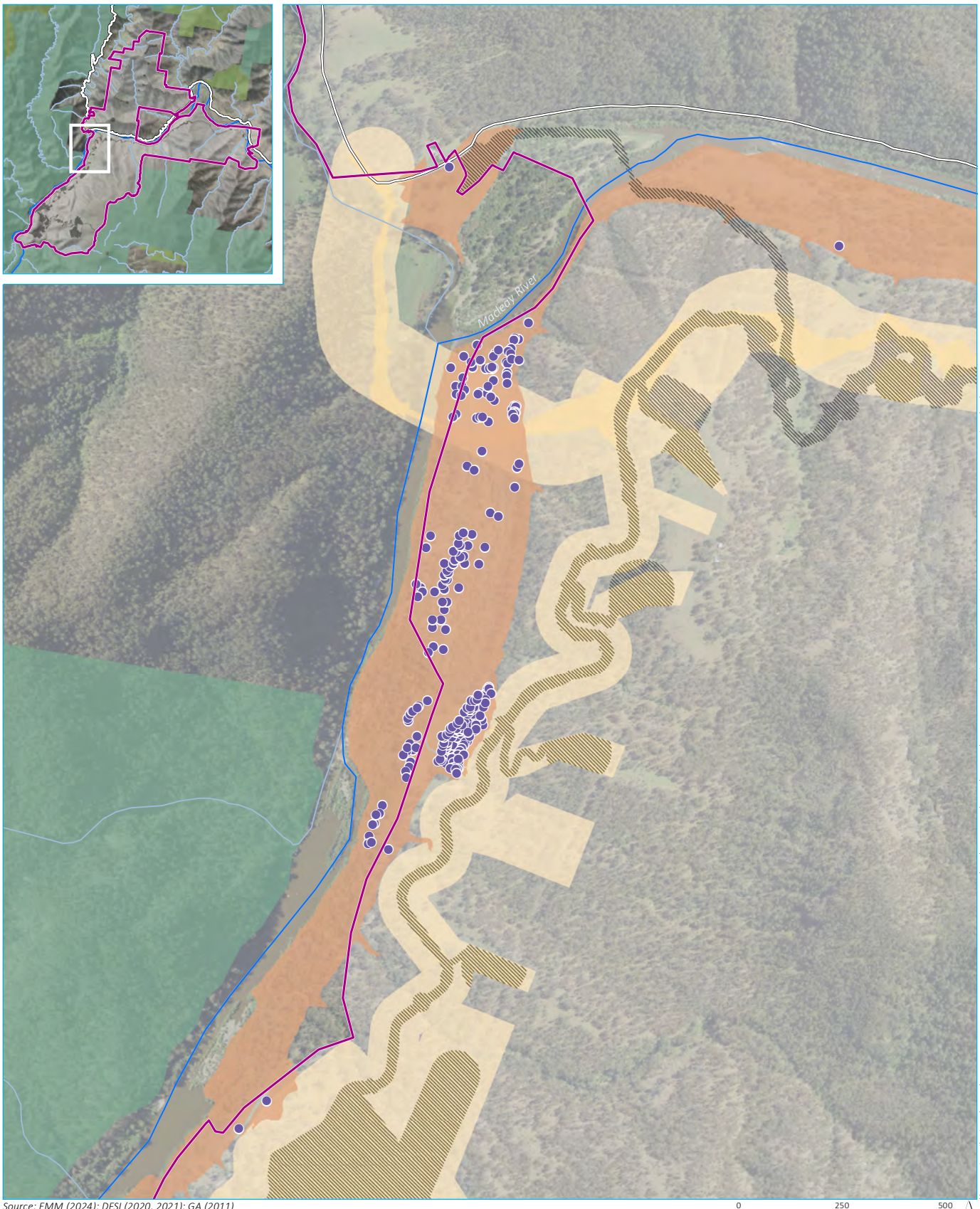
Figure 8.2

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Current disturbance footprint
- Design disturbance (Aug 2022)
- Design disturbance (Nov 2020)
- Wandering Pepper Cress sighting
- Wandering Pepper Cress habitat

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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Avoidance in design example: Wandering Pepper Cress

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Biodiversity development assessment report
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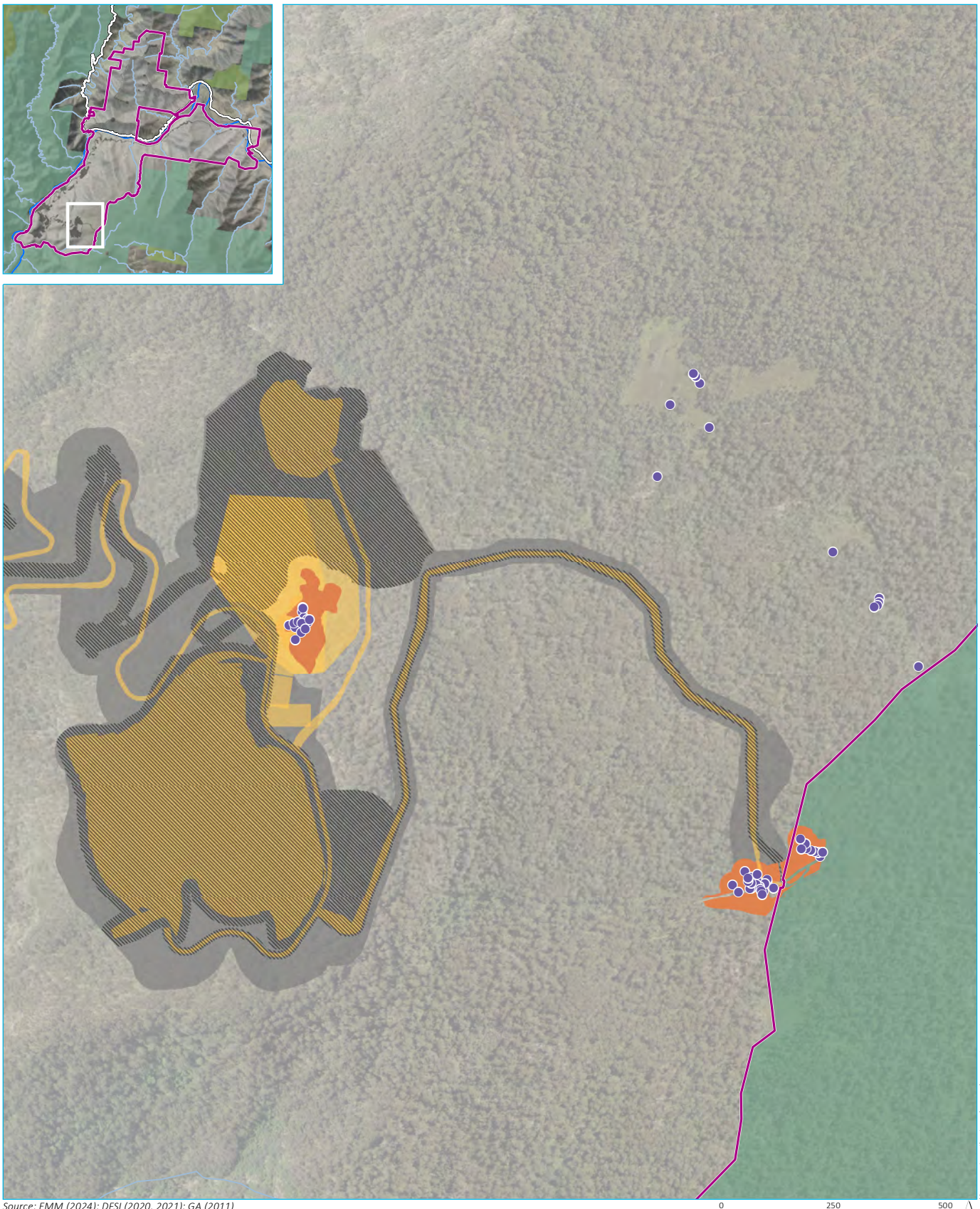
Figure 8.3

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Current disturbance footprint
- Design disturbance (Aug 2022)
- *Pultenaea rubescens*
- *Pultenaea rubescens* species polygon

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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Additional avoidance in design measures for *Pultanaea rubescens*

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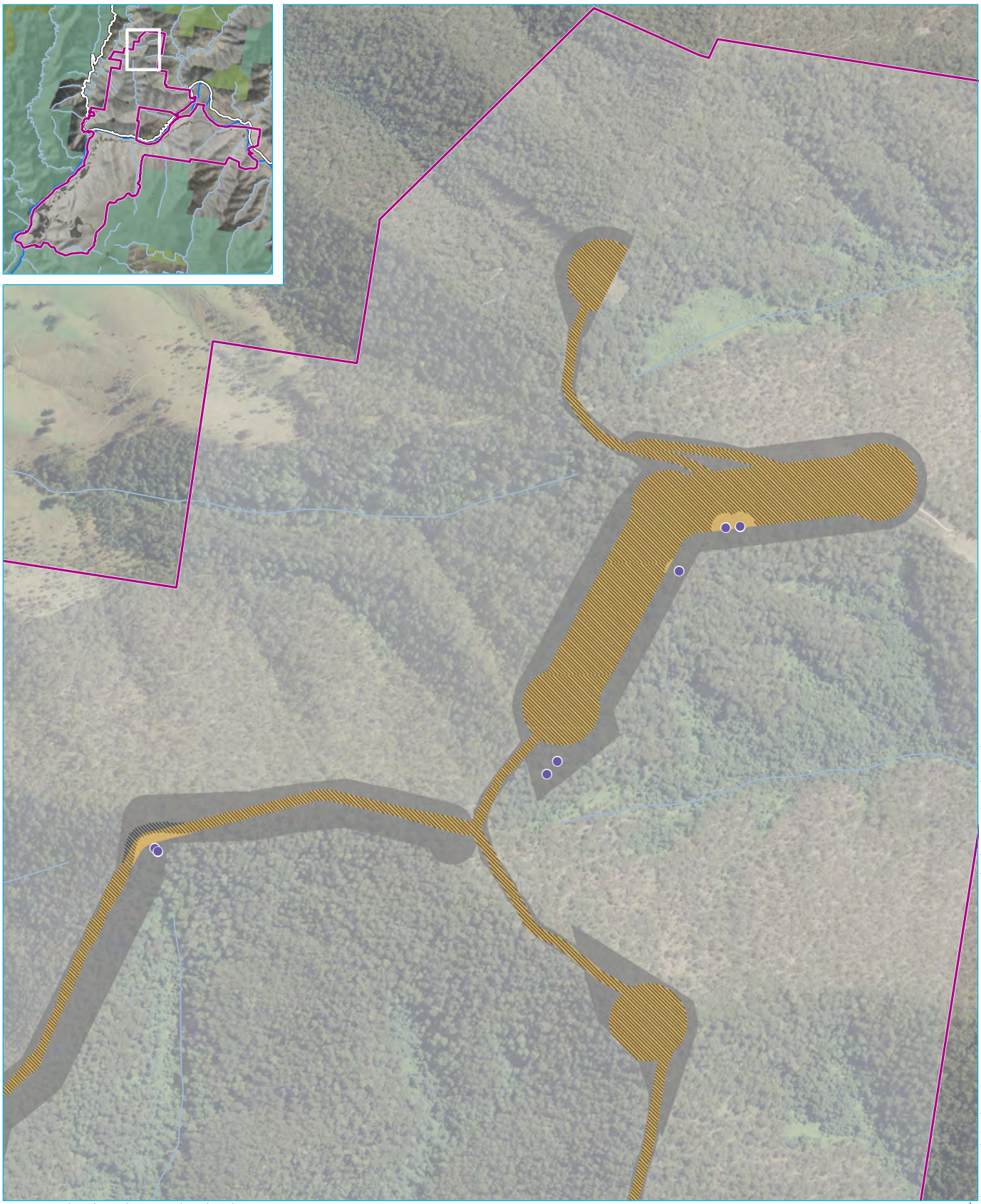
Figure 8.4

EMM creating opportunities



Source: EMM (2022); DFSI (2020, 2021); GA (2011)

0 250 500 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Current disturbance footprint
- Design disturbance (Oct 2020)
- Scrub Turpentine sighting

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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Avoidance in design example: Scrub Turpentine

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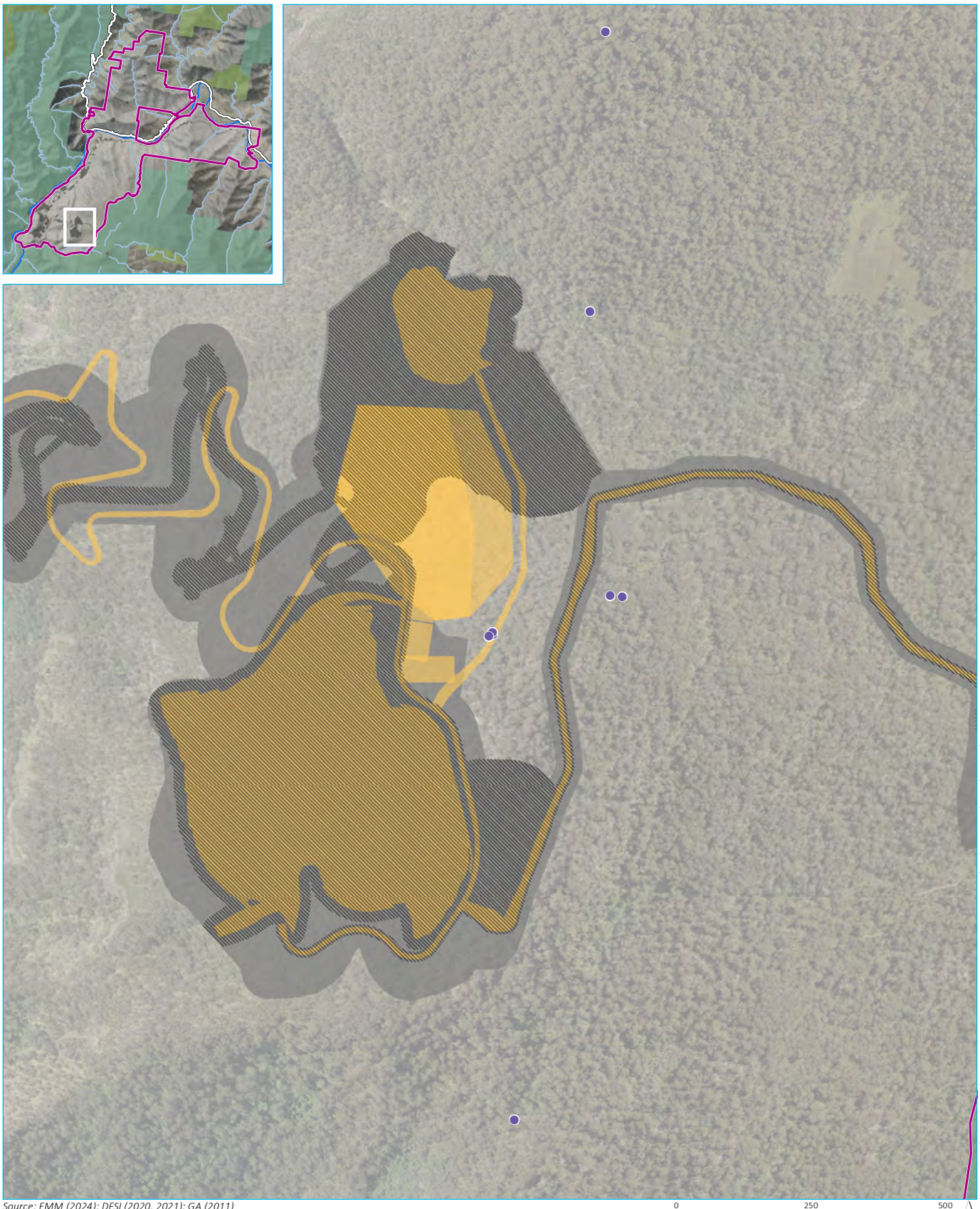
Figure 8.5

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

0 250 500 m

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Construction envelope
- Current disturbance footprint
- Design disturbance (Aug 2022)
- Cryptic Forest Twiner sighting

Existing environment

- Macleay River
- Named watercourse
- Major road
- NPWS reserve
- State forest

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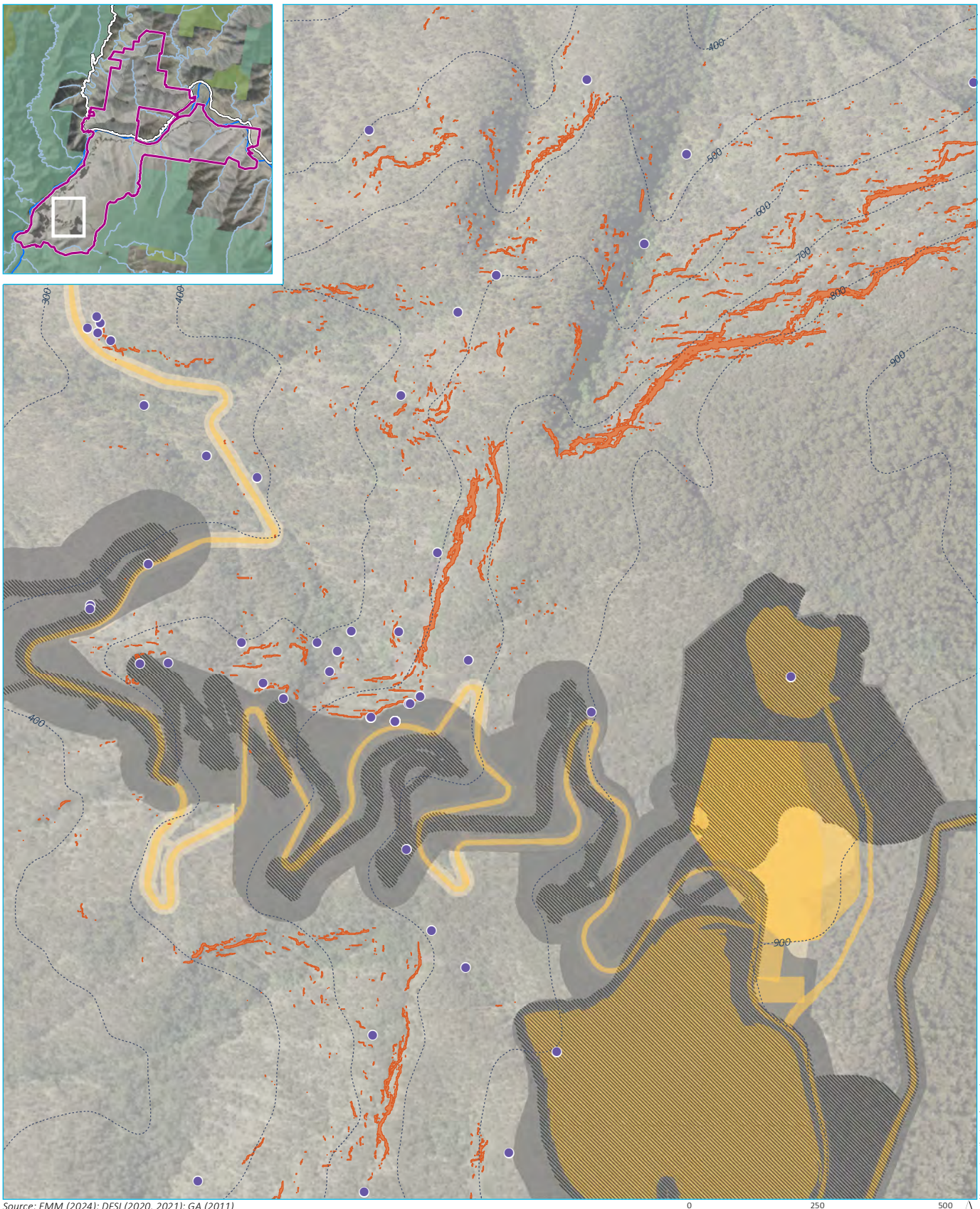
Avoidance in design example: Cryptic Forest Twiner

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 8.6

EMM creating opportunities



Source: EMM (2024); DFSI (2020, 2021); GA (2011)

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Construction envelope
- Current disturbance footprint
- Design disturbance (Nov 2020)
- Design disturbance (Aug 2022)
- Brush-tailed Rock-wallaby sighting
- Actual brush-tailed rock-wallaby denning and refuge (critical) habitat

Existing environment

- Macleay River
- Named watercourse
- Major road
- Contours (100 m)
- NPWS reserve
- State forest

Additional avoidance in design measures for Brush-tailed Rock-wallaby

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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Figure 8.7

EMM creating opportunities

8.3.2 Minimisation

All works will be undertaken in accordance with general mitigation measures to be identified in the construction environment management plan (CEMP). Prior to construction, a biodiversity management plan, forming part of the construction environmental management plan, would be prepared that would include the construction management measures proposed. Key minimisation and mitigation measures include:

- retention of vegetation and habitat
- minimising injury of native animals
- weed and pathogen management
- pest and predator monitoring program
- native vegetation restoration
- changes in fire regime.

These measures are described in detail below.

i Retention of vegetation and habitat

Site preparation works will require clearing of native vegetation and habitat for native animals. These works have the potential to cause inadvertent impacts on retained vegetation and habitat in the absence of appropriate controls. To minimise impacts on vegetation and prevent inadvertent impacts on retained vegetation and habitat the following controls will be implemented:

- Native vegetation and fauna habitat will be retained, wherever possible, with clearing minimised to the extent required to construct and operate the Project.
- The removal of large trees (>0.5 m diameter at breast height (dbh)), would be avoided, wherever practicable, by designing the precise location of access tracks and excavation areas with consideration of the 'structural root zone' of trees as described in the relevant Standards Australia, Protection of trees on development sites, Standards Australia, Sydney (AS, 2009). The precise locations of the trunks of large trees to be removed and retained would be identified by land survey and included on design plans to facilitate avoidance.
- Exclusion zones around all areas of retained vegetation and fauna habitat will be set up where practicable. These areas will be fenced using appropriate fencing materials and designated and signed as 'No-go Zones' or 'Environmentally Sensitive Areas'.
- Where feasible and required to protect significant vegetation, tree protection zones (TPZs) will be set up around all trees retained within and immediately adjacent to the disturbance footprint.
- When accessing construction sites, contractors would use only designated routes on existing tracks or through non-native vegetation.
- No materials, spoil or machinery should be stored or parked within the drip-line of any trees to be retained.

ii Minimising injury of native animals

The potential for increased traffic during construction to result in increased mortality of native animals should be minimised, where feasible, by the implementation of construction traffic driving rules in high-risk sections of road at night. Relevant mitigation measures are included in the Traffic Impact Assessment (EMM, 2022e). These mitigation measures to address impacts from vehicle collisions have proven to be successful for Snowy 2.0, year three of ongoing monitoring. No fauna mortality collisions have been recorded as part of that project implementing these measures.

Minimising collision and electrocution hazards to animals will be considered in the design of the overhead powerlines, including the spacing and configuration of conductors and use of transmission line markers (bird flappers) or diverters to assist in birds being able to avoid impacts.

With the proposed design mitigation, it is anticipated that the new overhead powerlines are unlikely to result in a significant increased hazard to local wildlife or to significantly affect the populations of any animal species.

The CEMP will include measures to manage potential impacts of construction activities during non-standard work hours.

Clearing of native vegetation and fauna habitat have potential to harm native fauna species. To minimise inadvertent injury of animals a number of controls, described below, will be implemented.

Prior to vegetation clearing, pre-clearance surveys will be undertaken by appropriately qualified ecologists. Pre-clearing inspections will follow a two-phase process, as outlined below:

- Phase 1 survey may be taken as close as possible to Phase 2 clearing or immediately beforehand and will include:
    - a visual check for the evidence of presence of threatened species and, if practicable, capture and relocation of any animals found
    - flagging of key habitat features outside the disturbance footprint, including (but not limited to) nests, hollow bearing trees, surface rocks and large logs
    - identification of nearby habitat suitable for the release of any native animals that may be encountered during clearing works
    - contacting a wildlife carer or veterinarian to inform them of vegetation clearing works upcoming.
- Phase 2 survey should be undertaken immediately prior to Phase 2 clearing and will include:
    - searching of accessible habitat features (e.g. logs, rocks etc) for the presence of animals and capture of animals for relocation to previously identify release sites
    - a final check for nests (if more than two weeks after Stage 1 survey).

Where practicable, removal of hollow bearing trees would be undertaken in spring (September to November), and outside the main breeding period for hollow-dependent fauna likely to occupy the disturbance footprint, and when bat species are likely to be active and able to flee (i.e. not in torpor). If hollow-bearing trees are to be removed prior to September and after November, monitoring of breeding activity would be carried out by an ecologist/s approximately one week prior to the proposed tree removal as a part of pre-clearing surveys. If nesting activity is recorded, additional mitigation measures, such as short-term delays in the removal of trees or careful removal of nestlings for rearing by wildlife carers, would be recommended, as necessary.

Vegetation clearing works are to follow a two-phase process, as outlined below:

- Phase 1 will include the removal of all non-habitat vegetation (e.g. shrubs and non-habitat trees). A minimum of 24 hours will be allowed between Phase 1 and Phase 2.
- Phase 2 will include the removal of all habitat features:
    - If safe to do without significant risk to plant operators, hollow bearing trees should be knocked several times with an excavator on the day prior to removal to encourage animals to move away immediately or overnight. Knocking should also be repeated immediately prior to the removal of hollow-bearing trees.
    - Where safe for staff and practicable with regard to tree height and terrain, tree limbs containing hollows would be removed using tree-climbing techniques and/or an elevated work platform to allow hollows to be gently lowered to the ground, thus minimising the risk of injury to fauna.
    - Nests and on-ground logs and rocks will be carefully inspected by an ecologist. Logs and rocks should be carefully rolled and inspection beneath the log undertaken.
    - Provision would be made for any fauna trapped in excavations to escape when works cease for the day. This may be achieved by placing logs in excavations to create escape ramps, or other means identified with the assistance of an ecologist.
    - Any fauna species are to be relocated to habitat identified during the pre-clearing process or, if injured, transported to a veterinarian or wildlife carer.

iii Weed and pathogen management

Indirect impacts could occur due to the introduction and/or spread of weeds, or plant pathogens. There is also potential for the spread of weeds already established in the Project area to occur during construction activities, particularly clearing works, if weeds are not managed appropriately.

To prevent this occurring the following controls will be implemented:

- Baseline surveys of all areas within 50 m of the disturbance footprint to collect data on presence and abundance of weeds, particularly High Threat Weeds, to inform mitigation and management measures.
- A weed control protocol would be developed as part of the biodiversity management plan. This would aim to stop the spread of environmental weeds, particularly those listed as High Threat Weeds.
- Undertaking of weed control in key areas prior to construction works, to minimize the impacts of weeds during construction and to minimise the requirements for disposal and management of weeds on-site.
- Appropriate management and disposal of weed species during clearing works, in accordance with the biodiversity management plan.
- Active and intensive weed control will be undertaken within 50 m of the disturbance footprint, in areas where significant weeds are known to occur to reduce the cover of weeds adjacent to the construction activities, preventing the spread of weeds into other areas.
- Vehicles, machinery and equipment must be clear of soil and plant debris when they arrive at the site and prior to movement between sites to minimise the potential for the introduction of weeds and pathogens.

- Wash-down stations will be constructed at suitable locations near entry points into key Project components, with wash down for weeds as well as pathogens.
- A weed and pathogen monitoring program will be implemented, with a weed control program to be implemented if weeds are identified in the disturbance footprint.
- Revegetation of cleared areas as quickly as possible following construction works in an area.

iv Pest and predator monitoring program

There is potential for increased human activity and creation of roads to result in increased activity of predators, particularly feral Cats and Foxes, which will increase pressure on native fauna. This has the potential to result in significant impacts to some threatened species, particularly species such as the Brush-tailed Rock-wallaby.

To minimise the risk of increased predator activity, the following controls will be implemented across the Project during the construction phase:

- Waste will be stored appropriately in inaccessible bins and disposed off-site. No waste will be left outside in open areas accessible to feral animals.
- A monitoring program will be implemented using remote cameras to monitor feral animal activity. Remote cameras will be placed along sensitive areas, such as the access road between the lower and upper reservoirs to monitor feral animal movements.
- A predator control program will be implemented, in conjunction with DPIE, to control feral animals.

Whilst these controls will be implemented broadly across the Project area, key areas of focus will be where key activity is occurring. It is considered that these controls will avoid and minimise impacts from the Project.

v Native vegetation and habitat restoration

Following completion of construction of the Project, and removal of temporary ancillary and construction work areas, extensive areas of the site will be rehabilitated, with 87 ha of the 367 ha disturbance footprint to be rehabilitated. The following measures will be implemented during rehabilitation to maximise the effectiveness of restoration of native woodland and forest:

- As soon as practicable, and over at least one spring-summer season prior to substantial vegetation clearing, a seed collection specialist should be employed to collect seed on the disturbance footprint for use in revegetation. Collection of seed from large trees is likely to be most practical during vegetation clearing activities.
- Where practicable, large surface rocks should also be moved into rehabilitated areas or retained native vegetation to provide habitat for ground-dwelling animals.
- Where practicable, areas of habitat identified as providing suitable habitat connectivity (eg creeks) include installation of suitable features to encourage safe passage of animals through the project area during construction and operation phases.
- Woody native vegetation removed from the disturbance footprint should be utilised for vegetation and habitat restoration. This should include mulching of shrubs and smaller trees for use in soil amelioration and use of large woody debris (i.e. large sections of tree trucks, root balls and large branches) for habitat enhancement in revegetation areas.

- Rehabilitation and revegetation will be undertaken within temporary infrastructure locations and should include restoration of native species composition consistent with nearby areas of structurally intact native vegetation on similar soil and terrain.
- Restoration should be achieved, at least in part, by spreading topsoil stripped from donor sites in temporary infrastructure locations and from other areas of native vegetation in the operational footprint. Topsoil donor sites should have diverse native groundcover and low weed cover.
- The success of native vegetation restoration should be monitored to determine whether any changes to management such as additional weed management or seedling of planting of native species are required.
- The measures outlined above should be included within a rehabilitation management plan to be prepared post-approval.

vi Changes in fire regime

To manage the bushfire risk for the project, mitigation measures such as use of asset protection zones (ATPs) and building of infrastructure that comply to building construction standards that incorporate bushfire resistance. Infrastructure located at the upper reservoir comprises of the reservoir, spoil pile, access roads and upper site office and communications tower. Only the site office and communications tower will require an APZ. No bushfire fuel management for the area surrounding the Project has been incorporated to manage risk of bushfire events. It is therefore considered that natural bushfire events will still occur within the Carrai. The sighting of the infrastructure such as the reservoir and spoil pile may change the nature on how some fires will spread within the project area and may have an impact on the sub-population of *Pultenaea rubescens* adjacent to the stock pile, however, the Project is not considered to remove the frequency of these fires.

8.3.3 Summary of measures to avoid and minimise impacts

Table 8.9 provides a summary of the measures to minimise impacts arising from the project.

Table 8.9 Summary of impacts and measures to avoid and minimise

Impact	Impact avoidance	Impact minimisation
Removal of native vegetation and threatened species habitat. **Type**: direct impact. **Frequency**: once, during construction. **Intensity**: removal of large areas of habitat for threatened species. **Duration**: initial stages of construction. **Consequence**: permanent removal of native vegetation and threatened species habitat.	• Consideration of biodiversity values during design. • Investigation of alternative locations for access roads during detailed design works to avoid impacts on identified refuge areas known to support Brush-tailed Rock-wallaby colonies. • Siting of the proposed access roads and powerline routes primarily in areas of non-native and highly modified vegetation, where possible. • Siting of stockpiles for excavated materials in low-quality vegetation, where possible. Siting of the construction compound and accommodation camp in partially cleared areas, where possible.	• Detailed design of the Project, seeking further minimisation of impacts to native vegetation. • Minimisation of clearing during construction, wherever possible. • Establishment of exclusion zones around retained vegetation, including fencing and signage. • TPZ and SRZs. • Mulching and stockpiling of cleared native vegetation for use during rehabilitation. • Retention of hollows logs and limbs for placement within retained vegetation and reuse during rehabilitation. • Collection of native seeds for propagation. • Propagation of locally indigenous native species for use in rehabilitation works. Restoration of native species composition consistent with nearby areas of structurally intact native vegetation on similar soil and terrain.

Impact	Impact avoidance	Impact minimisation
Injury of native animals during clearing and construction **Type**: direct impact. **Frequency**: once, during construction. **Intensity**: an unknown proportion of the local populations of some animal species may be injured. **Duration**: initial stages of construction. **Consequence**: reduction in the population of susceptible threatened species.	Not applicable.	• Detailed design of the Project, resulting in further minimisation of impacts to native vegetation and fauna habitat. • Minimisation of clearing during construction, wherever possible. • Pre-clearing surveys conducted prior to clearing, including translocation of less mobile fauna into areas of retained vegetation. Vegetation clearing undertaken in accordance with the two-stage process.
Edge effects **Type**: indirect impact. **Frequency**: once, during construction and rehabilitation. **Intensity:** unknown. **Duration**: ongoing through construction phase. **Consequence**: potential to impact on threatened species habitat, resulting in decline in habitat quality due to introduction or spread of weeds and pathogens.	Not applicable.	• Weed control prior to construction works being undertaken, where possible. • Appropriate disposal and management of weeds during clearing works. • Construction of wash-down stations at a suitable location. • Re-vegetation of cleared areas as quickly as possible following construction. • Vehicles, machinery and equipment to be clear of soil and plant debris when they arrive on the disturbance footprint and prior to movement between sites to minimise the potential for the introduction of weeds and pathogens. Design and implementation of a weed and pathogen monitoring program.
Disturbance to animals in adjacent habitat **Type:** indirect impact. **Frequency**: once, during construction. **Intensity:** unknown. **Duration:** ongoing during construction. **Consequence**: potential to result in noise impacts to retained vegetation and light spill into adjacent habitat areas, impacting on occupancy for some species.	Not applicable.	• Implementation of construction traffic driving rules in high risk sections of road speed limits and limitation of construction traffic movements at night. • Use of directional lighting to retain lighting within works areas as much as possible.

Impact	Impact avoidance	Impact minimisation
Fragmentation, resulting in reduction in connectivity. **Type:** prescribed impact. **Frequency**: ongoing through construction and operation. **Intensity:** minor reduction in habitat connectivity at local and regional scale. **Duration:** permanent. **Consequence**: minor reduction in potential for dispersal between habitats on opposing sides of the reservoirs.	Not applicable.	• Minimisation of tree clearing during construction of the access road and powerline. • Rehabilitation and revegetation within temporary infrastructure locations. • Design and implementation of a threatened species monitoring program to ensure impacts arising from clearing are within prediction.
Vehicle strikes impacts on animal populations **Type:** prescribed impact. **Frequency**: once, through construction. **Intensity:** minor increase in roadkill rate. **Duration:** temporary, during construction. **Consequence**: minor reduction in populations of susceptible species.	Not applicable.	• Implementation of construction traffic driving rules in high-risk sections of road speed limits and limitation of construction traffic movements at night. • Construction traffic rules at night. • Finding alternatives to fencing to prevent and minimise fauna vehicle strike. • Placement of speed restrictions on key roads to minimise potential for fauna vehicle strike.

Impact	Impact avoidance	Impact minimisation
Increase in predatory and pest species. **Type:** indirect impact. **Frequency:** ongoing during construction and operation. **Intensity:** significant increases in the number of predators and pest species. **Duration:** construction and operation. **Consequence:** increased predation and competition and a consequent reduction in populations.	Not applicable.	• Waste to be stored appropriately in inaccessible bins and disposed off-site. • No waste will be left outside in open areas accessible to feral animals. • Design and implementation of a pest and predator monitoring program to ensure the Project does not result in a significant increase in numbers of pest and predatory species and impacts to threatened species remain within prediction. • Design and implementation of a predator control program will be implemented, in conjunction with DPIE, to control feral animals.
Increase in weeds and pathogens. **Type:** indirect impact. **Frequency:** ongoing during construction and operation. **Intensity:** unknown. **Duration:** ongoing through construction phase. **Consequence:** potential to impact on threatened species habitat, resulting in decline in habitat quality.	Not required	• Undertaking of weed control in key areas prior to construction works, to minimize the impacts of weeds during construction and to minimise the requirements for disposal and management of weeds on-site. • Appropriate management and disposal of weed species during clearing works, in accordance with the biodiversity management plan. • Active and intensive weed control will be undertaken within 50 m of the disturbance footprint, in areas where significant weeds are known to occur to reduce the cover of weeds adjacent to the construction activities, preventing the spread of weeds into other areas. • Wash-down stations will be constructed at a suitable location, with wash down for weeds as well as *P.cimmamomi*. • A weed and pathogen monitoring program will be implemented, with a weed and pathogen control program to be implemented if weeds are identified in the project area. • revegetation of cleared areas as quickly as possible following construction works in an area.

Impact	Impact avoidance	Impact minimisation
Impacts from stormwater and water quality **Type:** indirect impact. **Frequency:** ongoing during construction and operation. **Intensity:** unknown. **Duration:** construction and operation. **Consequence:** Sediment deposition in areas containing threatened species and communities. .	Not applicable	• Design and implementation of a surface water monitoring program to ensure run-off does not impact on sensitive receiving environments. • Design and implementation of a threatened species monitoring program to ensure impacts arising from clearing are within prediction. • Installation of drainage pits, levees and detention basins including water treatment plants. • Management of sedimentation via sediment and erosion control plans for each construction zone. • Natural erosion controls incorporating organic materials, micro water capture and contour shaping. • Diversion of clean water around construction areas, rather than through them. • Stabilisation and rehabilitation of works areas as soon as practicable. • Siting of sediment basins to manage run-off from construction areas and use of captured water for dust suppression. • Landscaping of pervious surfaces using endemic species. • Collection of run-off from roof areas. • Treatment of run-off from camps in a bio-filtration system. • Separation of oil from water. • Treatment of wastewater using membrane filtration prior to disposal into Reservoirs.
Changes in fire regime. **Type:** indirect impact. **Frequency:** ongoing during construction and operation. **Intensity:** unknown. **Duration:** construction and operation. **Consequence:** Changes in fire patterns and intensity.	Not applicable.	• Use of APZ zones to manage fires near infrastructure to avoid impacts to natural fire events from use of fuel load management.

9 Serious and irreversible impacts (SAII)

Section 9.1.2 of the BAM 2020 (DPIE, 2020a) requires additional impact assessment for threatened species that are listed in the TBDC as possibly at risk of SAII and known or likely to occur in the disturbance footprint. Table 9.1 provides an assessment of SAII triggers for species known or predicted to occur in the Project area that are listed as possibly at risk of SAII and whether further assessment is required.

Table 9.1 Threatened species requiring assessment of SAII

Species	SAII Trigger	Reason for inclusion of exclusion from further assessment
Wandering Pepper Cress	Principles 2 and 3 – Species has a very small population size and very limited geographic distribution.	Recorded within the construction envelope. This species is further assessed in Table 9.2 and Table 9.3.
Pultenaea rubescens	Principles 2 and 3 – Species has a very small population size and very limited geographic distribution[3].	An unidentified *Pultenaea* sp., recorded during surveys, has been identified as a new species for the genus. It is proposed to recognise this as a distinct species, *Pultenaea rubescens* (Barrett, in prep 2023). *Pultenaea rubescens* was recorded within the construction envelope. No records of this species have been recorded within the disturbance footprint. This species is now currently known from two populations in north-eastern NSW. The species has a small population size and a limited geographic distribution with a known area of occupancy (AOO) of 12 km^2 (NSW TSSC, 2024). This AOO does not include surveys undertaken in 2023 outside, but in the vicinity, of the Project area which increases the known AOO to 12.36 km^2. As this is a newly discovered species, it is not listed as an SAII species. Taking the precautionary approach, despite no direct impacts and as a similar species *Pultenaea parrisiae* is listed as an SAII, this species has been assessed as an SAII in Table 9.5 and Table 9.6.
Scrub Turpentine	Principle 1 – Species in rapid rate of decline and unlikely to respond to management and is therefore irreplaceable.	Recorded within the Project area. No records within the disturbance footprint. Despite no impacts to this species, a precautionary approach has been undertaken and this species is further assessed in Table 9.8 and Table 9.9.

[3] Assessed based on surveys undertaken and Barrett (in prep 2023).

Species	SAII Trigger	Reason for inclusion of exclusion from further assessment
Little Bent-winged Bat Large Bent-winged bat	Principle 4 – Species or ecological community that is unlikely to respond to management and is therefore irreplaceable.	Potential breeding features could be present within the disturbance footprint, these include caves, or other structures known or suspected to be used by the species, 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 from the scientific literature (OEH, 2018). Maternity sites consist of deep caves with very specific and stable humidity and temperature conditions (Dwyer, P D & Hamilton-Smith, E, 1965). These species were recorded in the disturbance footprint by ultrasonic bat call recording and captured in harp traps. The recorded activity of the species was not consistent with the presence of a large colony of the species on the disturbance footprint. The absence of lactating females caught as part of the bat surveys indicated that no maternity roosts were considered within 1-2 km of the disturbance footprint. These species are not at risk of a SAII as a result of the Project as breeding habitat is unlikely to be affected. These species are excluded from further assessment.
Brush-tailed Rock-wallaby	Principle 4 – Any impacts on rocky habitat used by this species could be considered potentially SAII.	Recorded within the construction envelope. This species is further assessed in Table 9.10 and Table 9.11.

Table 9.2 to Table 9.11 provides SAII assessments for each species identified in Table 9.1 as requiring further assessment.

9.1 Wandering Pepper Cress

Table 9.2 provides an assessment of the current status of the Wandering Pepper Cress.

Table 9.2 Assessment of the current status of Wandering Pepper Cress

Factors contributing to the impact	Project impact on factors
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).	Not required as not considered under Principle 1.
Evidence of small population size (Principle 2)	
Current population size in NSW.	< 250 mature individuals (BCD pers. comm., 1 November 2022, EES BOS Help Desk). This estimate is considered to have a low level of confidence given the current surveys have increased the known population by more than 600%. The species is likely to be much more extensive than previously realised as evidenced by the below: • an individual was recorded by the project botanist at Foster (refer to INaturalist record 26/02/2022 verified by G Phillips (DPE) Facebook post 26/02/2022) • individuals have been recorded in 2020 near Stony Batter Creek Nature Reserve west of Armidale (AoLA) This species has been recorded historically from the Blue Mountains (PlantNet)
Decline in species' population size in 3 years or one generation.	Not provided within the TBDC.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations.	Species is likely to undergo extreme fluctuations (BCD pers. comm., November 2022 EES BOS Help Desk).
Evidence of limited geographic range (Principle 3)	
Extent of occurrence (EOO) (ha).	86 km^2 (Best available estimates (BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Area of occupancy (AOO) (ha).	20 km^2 (Best available estimates BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Number of threat defined locations.	Not provided within the TBDC.
Whether the species' population is likely to undergo extreme fluctuations.	Not provided within the TBDC.

Table 9.3 provides an impact assessment for the Wandering Pepper Cress.

Table 9.3 Impact assessment Wandering Pepper Cress

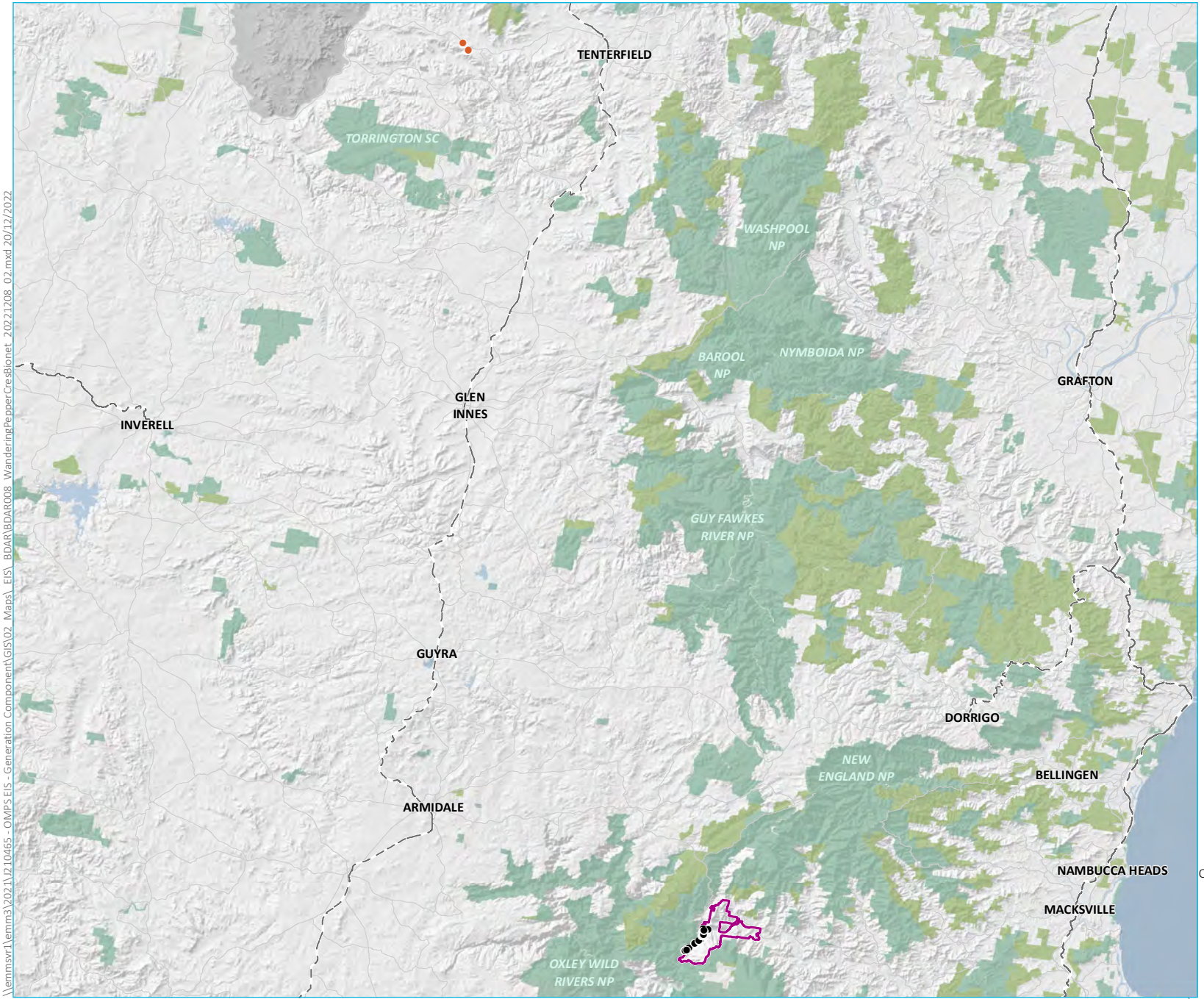
Impact	Data/information
Number of individuals (mature and immature) present in the subpopulation on the subject land (disturbance footprint).	The Project area recorded 1,577 individuals, with the majority located along the Macleay River floodplain on the eastern bank where the river runs south to north. It is considered that all records within the project area are part of the same subpopulation, and likely to exchange genetic material. Two individuals are present within the disturbance footprint; these two are considered outliers from the subpopulation and were recorded in a small wet depression area along a creekline. These two individuals were not re-recorded in additional surveys undertaken in 2023 and 2024.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	Targeted surveys in 2021 recorded a total of 192 mature plants and 123 juveniles across six sites in NSW and Queensland. This species has recently been recorded from 24 populations, mostly in Queensland, with only five known populations in NSW (excluding this site) (BCD pers. comm., email 1 November 2022 EES BOS Help Desk). As of 2014, the largest known population in Queensland contained 142 mature individuals (DoE, 2014b). The TBDC estimates the NSW population to be less than 250 individuals. The plants present within the broader subpopulation in the Project area as a percentage of total NSW population would be: • 1,577 ÷ 250 x 100 = 630.8%. Including this new subpopulation within the estimated NSW population would make the percentage: • 1,577 ÷ (1,577 + 250) x 100 = 86.32% of the total NSW population located within the Project area. Table 9.1 shows known locations in NSW. This would make the sub-population recorded within the Project area the largest population known within NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The Project will impact on two individuals that were initially recorded during the 2021 surveys, but not recorded at this location between December 2023 to March 2024.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	The two plants to be impacted by the proposal as a percentage of NSW population (inclusive of this new subpopulation) would be: • 2 ÷ (1,577 + 250) x 100 = 0.12%. The current surveys have increased the known population by more than 600%.
Area of habitat to be impacted (ha) (for species measured by area only)	The Project will impact on 2.5 ha of habitat for the species.
Area of the species' geographic range to be impacted by the proposal (ha)	This population was recorded outside of this species previously known geographical range. Therefore, the Project area represents the only known occurrence of the species within the IBRA subregion (Macleay Gorges and Macleay Hastings). The area of habitat for this species within the Project area and adjoining flood plan of the Macleay River is 118.14 ha. Area of this species to be impacted within the disturbance footprint is 2.5 ha. Impact as a percentage = 2.5 ha ÷ 118.14 ha x 100 = 2.1% of the local geographic range of this species.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	This population was recorded outside of this species previously known geographical range. The area of the impact as a percentage is: • Impact of AOO = 2.5 ha ÷ 20 km^2 x 100 = 0.125% • Impact of EOO = 2.5 ha ÷ 86 km^2 x 100 = 0.03%.
Individuals impacted	Two individuals that are considered outliers from the subpopulation of 1,577 and were recorded in a small wet depression area along a creekline. These were not re-recorded at this location between December 2023 to March 2024.

Impact	Data/information
Viability of a fragmented population	The construction envelope was moved to avoid the majority of the suitable habitat that was recorded within the Project area to support this species; refer to Section 8.3.1. This species will not become fragmented as part of the proposed works as the disturbance footprint is located upslope of all records of the species and extensive and continuous habitat will be maintained along the Macleay River.
Additional assessment	Due to the impacts on habitat to support this species, additional assessment has been considered in Table 9.4

Table 9.4 Additional impact assessment – Wandering Pepper Cress

Impact	Data/information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The consideration of options and development of the Project was informed by the occurrence of this species within the construction envelope. The disturbance footprint was moved outside of the floodplain area where large numbers of this species was recorded. This design modification will result in retention of over 384 plants (refer to Section 8.3.1 and Table 8.8).
The extent to which the impact exceeds any threshold for the potential entity.	No thresholds are defined within the SAII TBDC assessment for this species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	The Project will have a temporary impact on dispersal habitat where the temporary bridge crossing at Georges Junction is to be situated. This contains an area of habitat that is associated with the same connective vegetation zone. However, it is located in an area where only one individual was recorded during targeted surveys. Within the vegetation zone, this species predominantly occurred in areas of microhabitat that lacks rocky substrates. The location of the temporary bridge is an area that contains rocky substrates in which this species was observed to be largely absent. Therefore, this location is considered to lack suitable microhabitat for this species. The location for the temporary bridge will be rehabilitated on the completion of the works and would not lead to long term impacts on the dispersal of seeds along this area of the Macleay River flood plain. The remaining impacts to the potential dispersal habitat for this species are from small permanent loss of habitat located upslope from the species records. One vegetation zone associated with PCT 842 (DNG Moderate) did not record the presence of this species in surveys undertaken in 2023 and 2024. These records are considered to be associated with the upper slope limit of this species that was associated with the dispersal from high flood events as part of La Nina 2020 – 2023 events. Permanent habitat located within the disturbance footprint will not impact seed dispersal for this species that occurs along the Macleay River floodplain. Due to the small proportion of habitat to be impacted within the local geographic range of this species (1.52%), and the lack of permanent habitat fragmentation expected (disturbance footprint is located upslope of all records of the species), the proposed works are unlikely to impact on the ecology of the subpopulation.
A description of the extent to which the local population will become fragmented.	As described above, a temporary bridge will be located at Georges Junction that will cross the Macleay River. The construction of the bridge will not prevent the dispersal of seed along the flood plain within this vegetation zone. Only one individual was recorded downstream of the proposed temporary bridge. As the bridge will be elevated over a large amount of the flood plain and will not restrict the movement of water during flood events that help this species seed disperse it is unlikely to fragment the larger population that is located further upstream from this crossing. On completion of the construction works, this bridge will be removed. The permanent habitat loss is located upslope from preferred habitat for this species and will not cause fragmentation as part of the Project. The Project is not considered to split the subpopulation into two or more subpopulations as impacts will occur upslope of all records of the species.
The relationship of the local population to other populations.	This species has recently been recorded from 24 populations, mostly in Queensland, with only five known populations in NSW (excluding this site) (BCD pers. comm., email 1 November 2022 EES BOS Help Desk). The nearest specimen population is near Tenterfield approximately 160 km away from the records of the species in the Project area.

Impact	Data/information
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Surveys undertaken for this Project recorded a population of the Wandering Pepper Cress, which was a species that was hitherto unrecorded in the IBRA subregions within the project area. Part of the survey effort included surveys outside of the construction envelope, so that the extent of the population could be more accurately identified, and the potential impacts on this species from the Project better assessed. Through this, more data on the species was captured which contributes to the recovery of the species in the IBRA subregion.



KEY

- Project area
- EMM species sighting
- BIONET species sighting

Existing environment

- Major road
- Rail line
- Named waterbody
- Waterbody
- NPWS reserve
- State forest

Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); DPE (2022)

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Species records of Wandering Pepper Cress in NSW

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 9.1

EMM
creating opportunities

9.2 Pultenaea rubescens

Table 9.5 provides an assessment of the current status of *Pultenaea rubescens*.

Table 9.5 SAII assessment of impact on *Pultenaea rubescens*

Factors contributing to the impact	Project impact on factors
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).	Not required as not considered under Principle 1.
Evidence of small population size (Principle 2)	
Current population size in NSW.	Surveys undertaken as part of the Project recorded 595 individuals. Another survey undertaken in Werrikimbe National Park estimated at least 200 individuals (NSW TSSC, 2024). The total known population is therefore conservatively estimated at 795 individuals.
Decline in species' population size in 3 years or one generation.	Unknown
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations.	Unknown
Evidence of limited geographic range (Principle 3)	
Extent of occurrence (EOO) (ha).	41 km^2 (NSW TSSC, 2024)
Area of occupancy (AOO) (ha).	12.36 km^2 (NSW TSSC, 2024) (This AOO does not include surveys undertaken in 2023 by EMM within the National Parks estate which increases the known AOO to 12.36 km^2.)
Number of threat defined locations.	Unknown
Whether the species' population is likely to undergo extreme fluctuations.	Unknown

Table 9.6 provides an impact assessment for *Pultenaea rubescens*.

Table 9.6 Impact assessment *Pultenaea rubescens*

Impact	Data/information
Number of individuals (mature and immature) present in the subpopulation on the subject land (disturbance footprint).	A total of 384 individuals were recorded within the Project area, all located within the Carrai Plateau IBRA subregion. Additional individuals were recorded in the vicinity of the site in Carrai National Park (29 individuals) and Carrai State conservation area (182 individuals). As well as these records, an estimated population of at least 200 individuals has been recorded in Werrikimbe National Park (NSW TSSC, 2024). It is considered that all records within the Project area are part of the same subpopulation, and likely to exchange genetic material. Plants in Werrikimbe National Park are likely part of a separate subpopulation. No individuals occur within 30 m of the disturbance footprint for the spoil pile and have been removed from any potential impacts from design changes within the construction envelope. No habitat that supports this species occurs within the development footprint.

Impact	Data/information
Number of individuals (mature and immature) present as a percentage of total NSW population (%).	It is considered that this is a new species, with the current population number known only from what was recorded as part of the Project's targeted threatened flora surveys, and the records in Werrikimbe National Park. Surveys undertaken as part of the Project recorded 595 individuals, 384 of which are within the Project area. Another survey undertaken in Werrikimbe National Park estimated at least 200 individuals (NSW TSSC, 2024). The total known population is therefore conservatively estimated at 795 individuals. The plants present within the broader subpopulation in the project area are: • 384 ÷ 795 x 100 = 48.3%.
Number of individuals (mature and immature) to be impacted by the proposal.	The Project will not impact on any individuals, or microhabitat for this species. No direct impacts will occur on the known occurrences of this species as microhabitat within the construction envelope has been excluded.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%).	0%
Area of habitat to be impacted (ha) (for species measured by area only).	0 ha The project will not impact on suitable habitat that supports this species. No direct impacts will occur on the known occurrences of this species as microhabitat within the construction envelope has been excluded.
Area of the species' geographic range to be impacted by the proposal (ha).	The project will not impact on suitable habitat that supports this species.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%).	The area of the impact as a percentage is: 0%.
Individuals impacted.	0
Viability of a fragmented population.	The subpopulation at the eastern end of the disturbance footprint has an existing track running through the middle of it. While the details on the ecology of this species are not known, seeds in *Pultenaea* are dispersed locally by ants (NSW TSSC, 2024). The road is not considered to fragment this species as it is unlikely to interfere with the dispersal mechanism of this species within the subpopulation. The same is said for the subpopulation adjacent to the spoil pile. While this subpopulation is near the development footprint, a large part of the development is the access road, which is considered unlikely to affect the genetic flow of this subpopulation. The Project is located on the western edge of this species known distribution in the Carrai. Therefore, the Project is considered unlikely to fragment the population.
Additional assessment.	Due to the unknown status of this species, additional assessment has been considered in Table 9.7.

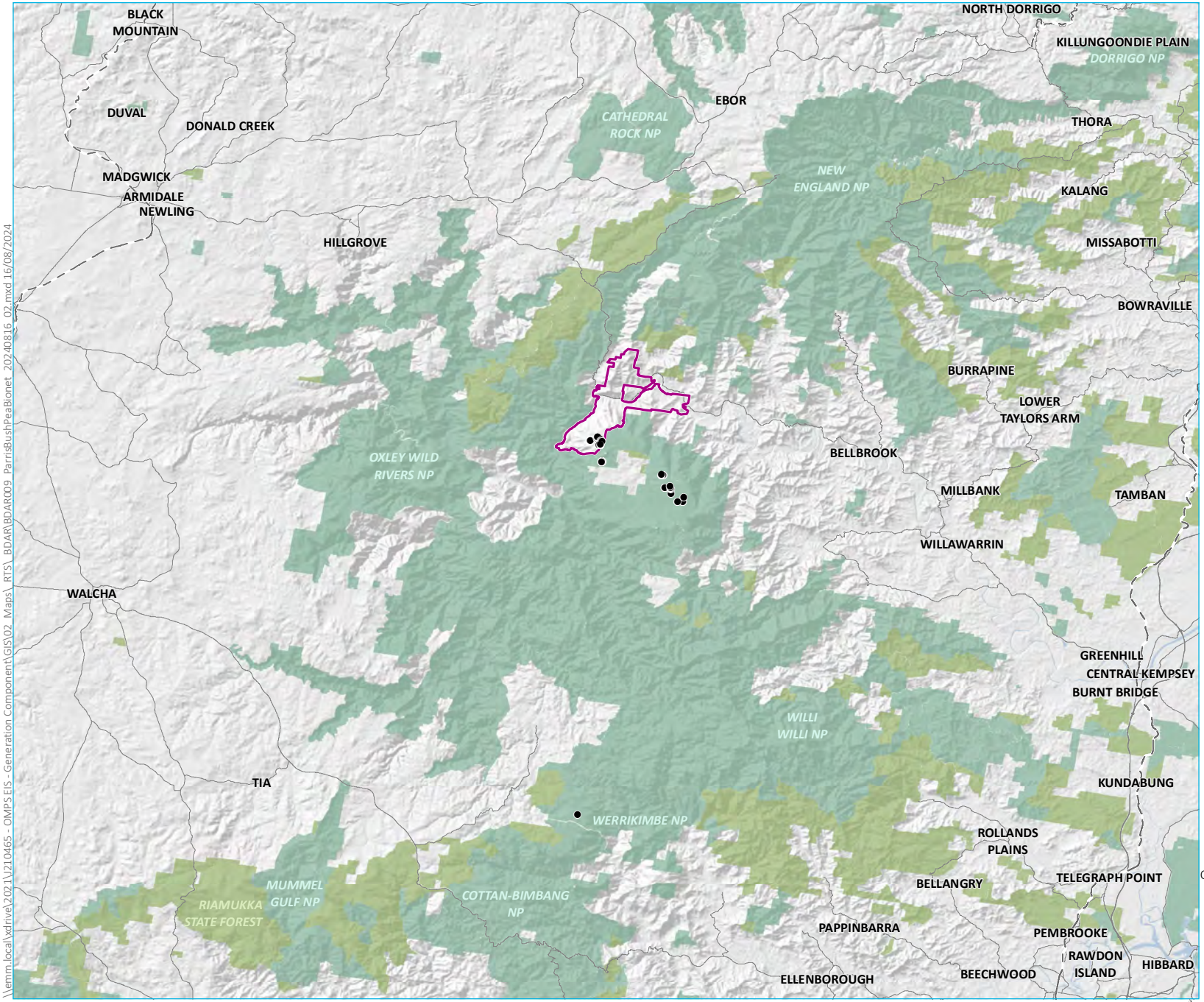
Table 9.7 Additional impact assessment – *Pultenaea rubescens*

Impact	Data/information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The consideration of options and development of the Project was informed by the occurrence of this species within the construction envelope. Spoil locations and the emergency access road in the upper reservoir were modified to avoid impacts to *Pultenaea rubescens* following targeted surveys once this species was identified as potentially being classified as a new species. This design modification will result in avoidance of removal of approximately 143 plants, avoiding direct impacts to all individuals recorded within the construction envelope (refer to Section 8.3.1 and Table 8.8).
The extent to which the impact exceeds any threshold for the potential entity.	No thresholds are defined within the SAII TBDC assessment for this species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	The Project may have the potential to indirectly impact on fire regimes on the Carrai, which would have implications for *Pultenaea rubescens*. While the details on the ecology of *Pultenaea rubescens* are not known, several of its close relatives (*P. parrisiae, P. palacea*) are obligate seeders and are killed by fire (Ferrer-Paris JR and Keith DA, 2022). Obligate seeders are completely dependent on seed for regeneration. Assuming that *Pultenaea rubescens* is an obligate seeder, this means that *Pultenaea rubescens* requires a period of time without fire, so that it can replenish its soil seed bank, so that declines do not occur. As well as this species likely being susceptible to too frequent fire, it is likely susceptible to less frequent fire, as the germination of *Pultenaea* is often triggered by soil heating in the passage of a fire (Auld TD and O'Connell MA, 1991). To manage the bushfire risk for the project, mitigation measures such as use of asset protection zones (ATPs) and building of infrastructure that comply to building construction standards that incorporate bushfire resistance. Infrastructure located at the upper reservoir comprises of the reservoir, spoil pile, access roads and upper site office and communications tower. Only the site office and communications tower will require an APZ. No bushfire fuel management for the area surrounding the Project has been incorporated to manage risk of bushfire events. It is therefore considered that natural bushfire events will still occur within the Carrai where this species occurs. The sighting of the infrastructure such as the reservoir and spoil pile may change the nature on how some fires will spread within the project area and may have an impact on the sub-population adjacent to the stock pile, however, the Project is not considered to remove the frequency of these fires.
A description of the extent to which the local population will become fragmented.	While the details on the ecology of this species are not known, seeds in *Pultenaea* are dispersed locally by ants (NSW TSSC, 2024). The creation of access roads are not considered to fragment this species as it is unlikely to interfere with the dispersal mechanism of this species within the subpopulation. The subpopulation adjacent to the spoil pile is located at the western known distribution of this species. The reservoir is located further west of suitable habitat and therefore not considered to fragment habitat. The spoil pile and access roads still allow pathways for this species dispersal eastwards where habitat occurs. Therefore, the Project is considered unlikely to fragment the population.
The relationship of the local population to other populations.	A population of the species is located in Werrikimbe National Park approximately 47 km south of the records of the species in the Project area.

Impact	Data/information
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Further surveys were undertaken within the Carrai Plateau to collect additional material and gain an understanding of the distribution and microhabitat requirements for the species. This data would help contribute to a better understanding about this species and what may be required for its recovery. **Construction envelope species data:** 138 plants were recorded during 2021 surveys undertaken to assess the construction envelope area, with 3.44 ha of habitat located. **Additional 2022 surveys** Approximately 371 plants were recorded in November 2022 within the Project area, with 10.52 ha of habitat. Many of the observed plants had finished flowering and some plants were observed to be senescing at the time. **Additional 2023 surveys** Approximately 86 plants were recorded in November 2023 outside of the Project area within the Carrai State Conservation Area and Carrai National Park with 36 ha of known occupied habitat. Many of the observed plants had finished flowering and some plants were observed to be senescing at the time. **Habitat observations** *Pultenaea rubescens* was typically recorded in swamp margins; i.e. the transition zone between nearly perpetually wet sedge-dominated middle of the swamps and the adjacent dry sclerophyll forest. The species appears to be absent, or at least scarce, in areas where the transition between swamp vegetation and dry forest is abrupt and in areas where transitional areas contain a dense layer of taller shrubs. In habitat occupied by the species, the ground layer typically contains a mixture of graminoid plants from the families Cyperaceae (e.g. *Lepidosperma* sp., *Gahnia* sp.) and Restionaceae (e.g. Spreading Rope-rush (*Empodisma minus*)) with a variety of forbs such as *Gonocarpus micranthus*, *Hypericum japonicum* and Mountain Woodruff (*Asperula gunnii*) and low wiry subshrubs including two undescribed species of *Hibbertia*, Clustered Bush-pea (*Pultenaea dentata*) and *Sphaerolobium minus*. A variety of erect shrubs such as *Epacris breviflora*, *Leptospermum* sp., Lemon Bottlebrush (*Callistemon pallidus*), Notched Bush-pea (*Pultenaea retusa*) and a member of the *Prostanthera scutellarioides* species complex are also found in this habitat at low to moderate density. In some areas the species also occurs in moist areas of open eucalypt forest on poorly drained relatively flat areas, and moist areas adjacent to streams. **Detectability** Detection of the species during 2023 surveys was difficult as almost all observed plants had finished flowering, suggesting that the peak flowering period occurred during mid-October or earlier. Lower densities of plants were seen at each data collection point and lower overall plant numbers were recorded in 2023 surveys compared to 2022 surveys despite the 2023 surveys covering a much larger area and detecting many more sites for the species. Possible causes for these lower counts include: • the switch in climate from La Nina to the currently prevailing El Nino conditions • the extra year of post-fire regrowth, noting that the species most closely related to *Pultenaea rubescens* is Parris' Bush-pea (*Pultenaea parrisiae*), a species which grows in similar habitats and is described as a fire ephemeral by NSW Department of Planning and Environment (DPE) in that species' Threatened Biodiversity Data Collection profile. In de Kok, Rogier & West, J. (2004), it is also noted that seedlings of Parris' Bush-pea (*Pultenaea parrisiae*) are abundant after fire. **Observed threats** Threats to the species observed during surveys in NPWS estate included: • Grazing and trampling of swamp vegetation by escaped cattle in areas adjacent to private property with damaged fences. • Extensive damage to swamp vegetation by feral pigs in localised areas, which was particularly prominent in areas also affected by cattle grazing and historical soil disturbance.

Impact	Data/information
	Discussion of species distribution and abundance Based on data collected to date, *Pultenaea rubescens* is likely: • to occur at scattered locations, where suitable habitat occurs (primarily swamp edges) across much of the Carrai Plateau • to occur in groups ranging from a few individuals to larger groups of 50 or more plants. • vary in population between years due to climate variability and time since fire. The accuracy of estimates of the species' distribution and abundance is limited by factors including: • Difficulty of detection of the species, in general and particularly at the time of surveys due to timing and prevailing climatic conditions. The relatively small proportion of potential habitat that was visited (around 15 – 20%). It is estimated that there is 707 ha of potential habitat within the Carrai Plateau IBRA sub region that has not been surveyed to date 4.

[4] This area was worked out using the Freshwater Wetlands Formation areas within the SVTM, within the Carrai Plateau IBRA sub region. Areas that were already checked as part of a survey effort and found not to have any individuals, were not included in this area.



KEY

- Project area
- Pultenaea rubescens species sighting

Existing environment

- Major road
- Rail line
- Waterbody
- NPWS reserve
- State forest

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); DPE (2022)

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Species records of Pultenaea rubescens in NSW

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Figure 9.2

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9.3 Scrub Turpentine

Table 9.8 provides an assessment of the current status of the Scrub Turpentine.

Table 9.8 SAII assessment of impact on Scrub Turpentine

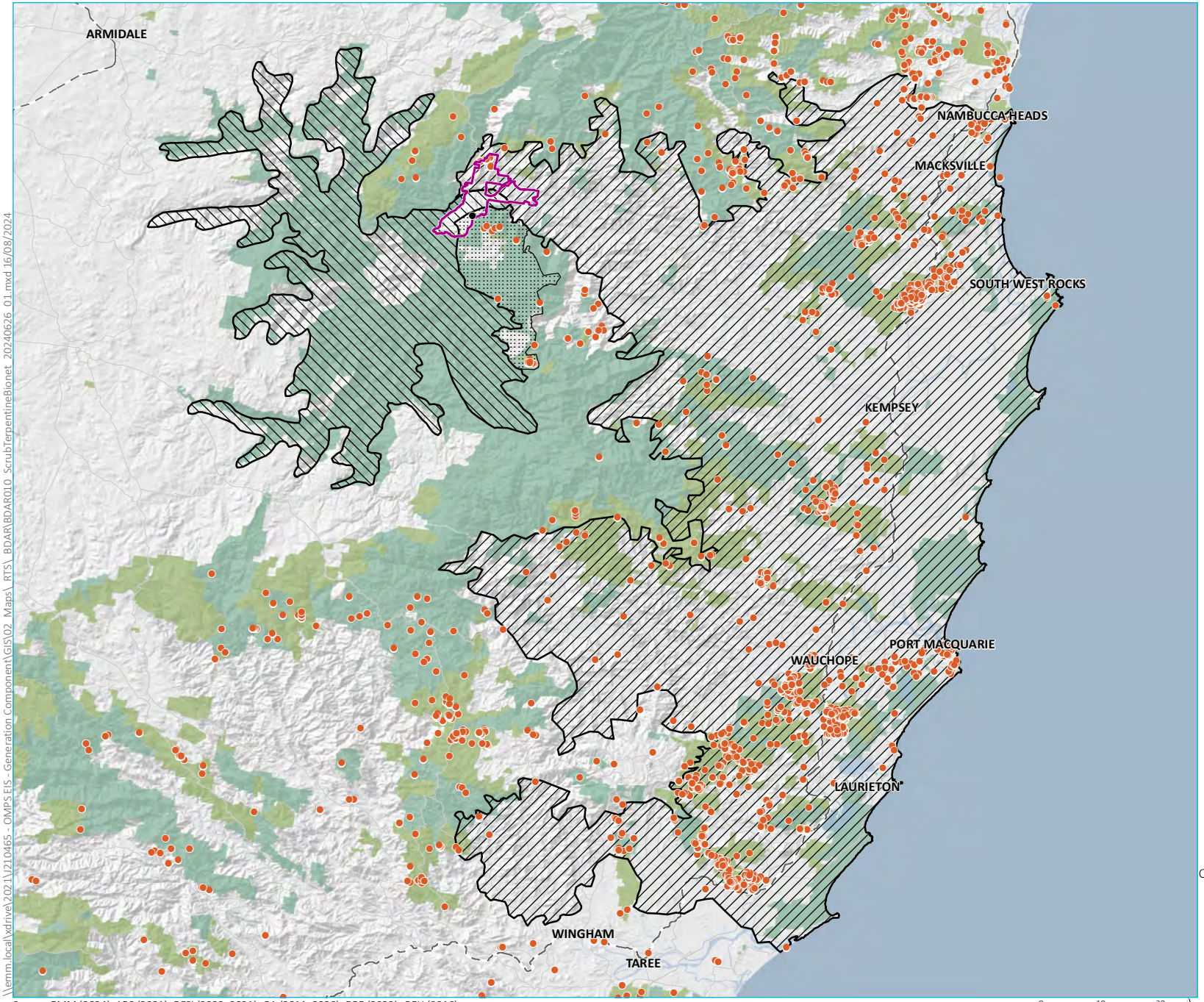
Factors contributing to the impact	Project impact on factors
Evidence of rapid decline (Principle 1)	
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate).	The population size has reduced by >=80% in the past 10 years or three generations (BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Evidence of small population size (Principle 2)	
Current population size in NSW.	Not required as not considered under Principle 2.
Decline in species' population size in 3 years or one generation.	Not required as not considered under Principle 2.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations.	Not required as not considered under Principle 2.
Evidence of limited geographic range (Principle 3)	
Extent of occurrence (EOO) (ha).	3,360 km^2 (BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Area of occupancy (AOO) (ha).	147,340 km^2 (BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Number of threat defined locations.	Threats beyond control for Scrub Turpentine (BCD pers. comm., email 1 November 2022 EES BOS Help Desk).
Whether the species' population is likely to undergo extreme fluctuations	Not provided within the TBDC.

Table 9.9 provides an impact assessment for Scrub Turpentine.

Table 9.9 Impact assessment Scrub Turpentine

Impact	Data/information
Number of individuals (mature and immature) present in the subpopulation on the subject land (disturbance footprint).	Thirteen individuals were recorded within the transmission line survey area within Macleay Hastings IBRA subregion, with an additional 59 individuals observed incidentally within the Project area (Macleay Gorges IBRA subregion) outside of the survey area. Additional surveys were not targeted outside of the construction envelope, so the Project area is considered to support larger numbers than what was recorded in the local area. All individuals were recorded as regrowth after the 2019/2020 bushfires or juvenile individuals. All effected by myrtle rust fungal disease. No individuals occur within the disturbance footprint or construction envelope.
Number of individuals (mature and immature) present as a percentage of total NSW population (%).	The number of distinct populations of Scrub Turpentine is unknown but is expected to be large given the wide distribution of the species. No formal estimate exists of the total pollution of the species however it is likely that that the number of mature individuals may be large (i.e. not <10,000) (TSSC, 2020a). It is unknown what the percentage is within the Project area but assuming >10,000 individuals the 17 records within the Project area represent <1%.

Impact	Data/information
Number of individuals (mature and immature) to be impacted by the proposal.	The Project will not impact on any individuals, or the 30 m buffer surrounding these individuals.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%).	0%
Area of habitat to be impacted (ha) (for species measured by area only).	The records of this species recorded within the construction envelope were buffered by 30 m. The disturbance footprint avoids direct impacts to the 30 m buffered area. The area of this species to be impacted within the disturbance footprint is: 0 ha.
Area of the species' geographic range to be impacted by the proposal (ha).	The records of this species recorded within the construction envelope were not associated with any PCTs on site. Records were buffered by 30 m. The disturbance footprint avoids direct impacts to the 30 m buffered area. The area of this species to be impacted within the disturbance footprint is: 0 ha.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%).	The area of the impact as a percentage is: 0%.
Individuals impacted.	0
Viability of a fragmented population.	The population recorded within the Project area was infected with myrtle rust fungal disease which is already impacting this population. The proposed works, which involves upgrading the existing access track and clearance required for the power easement, is outside of where this species occur. The construction envelope was moved to avoid the majority of the suitable habitat that was recorded within the Project area to support this species, refer to Section 8.3.1. Works are not considered to cause any additional fragmentation of these populations.
Additional assessment.	Based on the Project no having a direct impact on this species, no further SAII assessment is undertaken.



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Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); DPE (2022); OEH (2016)

Species records of Scrub Turpentine in the project IBRA sub-regions (Macleay Gorges, Carrai Plateau and Macleay Hastings)

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Figure 9.3

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9.4 Brush-tailed Rock-wallaby

Table 9.10 provides an assessment of the current status of the Brush-tailed Rock-wallaby.

Table 9.10 SAII assessment of impact on Brush-tailed Rock-wallaby

Factors contributing to the impact	Project impact on factors
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).	Not required as not considered under Principle 1.
Evidence of small population size (Principle 2)	
Current population size in NSW.	>1,000 (BCD pers. comm., September 2022 EES BOS Help Desk).
Decline in species' population size in 3 years or one generation.	Not provided within the TBDC.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations.	Not likely to undergo extreme fluctuations (BCD pers. comm., 7 September 2022 EES BOS Help Desk).
Evidence of limited geographic range (Principle 3)	
Extent of occurrence (EOO) (ha).	172,205 km^2 (BCD pers. comm., email 7 September 2022 EES BOS Help Desk).
Area of occupancy (AOO) (ha).	2,712 km^2 (BCD pers. comm., email 7 September 2022 EES BOS Help Desk).
Number of threat defined locations.	Unknown. Likely to be >10 (BCD pers. comm., email 7 September 2022 EES BOS Help Desk).
Whether the species' population is likely to undergo extreme fluctuations.	Not provided within the TBDC.

Table 9.11 provides an impact assessment for the Brush-tailed Rock-wallaby, including additional information as discussed in Appendix B in (DPIE, 2019).

Table 9.11 Impact assessment- Brush-tailed Rock-wallaby

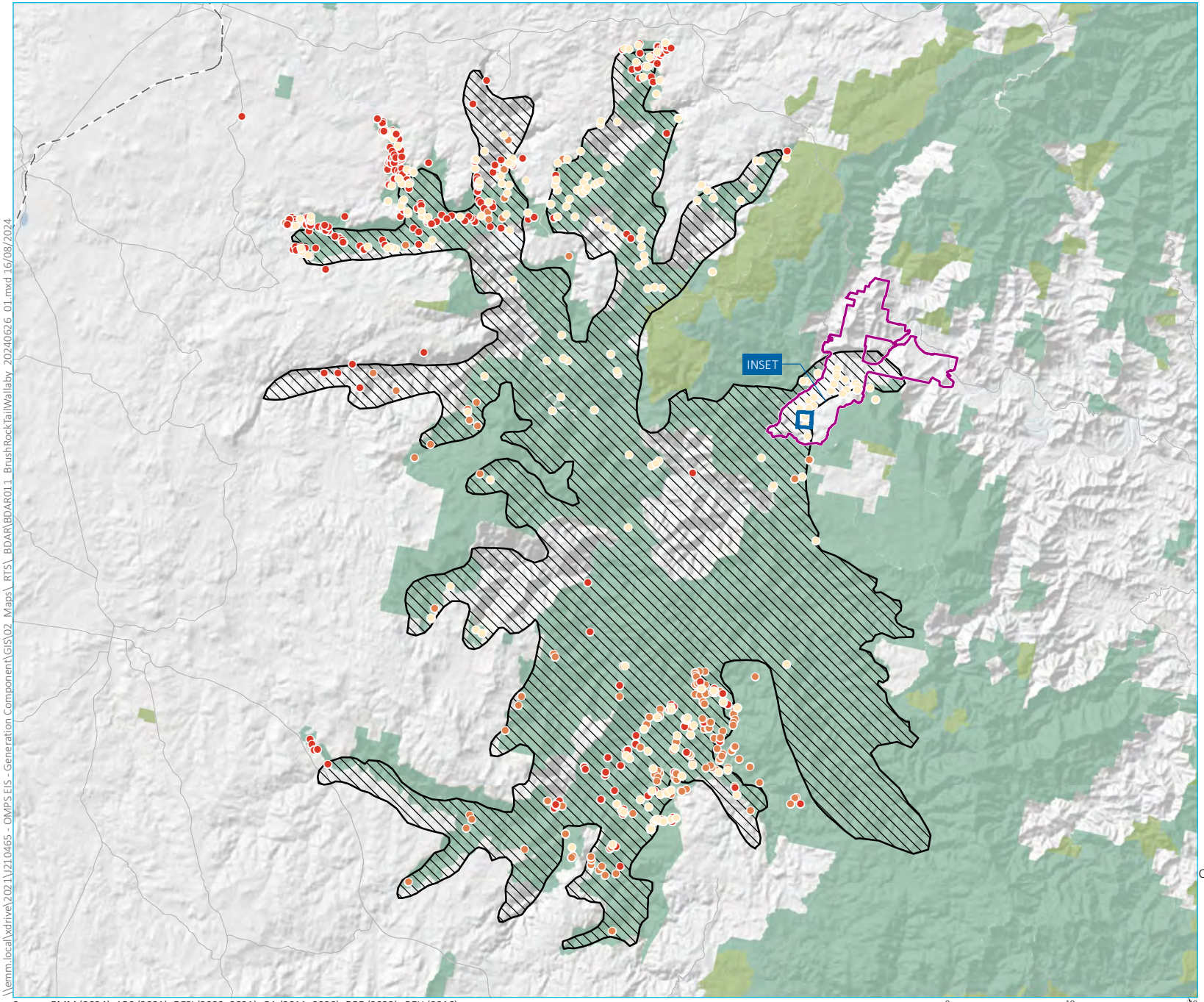
Impact	Data/information
Number of individuals (mature and immature) present in the subpopulation on the subject land (disturbance footprint).	The Brush-tailed Rock-wallaby was recorded in various locations throughout the Project area. The Brush-tailed Rock-wallaby lives in colonies comprising one or more social groups, colonies can range from 2–60 individuals (Bayne, 1994) (Piggott, Banks, & Taylor, 2006). Individual home ranges range from 6–30 ha which often overlap in nocturnal or crepuscular foraging areas (Laws, RJ; Goldizen, RW, 2003). Surveys within the project area include a combination of remote cameras, scat collection for genotype analysis, aerial surveys, targeted and incidental counts. Summarised count data can be found in Appendix D. From the survey data collected it is estimated that the project area supports a subpopulation of approximately 132 individuals across approximately 20–25 colonies. Within this area, the disturbance footprint supports refuge habitat for one colony that contain a minimum number of 2 individuals. Due to the mobility of this species obtaining an exact number is difficult. The Project area contains an area of 6,572 ha with this species associated with difficult terrain that contains areas that are inaccessible. Surveys required multiple site visits which may have double counted or missed individuals. Presence of colonies were also observed adjacent to the Project area heading along the northern gorges of the Carrai Plateau, west within Cunnawarra National Park and south within Oxley Wild Rivers National Park (see Figure 9.4). Numbers were not accurately counted in colonies located outside of the project area.
Number of individuals (mature and immature) present as a percentage of total NSW population (%).	• BCD: 132 ÷ 1,000 x 100 = 13%.
Number of individuals (mature and immature) to be impacted by the proposal.	Actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat that supports this species may be directly and indirectly impacted on. This habitat includes rocky areas that contain overhangs, crevices, caves and ledges with refuge features. The disturbance footprint was observed to support one colony, within the proposed access road connecting the Lower Reservoir to the Upper Reservoir. This colony contained a minimum number of 2 individuals calculated from results of genotype scat analysis and aerial surveys.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%).	Impacts on actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat that supports this species will affect one colony. Number of individuals associated within the project area as a percentage is: • BCD: 2 ÷ 1,000 x 100 = 0.2%.
Area of habitat to be impacted (ha) (for species measured by area only).	The definition of habitat that triggers an SAII assessment is defined in the TBDC as rocky habitat used by this species. Habitat constraints defined within the TBDC includes land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines. Calculations used to determine actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat is that as per the SAII assessment definition within the TBDC. This is also used to determine the AOO. The Project area was observed to contain approximately 2.89 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical). The actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat within the development footprint is: 0.00594 ha. Indirect impacts which have been calculated using a 20 m buffer from the development footprint include an additional 0.02591 ha, giving a total of 0.03185 ha that will be used in this assessment for impacts on actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat for this species. Habitat constraints, to be impacted on, which has been calculated using this species' associated PCTs within 1 km of rocky escarpment, gorges, steep slopes, boulder piles, rock outcrops and cliff lines is: 203.64ha for direct impacts and 98.25 ha for indirect ha a total of 301.9 ha. The project aera contains approximately 6,470.32 ha of habitat constraints and 2.85 ha actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat of that will not be impacted on.
Area of the species' geographic range to be impacted by the proposal (ha).	Actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat: 0.03185 ha Habitat constraints: 244 ha

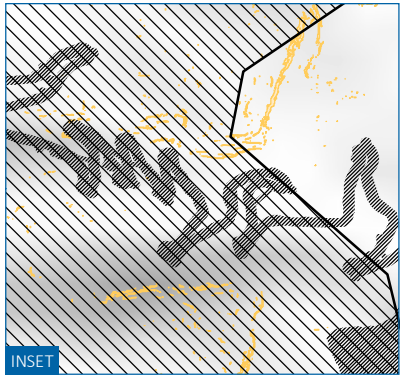
Impact	Data/information
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%).	The actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat area of the impact as a percentage is • Impact of AOO = 0.03185 ha (0.0003185 km^2) ÷ 2,712 km^2 = 0.000001%. The habitat constraints area of the impact as a percentage is: • Impact of EOO = 244 ha (2.44 $km^{2)}$ ÷ 172,205 km^2 x 100= 0.001%.
Individuals impacted.	One colony with a minimal number of 2 individuals will be directly and indirectly impacted on as part of the proposed works.
Viability of a fragmented population.	The actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat to be impacted on is part of the Macleay Gorges. Actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat within the Project area runs along the Carrai plateau, with cliffs and rocky habitat that support refuge areas running to the north-east of the Project area and north -south within the project area. Where the proposed road between the lower reservoir with the upper reservoir is to be constructed, there is a break in the rocky escarpment approximately 500 m wide. It is considered that the construction of the access road between the two reservoirs is likely to directly and indirectly impact on the one colony within the development footprint. Existing colonies located immediately adjacent to Green Gully track in Oxley Wild Rivers National Park are known to tolerate road upgrade works and disturbance from public accessing the park in cars and on foot (Piers Thomas, NPWS Senior Conservation Planning Officer, pers. comm.). While males are known to move between colonies within their home range to access females, females are largely sedentary over a smaller home range (DPE, 2023). It is therefore considered that any long-term indirect impacts to adjacent colonies from the Project are unlikely to occur, as the colonies are considered to be largely sedentary and unlikely to disperse to other areas of habitat. Operational use of the access road will be limited to maintenance works and emergency egress as part of the Project lifespan. As such it is likely that any adjacent colonies of Brush-tail Rock-wallabies will not be impacted by the Project over the long term once construction ends.
Additional assessment.	Due to the impacts on actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat to support this species, additional assessment has been considered in Table 9.12.

Table 9.12 Additional impact assessment – Brush-tailed Rock-wallaby

Impact	Data/information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The consideration of options and development of the Project was informed by occurrence of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat to support Brush-tailed Rock-wallabies and records of this species on site resulted in changes to the lower to the upper reservoir access road. The design of the Project has been through several iterations. The access roads were chosen, where practicable, to avoid large areas of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat (refer to Section 8.3.1. and Table 8.8). As part of the response to submission stage, the access road between the lower and upper reservoir was redesigned to avoid direct impacts to a large colony that was located within the disturbance footprint Indirect impacts could occur due to fauna vehicle strike along the access road. A reduced speed limit will be imposed, see Section 8.3. This mitigation measures have proven to be successful for Snowy 2.0, with year three of ongoing monitoring for fauna mortality collisions have shown no mortalities with the implementation of these measures. Indirect impacts from increases of predatory and pest animal species could result from an increase of human activity and creation of roads adjacent to colonies that could lead to greater predator incursions. The Project will implement a pest and predator monitoring program to ensure the works do not result in a significant increase in predator numbers. The Project will also design and implement a predator control program that will be implemented, in conjunction with DPIE, to control feral animals during construction.
The extent to which the impact exceeds any threshold for the potential entity.	No thresholds are defined within the SAII TBDC assessment for this species. . The Project will impact on approximately 0.03185 ha of actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat known to support this species.

Impact	Data/information
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	Brush-tailed Rock-wallabies typically have low migration rates between colonies and low recolonisation rates (TSSC, 2003). As discussed in Table 9.10 males are generally the only ones to move between colonies. Should there be the loss of the colony within the development footprint, this may have an impact on nearby colonies as it relates to gene flow. The Project will impact on 244 ha of foraging and dispersal habitat; however, the Project area contains 6,170.96 ha of habitat constrains that will not be impacted on by the Project
A description of the extent to which the local population will become fragmented.	The Project may have an indirect impact on a small colony that may be associated with a larger colony located to the north. Observations within the Project area as part of the Brush-tailed Rock-wallaby habitat assessment and targeted surveys recorded outlier records of younger males and potential connective mammal paths with some having evidence of Brush-tailed Rock-wallaby scats. The majority of critical habitat that supports this species will be retained within the project area. The project area supports an estimated 20–25 colonies containing a minimum of 132 individuals. The local population is confined to identified refuge habitat associated with areas of rocky escarpment, gorges, steep slopes, boulder piles, rock outcrops, cliff lines and adjacent foraging habitat. This runs from the southwest to the northwest of the project area with a break in the rocky escarpment approximately 500 m wide. A proposed access road that will be used to connect the lower reservoir with the upper reservoir takes advantage of where the break occurs and avoids large areas of rocky habitat that is associated with actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat. The lower and upper reservoirs are situated below and above the rocky escarpment. The likely preferred movement of Brush-tailed Rock-wallabies within the Project area would be along the rocky escarpment. They are likely to use the shortest distance between the break in the escarpment which will only be intersected by the access road. During construction the colonies located to the north and south of the disturbance footprint could potentially become temporarily fragmented due to indirect disturbance during construction activities. The creation of the access road is not considered to cause a permanent fragmentation as, once construction ends, this road would only be used for maintenance and inspection purposes only, with minimal traffic flow. The narrow bands of clearing required for the access are unlikely to interfere with Brush-tailed Rock-wallaby movement since wallabies are capable of traversing narrow tracts of cleared land between forested areas.
The relationship of the local population to other populations.	Additional aerial presence/absence surveys were undertaken to close data gaps between the two known large sub-populations located approximately 20 km south-west at Kunderang Brook and north-west in Dangar and Gara Gorges. This extensive work, undertaken in consultation with species experts from DPE and NPWS, resulted in a greater understanding of the Brush-tailed Rock-wallaby populations in this area, confirming connection between the two known sub-populations. Colonies were recorded along the Macleay, Chandler and Apsley River which are likely to provide a connection to the larger and the smaller colonies located within the Macleay Gorges. It is noted that colonies remain largely in situ with home ranges potentially limited to 4 km or less and gene flow would be expected to occur at a low rate for neighbouring colonies over time (DPE, 2022a)). The project area is likely to be an area of high occupancy for colonies and the additional surveys show that they form part of another large sub-population that is linked largely by the river systems to the other sub-populations within the Macleay Gorges. See Figure 9.4.
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Part of the survey effort to inform this SAII impact assessment contributed to the recovery objective: • Determine distribution, abundance for the Brush-tailed Rock-wallaby within the IBRA subregion. • Survey effort extending throughout the Macleay Gorges where record gaps existed. These surveys identified an additional 70+ colonies outside of the project area within the IBRA subregion.





KEY

- Project area
- Disturbance footprint
- Actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat

BIONET species sighting

- >20 years old
- 5 - 20 years old
- <5 years old

IBRA Subregion

- Macleay Gorges

Existing environment

- Major road
- Rail line
- NPWS reserve
- State forest

Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); DPE (2022); OEH (2016)

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Species records of Brush-tailed Rock-Wallaby in the Macleay Gorges

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10 Cumulative impacts

10.1 Introduction

This section provides consideration of the Project's potential to generate cumulative impacts in the region related to biodiversity.

The *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2021) (DPHI, 2024) are part of the Rapid Assessment Framework introduced in 2021, aimed at improving the assessment of major projects in NSW. The scoping phase for OMPS preceded the implementation of these guidelines and as such, a scoping assessment for cumulative impacts was not performed at the time. The EIS has therefore performed a screening exercise of future projects, focusing on key matters that could be materially affected, to inform the cumulative impact assessment (EMM, 2024).

The Project is located within the Armidale Regional Council LGA. The cumulative impact assessment has considered other future projects (on the DPE Major Projects Planning Portal) that have the potential to interact with the Project, within the following spatial extent:

- within the Armidale Regional LGA
- within Kempsey Shire LGA
- within Walcha Council LGA
- within 70 km of the project area.

The following projects are within the above domain were considered in the biodiversity cumulative impact assessment:

- Doughboy Wind Farm (SSD-9161599) – 30.5 km north of the Project
- Winterbourne Wind Farm (SSD-10471) – 37 km south-west of the Project
- Metz Solar Farm (SSD-7931) – 40.5 km north-west of the Project
- Stringybark Solar Farm (DA 112-2019) – 45.5 km north-west of the Project
- Olive Grove Solar Farm (DA 17-2020) – 46 km north-west of the Project
- Oxley Solar Farm (SSD-10346) – 47 km north-west of the Project
- Armidale Battery Energy Storage System (SSD-23515853) – 52 km north-west of the Project
- Armidale Solar Farm (DA 164-2019) – 54 km north-west of the Project
- New England Solar Farm (SSD-9255) – 61 km north-west of the Project
- Salisbury Solar Farm (SSD-10347) – 62 km west of the Project
- Thunderbolt Community Solar Farm (DA-8-2021) – 67.5 km west of the Project
- Tilbuster Solar Farm (SSD-9619) – 68 km north-west of the Project.

10.2 Consideration of cumulative impacts related to biodiversity

Following review of impacts related to biodiversity from surrounding projects within the study domain, all projects identified are unlikely to result in any key interaction due to the distance, nature and scale of the Project (i.e. no operational interaction). Therefore, no cumulative impacts are expected related to biodiversity from the Project.

11 Impact summary

11.1 Impacts not requiring offsets

In accordance with Section 9.2.1 of BAM (DPIE, 2020a), impacts on vegetation zones and threatened species habitat do not require offsets where:

- a vegetation zone representative of a critically endangered or endangered ecological community has a vegetation integrity score less than 15, and/or
- a vegetation zone representative of a vulnerable ecological community and/or threatened species habitat has a vegetation integrity score less than 17, and/or
- a vegetation zone that is not listed has a vegetation integrity score less than 20.

Table 11.1 provides a summary of the vegetation zones that do not trigger the above thresholds.

Table 11.1 Summary of impacts not requiring offsets

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
762	Cabbage Gum open forest or woodland on flats of the North Coast	DNG Moderate	0.15	0.8	0	-0.8	0
		Exotic Grassland	1.62	3.9	0	-3.9	0
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	DNG Moderate	37.1	15	0	-15	0
		Exotic Grassland	3.7	1.9	0	-1.9	0

Areas not requiring assessment in accordance with Section 9.3 of BAM (DPIE, 2020a) include:

- existing roads
- cleared and highly disturbed land
- watercourses.

Areas of the disturbance footprint that do not generate an offset are displayed in Figure 11.1.

11.2 Impacts requiring offset

This section provides an assessment of the impacts requiring offsetting in accordance with the BAM (DPIE, 2020a).

11.2.1 Impacts on native vegetation requiring offsets

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 11.2 for the Macleay Gorges IBRA subregion – area assessment, Table 11.3 for the Macleay Gorges IBRA subregion – linear assessment and Table 11.4 for the Macleay Hastings IBRA subregion – linear assessment. Vegetation zones that require an offset are displayed in Figure 11.1. Credit reports are provided in Appendix E.

Table 11.2 Ecosystem credits required for impacts to all vegetation zones in the Macleay Gorges IBRA and Carrai Plateau subregions – area assessment

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	113.9	73	0	-73	3231
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High (indirect)	49.3	73	70.9	-2.1	39
Sub-total							**3270**
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry	6.8	66.9	0.0	-66.9	167
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry (indirect)	6.3	66.9	60	-6.9	16
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	47.3	72.5	0.0	-72.5	1285
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High (indirect)	13.0	72.5	64.6	-7.9	39
Sub-total							**1507**
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	High	7.3	73.1	0.0	-73.1	265

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	High (indirect)	1.6	73.1	68.5	-4.6	4
Sub-total							**269**
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	10.5	71.3	0.0	-71.3	374
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	High (indirect)	8.4	71.3	65.8	-5.5	23
							397
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High	0.07	54.5	0.0	-54.5	3
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High (indirect)	0.4	54.5	46.1	-8.3	2
Sub-total							**5**
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5.0	40.6	0.0	-40.6	102
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate (indirect)	0.4	40.6	25.9	-14.6	3
Sub-total							**105**
1287	Upland heath swamps of the New England Tableland Bioregion	High (indirect)	0.16	54.9	19.1	-35.8	1
Sub-total							**1**

Table 11.3 Ecosystem credits required for impacts to all vegetation zones in the Macleay Gorges IBRA subregion – linear assessment

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate	0.39	55.5	0	—55.5	11
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate (indirect)	0.26	55.5	50	-5.4	1
Sub-total							**12**
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	46.6	73	0.0	-73	1276
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High (indirect)	38.8	73	64.8	-8.3	30
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Poor	0.8	42.8	-42.8	-48.8	12
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Poor (indirect)	0.8	42.8	38.4	-4.4	1
Sub-total							**1319**
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	1.2	72.5	0.0	-72.5	33
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High (indirect)	0.6	72.5	70.3	-2.1	1
Sub-total							**34**
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	ModerateRF	0.5	62.4	0.0	-62.4	26
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	ModerateRF (indirect)	0.6	62.4	61.7	-0.7	1

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	0.3	64.8	0	-64.8	14
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate (indirect)	0.5	64.8	69.7	-4.9	2
Sub-total							**43**

Table 11.4 Ecosystem credits required for impacts to all vegetation zones in the Macleay Hastings IBRA subregion – linear assessment

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
762	Cabbage Gum open forest or woodland on flats of the North Coast	PCT 762 Moderate	0.1	55.5	0.0	-55.5	4
762	Cabbage Gum open forest or woodland on flats of the North Coast	PCT 762 Poor	0.3	47.8	0.0	-47.8	7
762	Cabbage Gum open forest or woodland on flats of the North Coast	PCT 762 Moderate (indirect)	0.2	55.5	49.8	-5.6	1
762	Cabbage Gum open forest or woodland on flats of the North Coast	PCT 762 Poor (indirect)	0.3	47.8	44.8	-3.1	1
Sub-total							**13**
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	PCT 842 High	8.4	73	0.0	-73	231
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	PCT 842 Poor	0.9	42.8	0.0	-42.8	14
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	PCT 842 High (Indirect)	7.5	73	64	-8.2	6

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	PCT 842 Poor (Indirect)	2.1	42.8	38.4	-4.4	1
Sub-total							**252**
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	PCT 868 High	12.9	75.1	0.0	-75.1	363
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	PCT 868 High (Indirect)	7.5	75.1	70.3	-2.1	6
Sub-total							**369**
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 High	0.4	54.5	0.0	-54.5	15
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 Moderate	2.1	64.8	0.0	-75.3	83
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 ModerateRF	0.3	62.4	0.0	-64.1	13
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 High (Indirect)	1.0	54.5	46.1	-8.3	1
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 Moderate (Indirect)	3.4	64.8	64.6	-0.2	1
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	PCT 1106 ModerateRF (Indirect)	0.3	62.4	61.7	-0.7	1
Sub-total							**114**
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	PCT 1215 High	52.1	64.9	0.0	-64.9	1268

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint / indirect disturbance footprint (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	PCT 1215 DNG Moderate	1.2	41	0.0	-41	18
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	PCT 1215 High (Indirect)	60.6	64.9	63.9	-1.1	25
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	PCT 1215 DNGModerate (Indirect)	0.4	41	40.1	-0.9	1
Sub-total							**1312**
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	PCT 1268 High	1.1	77	0.0	-77	31
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	PCT 1268 High (Indirect)	1.0	77	75.8	-1.3	1
Sub-total							**32**

11.2.2 Impacts on threatened species requiring offsets

A summary of the species credits required for all vegetation zones occupied by the threatened species, is provided Table 11.5 for the Macleay Gorges IBRA subregion – area assessment, Table 11.6 for Macleay Gorges IBRA subregion – linear assessment and Table 11.7 for the Macleay Hastings IBRA subregion – linear assessment of the NSW North Coast IBRA bioregion. Credit reports are provided in Appendix E. Offsets will be provided in accordance with the biodiversity offset framework outlined in Chapter 12.

Table 11.5 Threatened species credits require for impacts in the Macleay Gorges and Carrai Plateau IBRA subregion – area assessment

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Grevillea guthrieana	Guthrie's Grevillea	PCT 979 High	248	No	496
Grevillea guthrieana	Guthrie's Grevillea	PCT 979 High (indirect)	2	No	4
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 High	35	No	70
Grevillea guthrieana	Guthrie's Grevillea	PCT 868 High	93	No	186

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 High (Indirect)	91	No	182
Grevillea guthrieana	Guthrie's Grevillea	PCT 868 High (Indirect)	108	No	216
Sub-total					**1154**
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 High	0.07	Yes	3
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 DNG Moderate	0.82	Yes	9
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 DNG Moderate (indirect)	0.33	Yes	2
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 High (Indirect)	0.39	Yes	2
Sub-total					**16**
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	PCT 868 High (indirect)	0.06	Yes	1
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	PCT 822 High (Indirect)	0.16	Yes	1
Pultenaea rubescens	Pultenaea sp. Werrikimbe NP	PCT 1287 High (Indirect)	0.13	Yes	3
Sub-total					**5**
Tylophora woollsii	Cryptic Forest Twiner	PCT 979 High	1.4	No	52
Tylophora woollsii	Cryptic Forest Twiner	PCT 979 High (Indirect)	0.42	No	1
Tylophora woollsii	Cryptic Forest Twiner	PCT 988 High	1.4	No	72
Tylophora woollsii	Cryptic Forest Twiner	PCT 988 High (Indirect)	1.9	No	5
Sub-total					**130**
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 988 High	1.6	No	55
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 868 Dry	0.61	No	20
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 868 High	7.4	No	269
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 988 High (Indirect)	0.37	No	1
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 868 Dry (Indirect)	0.51	No	2

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Calyptorhynchus lathami	Glossy Black-Cockatoo	PCT 868 High (Indirect)	0.44	No	2
Sub-total					**349**
Myotis Macropus	Southern Myotis	PCT 842 High	4.7	No	171
Myotis Macropus	Southern Myotis	PCT 842 High (indirect)	5.2	No	21
Myotis Macropus	Southern Myotis	PCT 1106 High	0.07	No	2
Myotis Macropus	Southern Myotis	PCT 1106 High(indirect)	0.39	No	2
Sub-total					**196**
Ninox strenua	Powerful Owl	PCT 842 High	33.85	No	1236
Ninox strenua	Powerful Owl	PCT 842 High (Indirect)	17.08	No	71
Sub-total					**1307**
Petauroides volans	Greater Glider	PCT 979 High	7.3	No	265
Petauroides volans	Greater Glider	PCT 868 High	47	No	1702
Petauroides volans	Greater Glider	PCT 868 Dry	6.6	No	222
Petauroides volans	Greater Glider	PCT 842 High (indirect)	0.01	No	1
Petauroides volans	Greater Glider	PCT 979 High (Indirect)	1.6	No	4
Petauroides volans	Greater Glider	PCT 868 High (Indirect)	12.6	No	50
Petauroides volans	Greater Glider	PCT 868 Dry (Indirect)	6.1	No	21
Petauroides volans	Greater Glider	PCT 1142 Moderate	0.21	No	4
Petauroides volans	Greater Glider	PCT 988 High	10.3	No	369
Petauroides volans	Greater Glider	PCT 988 High (indirect)	8.3	No	23
Sub-total					**2661**
Petaurus norfolcensis	Squirrel Glider	PCT 842 High	113.9	No	4158
Petaurus norfolcensis	Squirrel Glider	PCT 868 High	44	No	1594
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High	0.07	No	2
Petaurus norfolcensis	Squirrel Glider	PCT 868 Dry	6.6	No	222

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Petaurus norfolcensis	Squirrel Glider	PCT 842 High (Indirect)	49.3	No	204
Petaurus norfolcensis	Squirrel Glider	PCT 868 High (Indirect)	12.40	No	49
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High (Indirect)	0.39	No	2
Petaurus norfolcensis	Squirrel Glider	PCT 868 Dry (Indirect)	6.1	No	21
Sub-total					**6252**
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 842 High	117.3	Yes	5877
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 High	47.3	Yes	28570
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 Dry	6.6	Yes	333
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 979 High	7.2	Yes	397
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 979 High (indirect)	1.6	Yes	5
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 842 High (Indirect)	47	Yes	291
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 High (Indirect)	13	Yes	77
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 Dry (Indirect)	6.33	Yes	33
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 988 High	8.7	463	
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 988 High (indirect)	4.8	Yes	20
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 1142 Moderate	5	Yes	152
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 1142 Moderate (Indirect)	0.46	Yes	5
Sub-total					**10222**
Potorous tridactylus	Long-nosed Potoroo	PCT 868 Dry	3.5	No	116
Potorous tridactylus	Long-nosed Potoroo	PCT 868 High	43.7	No	1583
Potorous tridactylus	Long-nosed Potoroo	PCT 868 High (Indirect)	11.4	No	45
Potorous tridactylus	Long-nosed Potoroo	PCT 868 Dry (Indirect)	3.3	No	11

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Sub-total					**1755**
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High	113.9	No	4158
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High (indirect)	49.3	No	204
Sub-total					**4362**
Tyto novaehollandiae	Masked Owl	PCT 842 High	30.8	No	1124
Tyto novaehollandiae	Masked Owl	PCT 842 High (Indirect)	16.1	No	66
Tyto novaehollandiae	Masked Owl	PCT 868 Dry	2.1	No	70
Tyto novaehollandiae	Masked Owl	PCT 868 Dry (indirect)	2.3	No	8
Tyto novaehollandiae	Masked Owl	PCT 868 High	41.7	No	1512
Tyto novaehollandiae	Masked Owl	PCT 868 High (indirect)	8.9	No	35
Tyto novaehollandiae	Masked Owl	PCT 979 High	6.2	No	226
Tyto novaehollandiae	Masked Owl	PCT 979 High (indirect)	1.1	No	2
Tyto novaehollandiae	Masked Owl	PCT 988 High	8.2	No	293
Tyto novaehollandiae	Masked Owl	PCT 988 High (indirect)	6.2	No	17
Sub-total					**3353**

6. Assumed presence.

Table 11.6 Threatened species credits require for impacts in the Macleay Gorges IBRA subregion – linear assessment

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 High	2	No	4
Grevillea guthrieana	Guthrie's Grevillea	PCT 842 DNG Moderate (Indirect)	1	No	2
Sub-total					**6**
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 842 High	15	No	30

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 842 High (Indirect)	29	No	58
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 762 Moderate (Indirect)	1	No	2
Sub-total					**90**
Myotis macropus	Southern Myotis	PCT 842 High	4.8	No	174
Myotis macropus	Southern Myotis	PCT 762 Moderate	0.1	No	3
Myotis macropus	Southern Myotis	PCT 762 Moderate (indirect)	0.17	No	1
Myotis macropus	Southern Myotis	PCT 1106 ModerateRF	0.29	No	9
Myotis macropus	Southern Myotis	PCT 1106 Moderate	0.29	No	9
Myotis macropus	Southern Myotis	PCT 1106 Moderate (indirect)	0.47	No	1
Myotis macropus	Southern Myotis	PCT 1106 ModerateRF (indirect)	0.59	No	1
Myotis macropus	Southern Myotis	PCT 842 Poor	0.56	No	12
Myotis macropus	Southern Myotis	PCT 842 Poor (indirect)	0.35	No	1
Myotis macropus	Southern Myotis	PCT 842 High (Indirect)	6.5	No	7
Myotis macropus	Southern Myotis	PCT 762 EG	0.01	No	1
Myotis macropus	Southern Myotis	PCT 842 DNG Moderate	0.55	No	4
Sub-total					**227**
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate	0.29	Yes	14
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate (Indirect)	0.47	Yes	2
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 EG (Indirect)	0.12	Yes	1
Sub-total					**17**
Petaurus norfolcensis	Squirrel Glider	PCT 842 High	46.61	No	1702
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor	0.77	No	16
Petaurus norfolcensis	Squirrel Glider	PCT 868 High	1.2	No	44
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate	0.29	No	9

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Petaurus norfolcensis	Squirrel Glider	PCT 1106 ModerateRF	0.55	No	17
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate	0.39	No	11
Petaurus norfolcensis	Squirrel Glider	PCT 842 High (Indirect)	38.8	No	41
Petaurus norfolcensis	Squirrel Glider	PCT 868 High (Indirect)	0.56	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate (Indirect)	0.26	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 1106 ModerateRF (Indirect)	0.65	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate (Indirect)	0.47	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor (Indirect)	0.80	No	1
Sub-total					**1845**
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 842 High	41.1	Yes	2249
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 High	1.2	Yes	66
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 868 High (Indirect)	0.56	Yes	1
Petrogale penicillata	Brush-tailed Rock Wallaby	PCT 842 High (Indirect)	31.4	Yes	49
Sub-total					**2365**
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High	44.6	No	1701
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High (Indirect)	35.8	No	41
Sub-total					**1742**
Ninox strenua	Powerful Owl	PCT 842 High	2.55	No	93
Ninox strenua	Powerful Owl	PCT 842 High (Indirect)	3	No	3
Sub-total					**96**
Tyto novaehollandiae	Masked Owl	PCT 842 High	10.18	No	372
Tyto novaehollandiae	Masked Owl	PCT 842 High (Indirect)	11.30	No	12
Sub-total					**384**

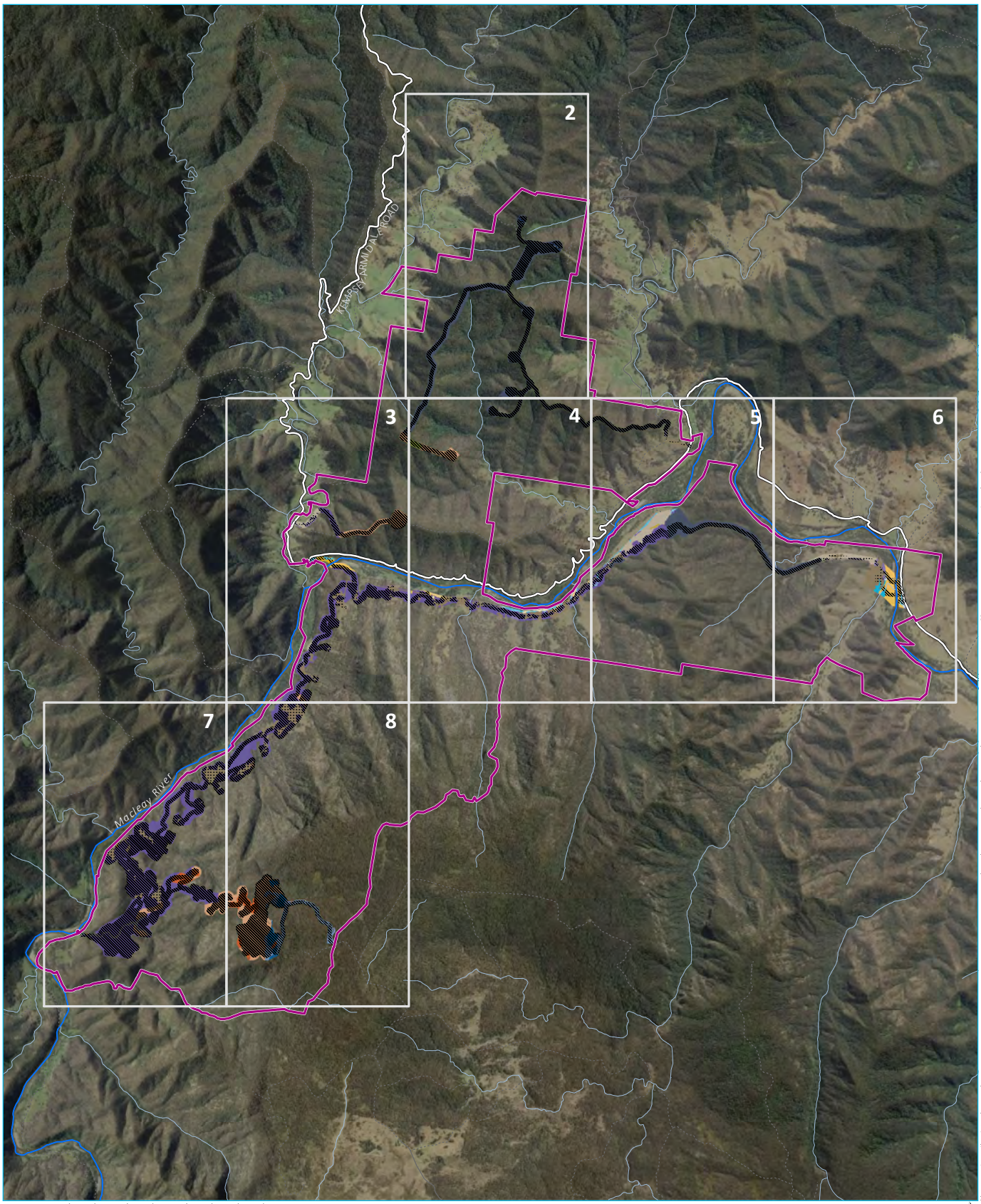
Table 11.7 Threatened species credits require for impacts in the Macleay Hastings IBRA subregion – linear assessment

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 1215 High	379	No	758
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 1215 DNG Mod	11	No	22
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	PCT 1215 DNG Mod (indirect)	1	No	2
Haloragis exalata subsp. *velutina*	Tall Velvet Sea-berry	PCT 1215 High (Indirect)	1110	No	2220
Sub-total					**3002**
Lepidium peregrinum	Wandering Pepper Cress	PCT 762 EG	0.92	Yes	3
Lepidium peregrinum	Wandering Pepper Cress	PCT 762 EG (indirect)	0.62	Yes	1
Lepidium peregrinum	Wandering Pepper Cress	PCT 842 EG (indirect)	0.1	Yes	1
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate (indirect)	0.59	Yes	2
Lepidium peregrinum	Wandering Pepper Cress	PCT 1106 Moderate	0.43	Yes	21
Sub-total					**28**
Tylophora woollsii	Cryptic Forest Twiner	PCT 1215	9.27	No	301
Tylophora woollsii	Cryptic Forest Twiner	PCT 1215 High (Indirect)	9.26	No	5
Sub-total					**306**
Myotis macropus	Southern Myotis	PCT 1106 Moderate	2	No	64
Myotis macropus	Southern Myotis	PCT 1106 Moderate (indirect)	3.2	No	8
Myotis macropus	Southern Myotis	PCT 842 High (indirect)	0.1	No	1
Myotis macropus	Southern Myotis	PCT 1106 ModerateRF (indirect)	0.26	No	1
Myotis macropus	Southern Myotis	PCT 1106 ModerateRF	0.34	No	11
Myotis macropus	Southern Myotis	PCT 1106 High (indirect)	0.8	No	1
Myotis macropus	Southern Myotis	PCT 1106 High	0.34	No	9

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Myotis macropus	Southern Myotis	PCT 762 Poor (indirect)	0.15	No	1
Myotis macropus	Southern Myotis	PCT 842 Poor (indirect)	0.37	No	1
Myotis macropus	Southern Myotis	PCT 842 Poor	0.16	No	3
Myotis macropus	Southern Myotis	PCT 762 Poor	0.23	No	6
Sub-total					**106**
Petauroides volans	Greater Glider	PCT 868 High	12.6	No	474
Petauroides volans	Greater Glider	PCT 1215 High	41.4	No	1345
Petauroides volans	Greater Glider	PCT 868 High (Indirect)	7.4	No	8
Petauroides volans	Greater Glider	PCT 1215 High (Indirect)	47.2	No	26
Sub-total					**1853**
Petaurus norfolcensis	Squirrel Glider	PCT 842 High	6.63	No	242
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor	0.87	No	19
Petaurus norfolcensis	Squirrel Glider	PCT 868 High	12.66	No	474
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High	0.10	No	3
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate	2.1	No	66
Petaurus norfolcensis	Squirrel Glider	PCT 1106 ModerateRF	0.34	No	11
Petaurus norfolcensis	Squirrel Glider	PCT 1215 High	51.51	No	1672
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate	0.13	No	4
Petaurus norfolcensis	Squirrel Glider	PCT 762 Moderate (indirect)	0.17	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 762 Poor	0.31	No	7
Petaurus norfolcensis	Squirrel Glider	PCT 762 Poor (indirect)	0.27	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 1106 High (Indirect)	0.38	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 1106 Moderate (Indirect)	3.4	No	8

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Petaurus norfolcensis	Squirrel Glider	PCT 1106 ModerateRF (Indirect)	0.26	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 868 High (indirect)	7.4	No	8
Petaurus norfolcensis	Squirrel Glider	PCT 842 High (Indirect)	6	No	6
Petaurus norfolcensis	Squirrel Glider	PCT 842 Poor (Indirect)	2.1	No	2
Petaurus norfolcensis	Squirrel Glider	PCT 1215 High (Indirect)	60.32	No	33
Petaurus norfolcensis	Squirrel Glider	PCT 1268 High (Indirect)	0.96	No	1
Petaurus norfolcensis	Squirrel Glider	PCT 1268 High	1.1	No	41
Sub-total					**2601**
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High	8.3	No	3.3
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 868 High	8.14	No	306
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 1215 High	50.81	No	1650
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 842 High (Indirect)	7.2	No	8
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 868 High (Indirect)	4.52	No	5
Phascogale tapoatafa	Brush-tailed Phascogale	PCT 1215 High (Indirect)	57.75	No	31
Sub-total					**2303**
Phascolarctos cinereus	Koala	PCT 842 High	1.69	No	62
Phascolarctos cinereus	Koala	PCT 1215 High	41.44	No	1345
Phascolarctos cinereus	Koala	PCT 1268 High	1.1	No	41
Phascolarctos cinereus	Koala	PCT 842 Poor	0.59	No	13
Phascolarctos cinereus	Koala	PCT 868 High	12.90	No	484
Phascolarctos cinereus	Koala	PCT 842 High (Indirect)	2.33	No	2

Scientific name	Common name	Vegetation zones in species polygon	Area (ha)/count	Potential SAII	Credits required
Phascolarctos cinereus	Koala	PCT 868 High (Indirect)	7.36	No	23
Phascolarctos cinereus	Koala	PCT 1215 High (Indirect)	47.22	No	128
Phascolarctos cinereus	Koala	PCT 1268 High (Indirect)	0.96	No	1
Phascolarctos cinereus	Koala	PCT 762 Poor	0.01	No	1
Phascolarctos cinereus	Koala	PCT 842 Poor (Indirect)	1.3	No	1
Sub-total					**1984**
Potorous tridactylus	Long-nosed Potoroo	PCT 1215 High	41.44	No	1345
Potorous tridactylus	Long-nosed Potoroo	PCT 1215 High (Indirect)	46.7	No	25
Sub-total					**1370**
Tyto novaehollandiae	Masked Owl	PCT 842 High	0.53	No	19
Tyto novaehollandiae	Masked Owl	PCT 842 High (Indirect)	0.68	No	1
Tyto novaehollandiae	Masked Owl	PCT 762 Moderate (indirect)	0.11	No	1
Tyto novaehollandiae	Masked Owl	PCT 762 Moderate	0.04	No	1
Tyto novaehollandiae	Masked Owl	PCT 1215 High	5.6	No	181
Tyto novaehollandiae	Masked Owl	PCT 1215 High (indirect)	8.9	No	5
Sub-total					**208**



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

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GDA 1994 MGA Zone 56

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Minor road
- Vehicular track

PCT | Condition

- 1106 | High
- 1106 | Moderate
- 1106 | ModerateRF
- 1106 | PoorRF
- 1142 | Moderate
- 1215 | DNGModerate
- 1215 | High
- 1268 | High
- 1287 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 780 | Moderate
- 842 | DNGModerate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High
- 979_High
- 988_High

Impacts requiring offsets and impacts not requiring offsets

Map 1 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
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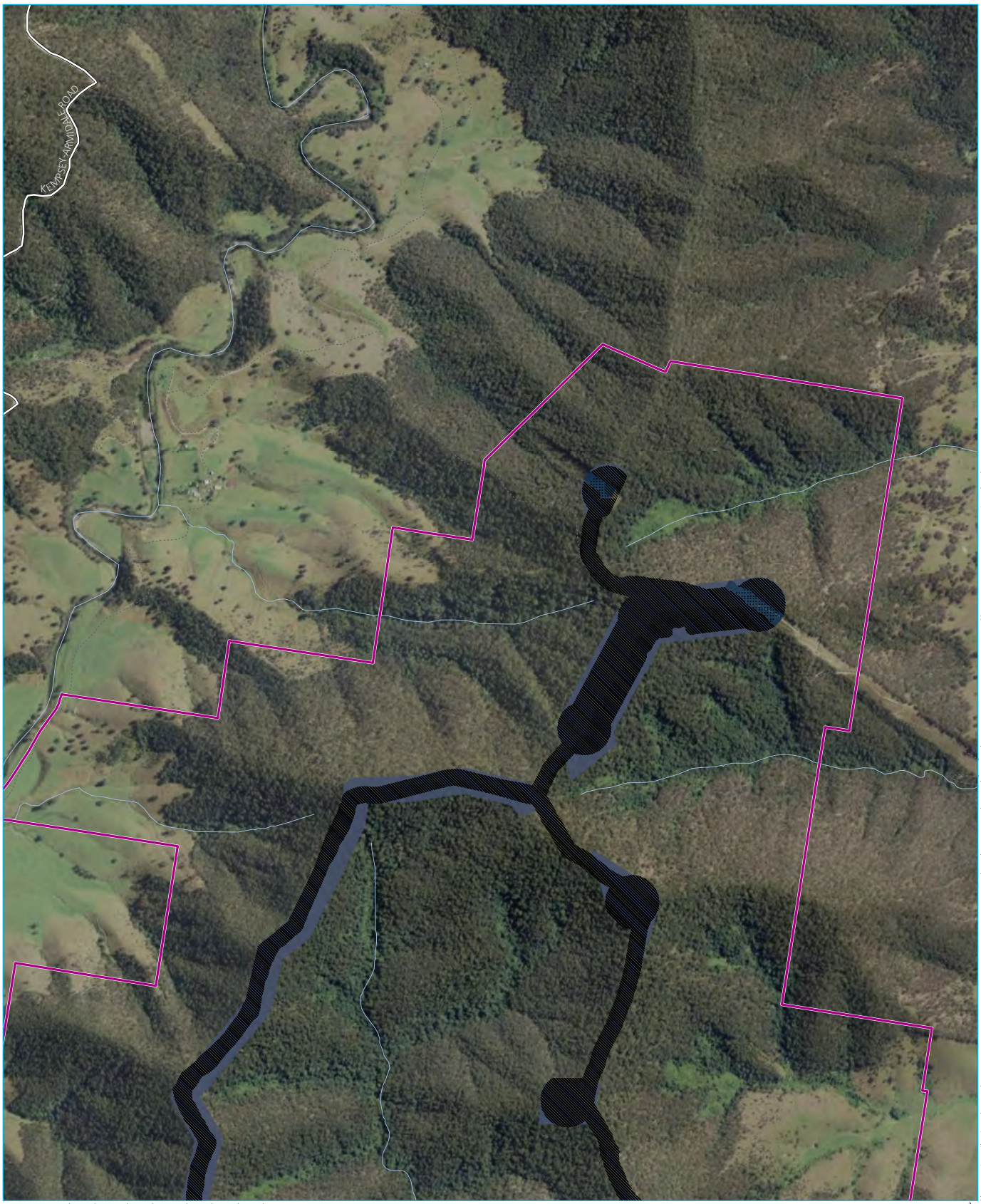
Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track

PCT | Condition

- 1215 | DNGModerate
- 1215 | High
- 762 | EG
- 842 | EG
- 868 | High

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Impacts requiring offsets and impacts not requiring offsets

Map 2 of 8

Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

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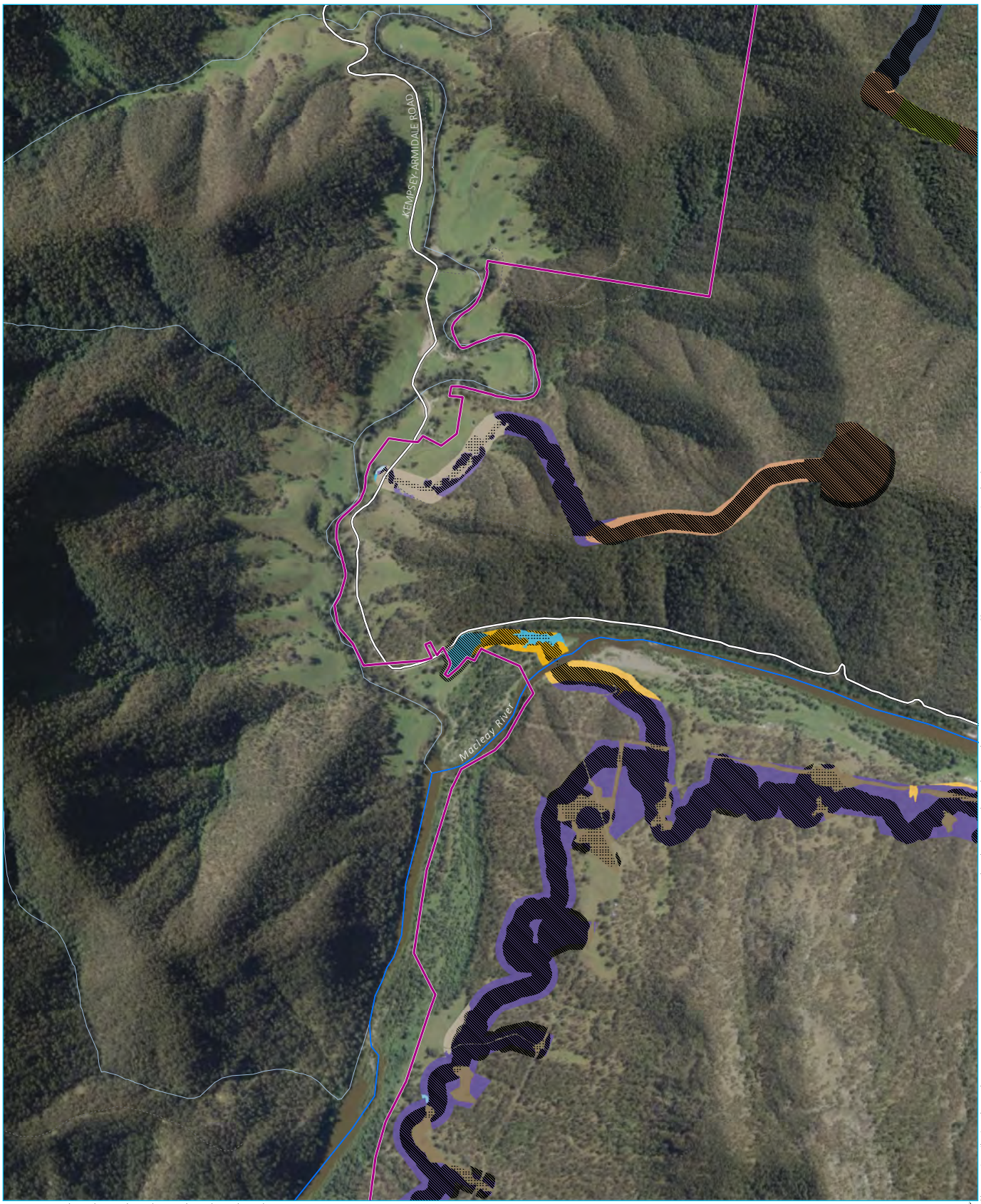
Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track

PCT | Condition

- 1106 | High
- 1106 | Moderate
- 1215 | High
- 1268 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNGModerate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High

Impacts requiring offsets and impacts not requiring offsets

Map 3 of 8

Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

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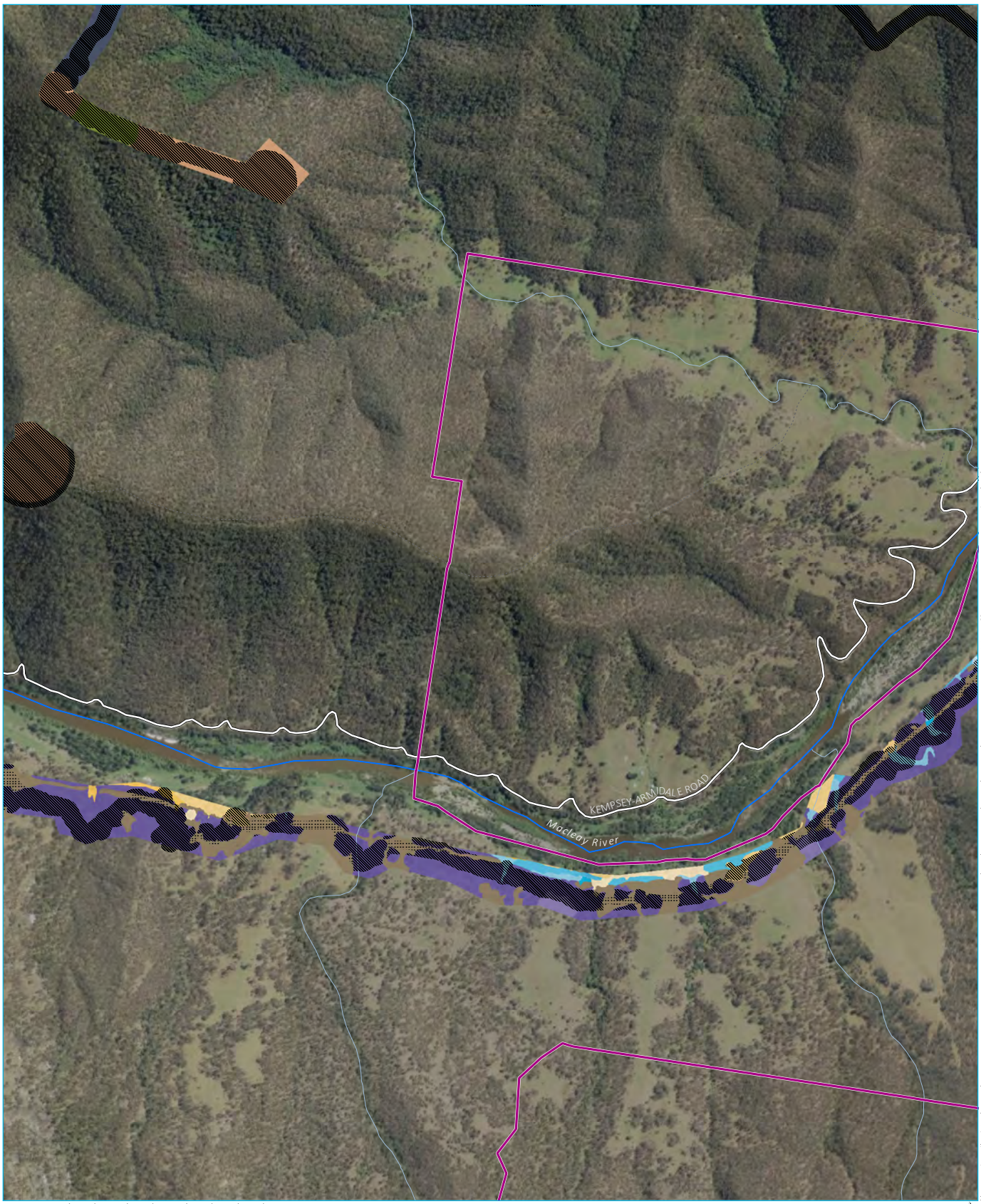
Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track

PCT | Condition

- 1106 | High
- 1106 | Moderate
- 1106 | ModerateRF
- 1106 | PoorRF
- 1215 | High
- 1268 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNGModerate
- 842 | EG
- 842 | High
- 842 | Poor
- 868 | Dry
- 868 | High

Impacts requiring offsets and impacts not requiring offsets

Map 4 of 8

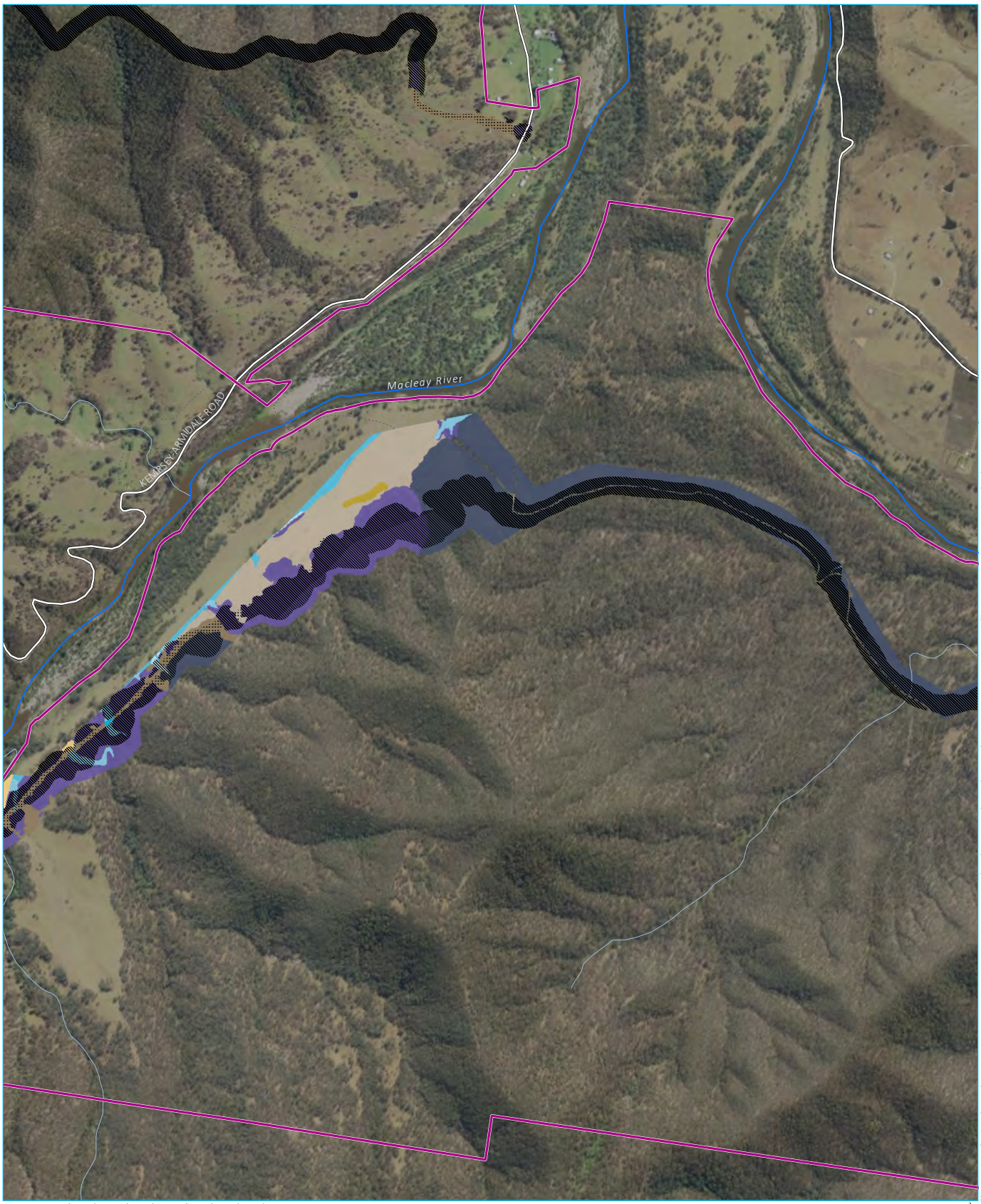
Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

OMPS Pty Ltd

Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track

PCT | Condition

- 1106 | High
- 1106 | Moderate
- 1106 | ModerateRF
- 1215 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 780 | Moderate
- 842 | DNGModerate
- 842 | EG
- 842 | High
- 842 | Poor

Impacts requiring offsets and impacts not requiring offsets

Map 5 of 8

Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

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Figure 11.1

EMM creating opportunities

Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track

PCT | Condition

- 1106 | Moderate
- 1106 | ModerateRF
- 1215 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNGModerate
- 842 | EG
- 842 | High
- 842 | Poor

Impacts requiring offsets and impacts not requiring offsets

Map 6 of 8

Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

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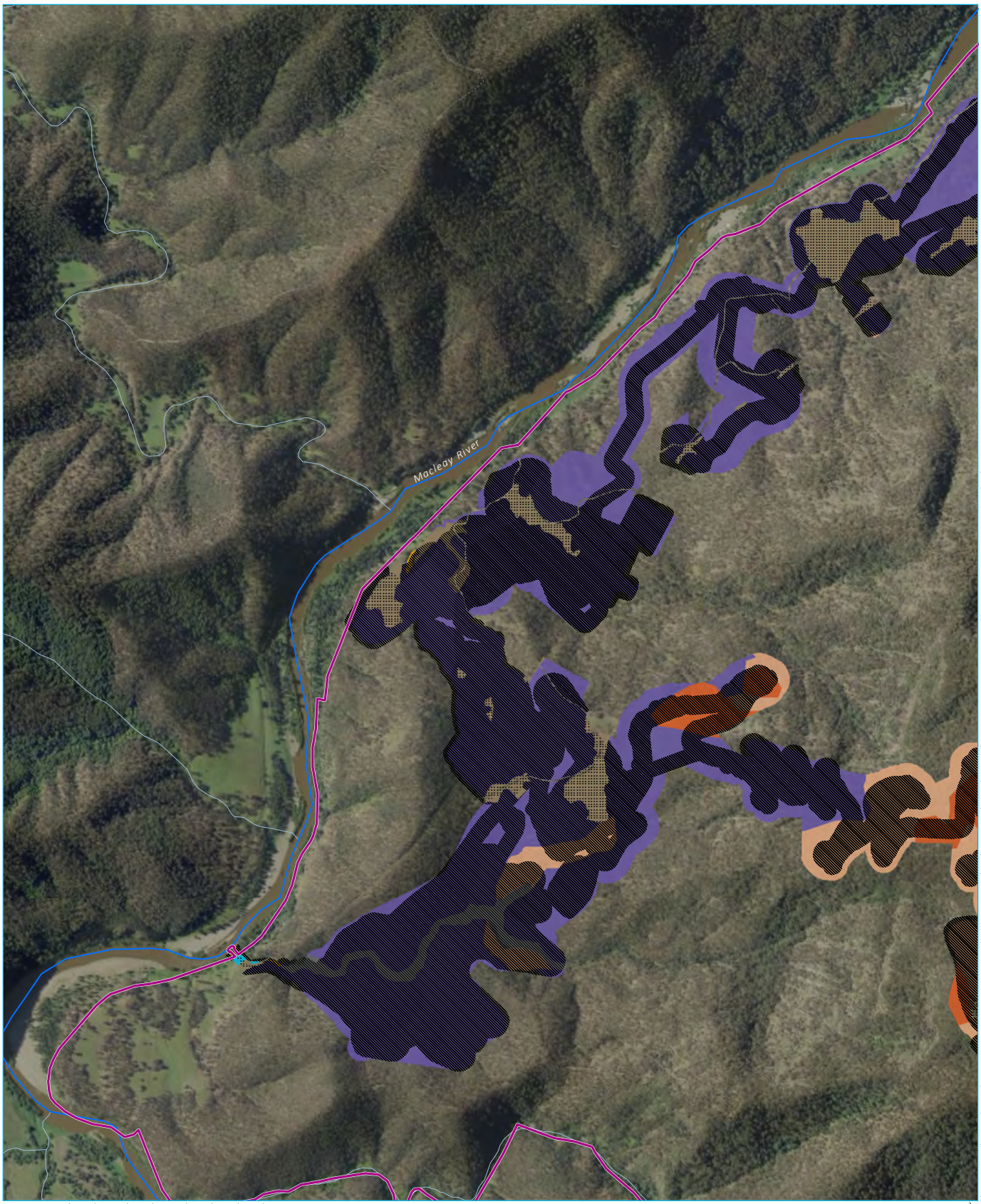
Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 56

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Vehicular track

PCT | Condition

- 1106 | High
- 1142 | Moderate
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNGModerate
- 842 | High
- 868 | Dry
- 868 | High

Impacts requiring offsets and impacts not requiring offsets

Map 7 of 8

Oven Mountain Pumped Hydro Energy Storage Project

Biodiversity development assessment report

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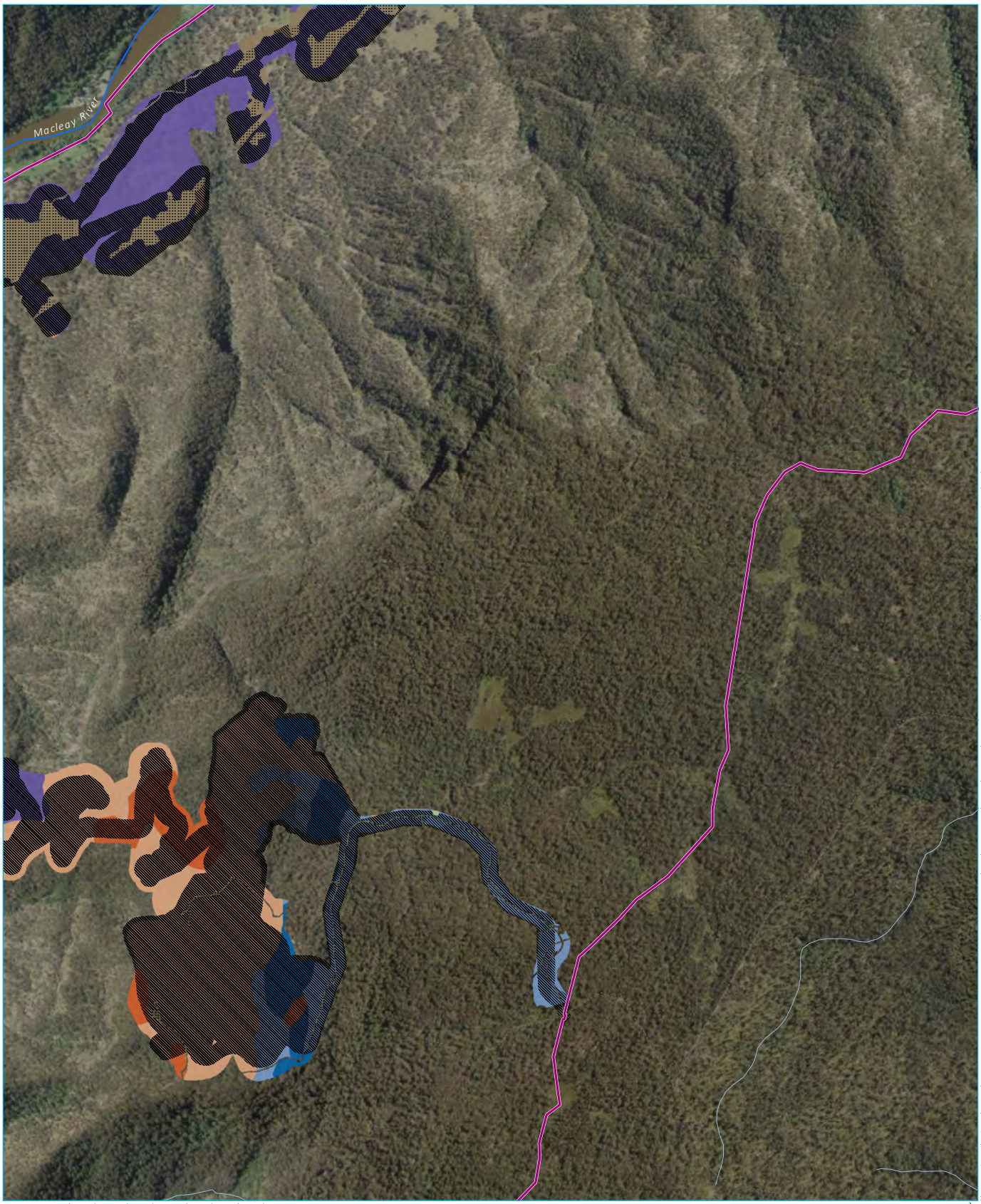
Figure 11.1

EMM creating opportunities



Source: EMM (2024); DFSI (2020); DPIE (2022); GA (2011)

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KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets

Existing environment

- Macleay River
- Watercourse/drainage line
- Vehicular track

PCT | Condition

- 1106 | High
- 1287 | High
- 762 | DNGModerate
- 762 | EG
- 762 | Moderate
- 762 | Poor
- 842 | DNGModerate
- 842 | High
- 868 | Dry
- 868 | High
- 979_High
- 988_High

Impacts requiring offsets and impacts not requiring offsets

Map 8 of 8

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 11.1

EMM creating opportunities

12 Biodiversity offset strategy

12.1 Offset requirements

Impacts and offset requirements for the Project are outlined above. The Project will result in clearing of 363 ha of native vegetation of varying condition and habitat for threatened species. A consolidated summary of the offset requirements is provided in Table 12.1 and summarised in credit class in Table 12.2. Offset requirements will be updated in the Biodiversity Offset Package to be prepared prior to any development being carried out that would impact on biodiversity values.

Table 12.1 Summary of offsets requirements for the Project

PCT ID	PCT Name/Species	Offset trading group	Credits
762	Cabbage Gum open forest or woodland on flats of the North Coast	Coastal Valley Grassy Woodlands; >=70% and <90%	0
		Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	25
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Northern Gorge Dry Sclerophyll Forests; <50%	4,843
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Northern Gorge Dry Sclerophyll Forests; <50%	1,910
979	New England Blackbutt - Diehard Stringybark dry open forest of the escarpment ranges of the eastern New England Tableland Bioregion and NSW North Coast Bioregion	Northern Escarpment Dry Sclerophyll Forests - < 50% cleared group.	296
988	New England Blackbutt - Tallowwood moist shrubby forest of the escarpment ranges of the NSW North Coast Bioregion and New England Tableland Bioregion	Northern Escarpment Dry Sclerophyll Forests - < 50% cleared group.	397
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Lowland Rainforest of Subtropical Australia	162
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Dry Rainforests - < 50% cleared group .	105
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Hunter-Macleay Dry Sclerophyll Forests; <50%	1,312
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	Northern Hinterland Wet Sclerophyll Forests; <50%	32
1287	Upland heath swamps of the New England Tableland Bioregion	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	1
	Guthrie's Grevillea	–	1160
	Tall Velvet Sea-berry	–	3092
	Wandering Pepper Cress	–	61
	Cryptic Forest Twiner	–	436

PCT ID	PCT Name/Species	Offset trading group	Credits
	Pultenaea rubescens	–	5
	Glossy Black-cockatoo	–	349
	Powerful Owl	–	1,403
	Masked Owl	–	3,945
	Brush-tailed Rock-wallaby	–	12,587
	Long-nosed Potoroo	–	3,125
	Squirrel Glider	–	10,698
	Greater Glider	–	4,514
	Brush-tailed Phascogale	–	8,407
	Koala	–	1,984
	Southern Myotis	–	529

Table 12.2 Summary of total offset credits

Credit type	Total
Ecosystem	9,056
Species	5,2377
Total	**6,1433**

12.1.1 Staging of offsets

Typically, offset liabilities need to be met before construction commences; however, Section 7.14 of the BC Act allows for the staged retirement of credits in line with the stages of development and OMPS will be seeking to separate offsets for three stages. The proposed timeframe for direct offset delivery is listed in Table 12.3 staging is shown in Figure 12.1.

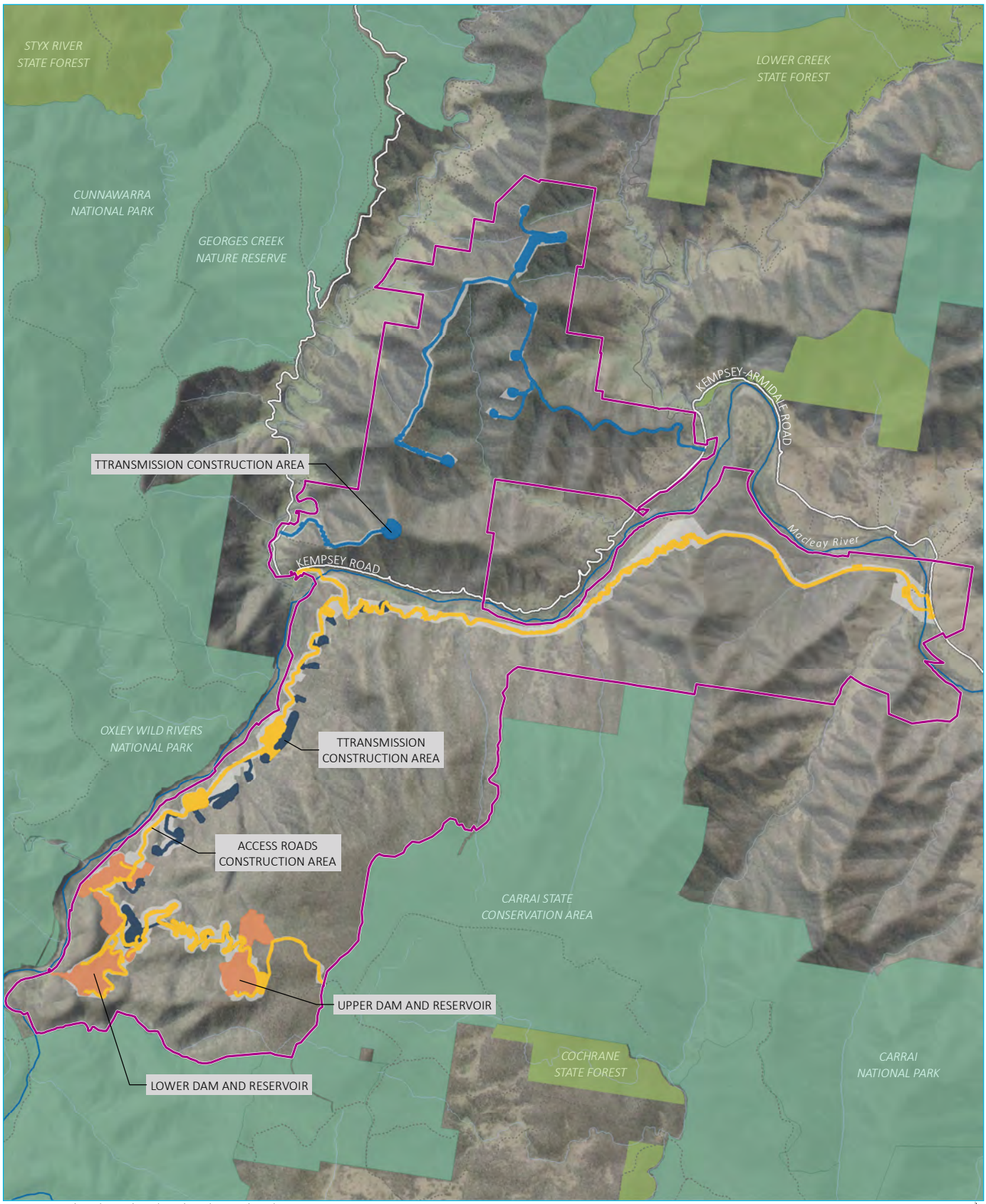
The area of each stage and the associated biodiversity credit requirements are yet to be determined as advice will be required from construction contractors to determine the exact areas required to be disturbed during each phase.

Table 12.3 Proposed timing and offsetting approach

Component	Impact	Offset timing
Stage 1: clearing for access roads and associated infrastructure	Direct loss of vegetation	Retirement of biodiversity credits within 12 months of construction and/or clearing works commencing on Stage , allowing for establishment of the on-site BSA..
Stage 2: clearing for reservoirs	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 2.

Component	Impact	Offset timing
Stage 3a: clearing for transmission line (including associated access roads & towers) south of the Macleay River at George's Junction	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 3a.
Stage 3b: clearing for transmission line (including associated access roads & towers) north of the Macleay River	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 3b.

Further, as this project is CSSI, OMPS is seeking two years from the date of approval to source initial credits for Stage 1 and 2, with credits for future construction stages to be secured before any development is carried out that would impact on biodiversity values for remaining components.



Source: EMM (2024); DFSI (2020); GA (2011); SMEC (2022)

0 1 2 km

GDA 1994 MGA Zone 56

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KEY

- Project area
- Cleared vegetation
  - Stage 1
  - Stage 2
  - Stage 3A
  - Stage 3B
- Existing environment
  - Macleay River
  - Watercourse/drainage line
  - Kempsey-Armidale Road
  - Minor road
  - Vehicular track
  - Existing transmission line
  - NPWS reserve
  - State forest

Staging of offsets

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 12.1

EMM creating opportunities

As the BAM-C for the Project combines all impact areas for the Project (i.e. they are not split by stages one to four), the following equations (as per Section 9.2 of the BAM) have been manually calculated to determine the split of credits by stage:

- Equation 1: Determine the number of ecosystem credits required for the impact on vegetation that is a TEC, contain threatened species habitat, or is any other PCT (refer to Plate 12.1); and
- Equation 2: Determine the number of fauna species credits or flora species credits required for the impact of development, activity, clearing or biodiversity certification (refer to Plate 12.2).
- Equation 3: Determine the number of flora species credits required for the impact of development, activity or biodiversity certification (refer to Plate 12.3).

Equation 1 Determine the number of ecosystem credits required for the impact on vegetation that is a TEC, contains threatened species habitat, or is any other PCT

$$\text{Ecosystem credits required for each vegetation zone} = \sum_{i=1}^{n} (\Delta\text{VI Loss} \times BRW \; x \; area) \; x \; 0.25$$

where:

i = the i^{th} vegetation zone on land directly impacted by the proposal

ΔVI Loss = the change (loss) in the vegetation integrity score of a vegetation zone at the development site as determined by Equation 27

BRW = means the biodiversity risk weighting applied to the vegetation zone. The biodiversity risk weighting for a TEC or a PCT containing threatened species habitat is based on the sensitivity to loss class of the TEC/PCT and the highest sensitivity to gain class of the predicted threatened species. For a PCT or TEC not associated with threatened species habitat, the sensitivity to loss class for the PCT or TEC is used with the low sensitivity gain class

area = the area in hectares of the vegetation zone

Plate 12.1 Equation 1, section 9.2 of the BAM (DPIE 2020a)

Equation 2 Determine the number of fauna species credits or flora species credits required for the impact of development, activity, clearing or biodiversity certification

$$\text{Number of fauna or flora species credits required} = [\textstyle\sum_{n=i}(HC_i \; x \; HL_i)] \; x \; BRW \; x \; 0.25$$

where:

HC_i = the condition of fauna or flora habitat within each vegetation zone (or portion thereof) which occurs within the i^{th} species polygon

HL_i = the area of habitat within each vegetation zone (or portion thereof) which occurs within the i^{th} species polygon for the development site or biodiversity certification proposal, prepared in accordance with Box 2

HC_i x HL_i is summed for each vegetation zone (or portion thereof) which occurs within the i^{th} species polygon

BRW = the biodiversity risk weighting for the species as set out in the TBDC

Plate 12.2 Equation 2, section 9.2 of the BAM (DPIE 2020a)

Equation 3 Determine the required number of flora species credits for the impact of development, activity, clearing or biodiversity certification

$$Number\ of\ flora\ species\ credits\ required = HI \times BRW$$

where:

HI = the number of individuals determined to be within the species polygon on the land directly impacted by the proposal, prepared in accordance with Box 2

BRW = the biodiversity risk weighting for the threatened species as set out in the TBDC

Plate 12.3 Equation 3, section 9.2 of the BAM (DPIE 2020)

The credit requirements per stage are listed in Table 12.4 (ecosystem credits) and Table 12.5 (species credits). Manual calculation data is provided in Appendix F.

Table 12.4 Summary of staged offset delivery ecosystem credits

PCT	Stage 1		Stage 2		Stage 3a		Stage 3b	
	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits
762	4.79	25	0.1	0	-	-	0.01	0
842	170.07	2,124	79.15	1,779	68.56	984	11.46	65
868	30.39	478	41.27	1,122	3.57	71	20.37	408
979	2.87	82	5.95	187	-	-	-	-
988	13.01	211	5.88	186	-	-	-	-
1106	9.41	205	0.47	5	-	-	-	-
1142	0.3	3	5.24	102	-	-	-	-
1215	24.06	286	-	-	-	-	90.21	1,124
1268	-	-	-	-	-	-	2.02	31
1287	0.16	3	-	-	-	-	-	-
TOTAL	**255.06**	**3,417**	**138.06**	**3,381**	**72.13**	**1,055**	**124.07**	**1,628**

Table 12.5 Summary of staged offset delivery – species credits

Species	Stage 1		Stage 2		Stage 3a		Stage 3b	
	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits
Brush-tailed Phascogale	154.7	3,009	73.7	2,371	54.2	1,293	103	1,734
Brush-tailed Rock-wallaby	148.14	4,573	123.99	5,947	57	2,067	-	-
Cryptic Forest Twiner	2.3	30	3.2	100	-	-	18.6	306
Glossy Black Cockatoo	1.7	39	8.9	308	0	2	-	-

Species	Stage 1		Stage 2		Stage 3a		Stage 3b	
	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits
Greater Glider	45.6	896	53.28	1,730	1.5	35	108.6	1,853
Guthrie's Grevillea	4	8	575	1,150	1	2	-	-
Koala	-	-	-	-	-	-	117	1,984
Long-nosed potoroo	22.8	440	38.52	1,283	1.4	32	88.1	1,370
Masked Owl	74.84	1,405	64.5	2,107	17.7	392	3.7	41
Powerful Owl	18	389	15.1	480	23.3	534	-	-
Pultenaea aff. parrisiae	0.4	5	-	-	-	-	-	-
Southern Myotis	27.9	411	5.47	117			0.01	1
Squirrel Glider	195.54	3,739	111.5	3,607	57	1,379	116.6	1,973
Tall Velvet Sea-berry	45	90	-	-	-	-	1501	3,002
Wandering Pepper Cres Habitat	3.5	45	1.6	16	-	-	-	-
Total	**743.72**	**15,084**	**1074.76**	**19,229**	**214.6**	**5,778**	**2056.61**	**12,264**

12.2 Objectives of the biodiversity offset strategy

The objectives of the biodiversity offset strategy are to:

- meet the requirements of the NSW Biodiversity Offset Scheme and the EPBC Environmental Offsets Policy (DSEWPaC, 2012)
- maximise the benefits to biodiversity values through the offset program
- identify offsets that have additional social, economic and/or environmental co-benefits, particularly for the local environment
- minimise costs to the Project.

12.3 Options under the Biodiversity Offsets Scheme

Under the NSW Biodiversity Offsets Scheme, several pathways are available to the proponent to meet the offset obligation arising from the Project. These pathways are shown in Plate 12.4. Funding of a biodiversity conservation action is only available for a limited set of species and communities, as set out in the *Ancillary rules: Biodiversity conservation actions* (OEH, 2017); none of these species occur. The Project is not a State Significant Development (SSD) mining project and thus ecological rehabilitation is not available. This means that offsets will need to be provided via retirement of like-for-like credits or payment into the Biodiversity Conservation Fund (BCF).

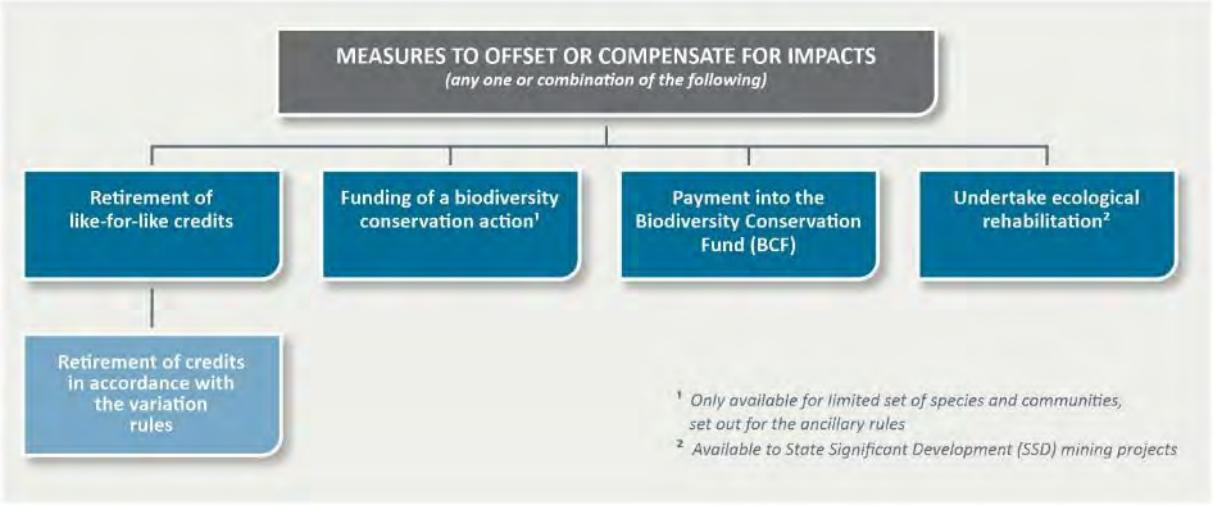


Plate 12.4 NSW Biodiversity Offset Scheme offset options

The various options available to meet the offset requirements of the are discussed below.

12.3.1 Like-for-like credits

i Credits available on the market

The Biodiversity Offset Scheme credit market allows proponents to buy biodiversity credits from landholders with biodiversity stewardship agreements in order to fulfil their offset obligation. A A review of existing credits available in the market indicates that while there are limited credits available for a number of offset trading groups or species, there are insufficient credits available to meet the needs of the Project.

ii Proponent driven offsets

OMPS have options to use the land surrounding the disturbance footprint to offset the impacts of the Project. This approach would have several benefits:

- Use of surrounding land is most likely to meet the needs of the Project by providing the right types of credits. PCTs and species impacted by the Project are likely occur within the land immediately adjacent to the site.
- This approach has the additional benefit of adding to and further protecting the adjacent National Parks.
- This approach would provide a local benefit for the Project.

Preliminary assessments, including high-level PCT mapping and some surveys for threatened species (where adjacent to the disturbance footprint), have been undertaken. This preliminary work has identified that this land is likely to generate sufficient ecosystem credits to meet a significant proportion of the offset requirements for the Project, exc with the focus on achieving the offset obligation for Stages 1, 2 and 3A.

Further detailed assessment of this land is required to provide more detailed estimates of credit yield and confirm presence of threatened species within this land and determine credit yields. Subject to agreements with the landowners, the proponent proposes to develop a Biodiversity Stewardship Agreement over this land to offset the impacts arising from the Project.

12.3.2 Credits under the variation rules

Following reasonable steps to obtain like-for-like credits the proponent may seek to retire credits under the variation rules. The variation rules allow broader trading:

- For ecosystem credits:
  - they represent the same vegetation formation
  - they are in the same or a higher offset trading group
  - they represent a location that is in:
    - the same Interim Biogeographic Regionalisation of Australia region as the impacted site, or
    - a subregion that is within 100 kilometres of the outer edge of the impacted site
  - if the impacted habitat contains hollow bearing trees—they represent vegetation that contains hollow bearing trees or artificial hollows.
- For species credits:
  - if the impacted species is a plant—they represent a plant
  - if the impacted species is an animal—they represent an animal
  - they represent a species that has the same or a higher category of listing under the BC Act as a threatened species
  - they represent a location that is in:
    - the same Interim Biogeographic Regionalisation of Australia region as the impacted site, or
    - a subregion that is within 100 kilometres of the outer edge of the impacted site.

12.4 Biodiversity Offset Package

Prior to any development being carried out that would impact on biodiversity values, a detailed Biodiversity Offset Package will be prepared that is consistent with this Biodiversity Offset Strategy. The Biodiversity Offset Package will include:

- Details of the specific biodiversity offset measures to be implemented and delivered in accordance with the EIS and this Biodiversity Offset Strategy, including the proposed location for the retirement of like-for-like credits from existing and proponent driven offset sites and certainty that this can be achieved.

- The estimated cost which would be required to be paid into the BCF if the relevant proponent driven offset measure is not implemented and delivered (as calculated in accordance with Division 6 of *the BC Act* and the biodiversity offsets payment calculator).
- The timing and responsibilities for the implementation and delivery of the measures required in the Package.
- Confirmation that the biodiversity offset measures will be implemented and delivered within two years of approval.

The Biodiversity Offset Strategy outlined herein, and the detailed Biodiversity Package to be developed post-approval will provided certainty that the residual impacts of the Project can be adequately offset.

13 Assessment of other relevant legislation

13.1 Environment Protection and Biodiversity Conservation Act 1999

On 1 February 2021, a delegate of the Federal Minister for the Environment determined that the Project was a controlled action under Section 75 of the EPBC Act. The Project will be assessed under the bilateral agreement. This section provides an assessment of the Project's impacts specific to species and communities listed under the EPBC Act. On 23 December 2022, the variation of the proposal was agreed by the delegate for the Minister (EPBC 2020/8850) this included the access road and transmission line into the Project.

In accordance with the assessment and approval process under a bilateral agreement as stated in the Matters of National Environmental Significance: Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 "If a bilateral agreement is in place the action may be assessed by the state or territory in which the action is to be undertaken, using the processes accredited under the bilateral agreement". Threatened species listed in the EPBC Act that were not identified as candidate credit species within the BDAR or species identified within the SEARs were not surveyed for. These species were either ecosystem credit species or species not triggered for assessment under the BDAR or SEARs. Candidate species and survey methodology for threatened species listed under the EPBC Act that were surveyed under the bilateral agreement can be found in Section 6 of this report.

13.2 Likelihood of occurrence

i Threatened ecological communities

Candidate EPBC Act listed endangered ecological communities (EECs) were predicted to occur in the locality based on searches of the EPBC Act Protected Matters Search Tool (PMST) including an assessment of EEC associated with PCTs recorded within the project area. The PMST identified five TECs as having potential to occur in the project area:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Lowland Rainforest of Subtropical Australia
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands
- Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions.

An assessment of the likelihood of these EECs occurring within the project area is provided in Table 13.1.

Table 13.1 Endangered ecological communities known or predicted to occur in the locality

Ecological community	Status	Habitat requirements	Likelihood of occurrence
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	The ecological community typically occurs in low-lying coastal alluvial areas with minimal relief, such as swamps, floodplain pockets, depressions, alluvial flats, back-barrier flats, fans, terraces, and behind fore-dunes. The Coastal Swamp Sclerophyll Forest typically features a canopy and/or sub-canopy dominated by *Melaleuca spp*. and/or *Eucalyptus robusta*.	Absent. No areas of lowland coastal swamp sclerophyll forest that meet the criteria of this listing were recorded within the construction envelope.

Ecological community	Status	Habitat requirements	Likelihood of occurrence
Lowland Rainforest of Subtropical Australia	Critically Endangered	The ecological community occurs on basalt and alluvial soils, including sand and old/elevated alluvial soils as well as floodplain alluvia. The ecological community is generally a moderately tall (≥20 m) to tall (≥30 m) closed forest (canopy cover ≥70%). Tree species with compound leaves are common and leaves are relatively large (notophyll to mesophyll). Typically, there is a relatively low abundance of species from the genera Eucalyptus, Melaleuca and Casuarina. Buttresses are common as is an abundance and diversity of vines.	Low. All occurrences of this PCT within the construction envelope were determined to be inconsistent with the EEC definitions under the EPBC Act as it does not meet the species richness required as per the key diagnostic characteristics of the listing advice (NSW TSSC, 2011d).
New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands	Critically Endangered	This woodland occurs in valley bottoms, flats or lower slopes, often in areas subject to cold air drainage. Characterised by a tree canopy is typically dominated (>50%) or co-dominated (>30%) by the tree species *Eucalyptus nova-anglica* (New England Peppermint). A range of other associated tree species may be present, and may be co-dominant in the ecological community, but do not dominate it by themselves, in particular *E. pauciflora* (Snow Gum) and *E. dalrympleana subsp. heptantha* (Mountain Gum). The understorey is usually made up of a dense, species-rich ground layer of grasses and herbs. Shrubs are typically sparse to absent.	Negligible. New England Peppermint was not recorded anywhere in the construction envelope. No vegetation within or adjacent to the subject land has a tree canopy dominated or co-dominated by New England Peppermint.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. Tree-cover is generally discontinuous and consists of widely spaced trees of medium height in which the canopies are clearly separated.	Negligible. White Box, Yellow Box, and Blakely's Red Gum were not recorded anywhere in the construction envelope.
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions	Endangered	Is a floodplain forest community characterised by the dominance of eucalypt and other myrtaceous trees. It may be dominated by a single tree species, or by a mix of several tree species, from five genera that characterise the ecological community. These five genera are *Angophora, Corymbia, Eucalyptus, Lophostemon* and *Syncarpia.*	Recorded. The EEC is associated with PCT 762 as part of the following vegetation class: Moderate, Poor and DNG Moderate.

ii Threatened species

The PMST and/or BAMC predicted that 27 flora species and 28 fauna species listed under the EPBC Act could occur within the project area. The likelihood of occurrence for these species is assessed in Table 13.2 and Table 13.3.

Table 13.2 Threatened flora species known or predicted to occur in the locality

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Hairy Joint grass *Arthraxon hispidus*	Vulnerable	PMST	Negligible. This species was not recorded during the surveys.
North Brothers Wattle *Acacia courtii*	Vulnerable	BAM-C	Negligible. Construction envelope is outside of its geographic restriction. This species was not recorded during the surveys.
Trailing Woodruff *Asperula asthenes*	Vulnerable	BAM-C	Negligible. This species was not recorded during the surveys.
Callistemon pungens	Vulnerable	PMST SEARs	Negligible. This species was not recorded during the surveys.
Leafless Tongue-orchid *Cryptostylis hunteriana*	Vulnerable	PMST	Negligible. This species was not recorded during the surveys.
White-flowered Wax Plant *Cynanchum elegans*	Endangered	SEARs BAM-C	Recorded This species was recorded outside of the construction envelope but within the project area. It is located approximately 180 m away from the disturbance footprint. This was recorded during surveys for offsets in 2024.
Bluegrass *Dichanthium setosum*	Vulnerable	PMST BAM-C	Negligible. This species was not recorded during the surveys.
Diuris eborensis *Diuris eborensis*	Endangered	PMST SEARs	Negligible. This species was not recorded during the surveys.
Small Snake Orchid *Diuris pedunculata*	Vulnerable	SEARs	Negligible. This species was not recorded during the surveys.
Narrow-leaved Peppermint *Eucalyptus nicholii*	Vulnerable	PMST BAM-C	Negligible. This species was not recorded during the surveys.
Euphrasia arguta	Critically Endangered	PMST SEARs	Negligible. This species was not recorded during the surveys.
Beadle's Grevillea *Grevillea beadleana*	Endangered	BAM-C	Negligible. This species was not recorded during the surveys.
Guthrie's Grevillea *Grevillea guthrieana*	Endangered	PMST SEARs BAM-C	Recorded. This species was recorded at multiple locations within the survey area south of the Macleay River. This species was recorded along creek lines and steep cliff areas close to creek and drainage lines and gullies.
Gorge Hakea *Hakea fraseri*	Vulnerable	BAM-C	Negligible. This species was not recorded during the surveys.
Big Nellie Hakea *Hakea archaeoides*	Vulnerable	BAM-C	Negligible. This species was not recorded during the surveys.

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Tall Velvet Sea-berry *Haloragis exalata* subsp. *velutina*	Vulnerable	PMST SEARs BAM-C	Recorded. This species was recorded at multiple locations. South of the Macleay River, this species was associated with wet creek lines. North of the Macleay River this species was associated with steep wet slopes.
Wandering Pepper Cress *Lepidium peregrinum*	Endangered		Recorded. This species was recorded along the eastern bank of the Macleay River with one individual recorded along the northern bank of the Macleay River.
Macadamia Nut *Macadamia integrifolia*	Vulnerable	PMST	Negligible. Habitat in the project area is considered unsuitable given the absence of associated PCTs. The project area is outside of the known distribution for this species. The closest record of this species occurring is in Bellingen. The species was not recorded during surveys.
Slender Marsdenia *longiloba*	Vulnerable	PMST SEARs BAM-C	Negligible. This species was not recorded during the surveys.
Biconvex Paperbark *Melaleuca biconvexa*	Vulnerable	BAM-C	Negligible. Construction envelope is outside of its geographic restriction.
Milky Silkpod *Parsonsia dorrigoensis*	Endangered	BAM-C	Negligible. This species was not recorded during the surveys.
Pultenaea rubescens Pultenaea sp. Werrikimbe	-	-	Recorded. This species is not associated with any PCTs within the study area. Specimens of a *Pultenaea* sp. recorded on site during targeted surveys have been sent to herbarium for identification but could not be definitively identified at that time. At the time of survey, it was considered that the specimen could be Parris' Bush-pea (*Pultenaea parrisiae*) or an as yet undescribed *Pultenaea* spp. In July 2023 confirmation was received from the herbarium that the plants recorded on site were a new species for the genus. There is an existing phrase name for this taxon; *Pultenaea* sp. Werrikimbe NP. However, it is proposed to recognise this as a distinct species, *Pultenaea rubescens* (Barrett, in prep 2023).
Scrub Turpentine *Rhodamnia rubescens*	Critically Endangered	PMST SEARs	Recorded. This species was recorded outside of the construction envelope within the transmission line as regrowth from fire affected individuals or as juveniles. All individuals were infected by myrtle rust fungus.
Native Guava *Rhodomytus psidioides*	Critically Endangered	PMST	Negligible. Habitat in the project area is considered unsuitable given the absence of associated PCTs. Closet record of this species occurring is Ngambaa Nature Reserve towards South West Rocks. The species was not recorded during surveys.
Ravine Orchid *Sarcochilus fitzgeraldii*	Vulnerable	PMST SEARs	Negligible. This species was not recorded during the surveys.

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Austral Toadflax *Thesium australe*	Vulnerable	PMST	Negligible. Habitat in the project area is considered unsuitable given the absence of associated PCTs. Closet record of this species occurring is Armidale. The species was not recorded during surveys.
Cryptic Forest Twiner *Tylophora woollsii*	Endangered	PMST SEARs	Assumed presence. Three Tylophora specimens were recorded in 2022 during the flora surveys. Samples were sent to the herbarium for confirmation but could not be confirmed due to lack of flowering part for identification. The known locations of this species were resurveyed in the flowering period in 2023 and 2024. Additional *Tylophora* specimens were recorded in 2024. Both survey efforts failed to observe this species in flower, which is the key distinguishing feature to identify this species from the more common Thin-leaved Twiner (*Tylophota paniculata*). Due to the lack of flowering specimens, samples were undertaken in 2024 for genetic analysis. Genetic analysis showed that the plants sampled from the Project area are genetically similar to both the Thin-leaved Twiner and Cryptic Forest Twiner. Based on the data analysis conducted to date, the species may not be clearly distinguishable based on commonly used plant genetic barcodes. Using the precautionary principle, the records within the construction envelope remain

Note * PMST - indicates that the species was returned from the EPBC Protected Matter Search Tool.

BAM-C - indicates that the species was returned from the BAM Calculator based on the PCTs present.

SEARs – indicates that the species, although not returned from the BAM-C or PMST was referenced in the SEARs as possibly affected.

Table 13.3 Threatened fauna species known or predicted to occur in the locality

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Birds			
Regent Honeyeater *Atnthochaera phrygia*	Critically Endangered	PMST BAM-C SEARs	Low. Potential habitat was recorded in the project area. Unlikely to breed in the construction envelope or regularly forage there but may forage there intermittently. The species was not recorded during surveys.
Rufous Scrub-bird *Atrichornis rufescens*	Endangered	PMST	Negligible. This species occurs above 600 m elevation in subtropical, warm temperate and cool temperate rainforests and wet sclerophyll forests. Species requires suitable areas of wet rainforest habitat that is absent within the project area. The species was not recorded during surveys.
Australasian Bittern *Botaurus poiciloptilus*	Endangered	PMST BAM-C	Negligible. Associated wetland habitats are absent from the construction envelope.
Curlew Sandpiper *Calidris ferruginea*	Critically Endangered	PMST	Negligible. Associated habitats, including intertidal mudflat or mud and sand edges of lakes, are absent from the construction envelope.

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Coxen's Fig-Parrot *Cyclositta diophthalma coxeni*	Endangered	PMST	Negligible. The project area is outside of the known distribution for this species. Closet historical records are around Coffs Harbour. This species has not been recorded in Australia for over 50 years. The species was not recorded during surveys.
Eastern Bristlebird *Dasyornis brachypterus*	Endangered	PMST SEARs	Negligible. In northern NSW this species requires dense tussocky grass understorey and sparse mid-storey near rainforest ecotone. Generally found more towards the coast. Closest records are around Dorigo. This project area does not contain suitable habitat to support this species. The species was not recorded during surveys.
Red Goshawk *Erythrotriorchis radiatus*	Vulnerable	PMST	Negligible. This project area is located just south of the southernmost distribution for this species. This species hunts along permanent water and riparian habitats along watercourses or wetlands. Closest record is in Armidale. The species was not recorded during surveys.
Grey Falcon *Falco hypoleucos*	Vulnerable	PMST	Negligible. The project area is outside of the known distribution for this species. The species was not recorded during surveys.
Painted Honeyeater *Grantiella picta*	Vulnerable	PMST	Negligible. There are no records of the species in the Project's locality. Closest records are in Armidale. The project area lacked large numbers of trees that supported mistletoe, the main food source for this species. The species was not recorded during surveys.
White-throated Needletail *Hirundapus caudacutus*	Vulnerable	PMST BAM-C SEARs	Recorded. This species was recorded flying overhead near the Macleay River along the proposed access route.
Swift Parrot *Lathamus discolor*	Critically Endangered	PMST BAM-C SEARs	Low. Potential habitat was recorded in the project area. The species was not recorded during surveys. This species only breeds in Tasmania and is therefore highly unlikely to breed in the construction envelope or regularly forage there but may forage there intermittently. The species was not recorded during surveys.
Eastern Curlew *Numenius madagascariensis*	Critically Endangered	PMST	Negligible. This species is a shoreland and coastal wetland species. The Project is outside the known species distribution.
Australian Painted Snipe *Rostratula australis*	Endangered	PMST BAM-C	Negligible. Associated wetland habitats are absent from the construction envelope.

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Mammals			
Large-eared Pied Bat *Chalinolobus dwyeri*	Vulnerable	PMST SEARs BAM-C	Negligible. The species was not recorded during surveys.
Spotted-tailed Quoll *Dasyurus maculatus*	Endangered	PMST BAM-C SEARs	Recorded. The species was recorded sporadically within the construction envelope, largely restricted in the higher and rocky terrain associated with the project area.
Greater Gilder *Pelauroides Volans*	Endangered	PMST SEARs BAM-C	Recorded. This species was recorded around the flatter terrain at the Carrai Plateau.
Yellow-bellied Glider *Petaurus australis australis*	Vulnerable	PMST BAM-C	Recorded. This species was recorded around the flatter terrain at the Carrai Plateau.
Brush-tailed Rock-wallaby *Petrogale penicillata*	Vulnerable	PMST SEARs BAM-C	Recorded. This species was recorded throughout the project area south of the Macleay River, largely associated with cliffs, escarpments, rocky areas and steep terrain.
Koala *Phascolarctos cinereus*	Endangered	PMST SEARs BAM-C	Recorded. Evidence of Koala was recorded to the north of Macleay River with old scats found near the river in the most eastern section of the access road.
Long-nosed Potoroo *Potorous tridactylus*	Vulnerable	PMST SEARs	Recorded. This species was recorded at higher altitudes where the understorey was more intact and were habitat comprised of damper and thicker understory. Recorded above within the Carrai Plateau and along the transmission line.
New Holland Mouse *Pseudomys novae-hollandiae*	Vulnerable	PMST SEARs	Negligible. No potential habitat was recorded in the project area, this species occurs on sandstone country (Wilson & Laidlaw, 2003), this species requires deeper topsoils and softer substrates for digging burrows, this species was not recorded during surveys.
Hastings River Mouse *Pseudomys novaehollandiae*	Endangered	PMST SEARs	Recorded. This species was recorded throughout the survey area.
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable	PMST SEARs BAM-C	Recorded. This species was recorded either feeding or commuting through the project area.
Frogs			
Stuttering Frog *Mixophyes balbus*	Vulnerable	PMST SEARs BAM-C	Negligible. This species was not recorded during the surveys.
Green and Golden Bell Frog *Litoria aurea*	Vulnerable	BAM-C	Negligible. Associated swamp, semi-permanent/ephemeral wet areas are absent from the construction envelope.

Name (common and scientific)	Status	Source*	Likelihood of occurrence
Booroolong Frog *Litoria booroolongensis*	Endangered	BAM-C	Negligible. This species occurs west of the great dividing range. The project area is outside of the known distribution for this species. The species was not recorded during surveys.
Giant Barred Frog *Mixophyes iteratus*	Endangered	BAM-C	Negligible. No permanent or semi-permanent creeks within the Macleay Hastings IBRA sub-region contained suitable habitat such as rainforest with deep leaf litter for this species.
Reptiles			
Three-toed Snake-tooth Skink *Coeranoscincus reticulatus*	Vulnerable	PMST SEARs	Negligible. Habitat in the project area is considered unsuitable given the absence of associated PCTs. The project area is outside of the known distribution for this species. Closet historical records are around Coffs Harbour.

Note* PMST - indicates that the species was returned from the EPBC Protected Matter Search Tool.

BAM-C - indicates that the species was returned from the BAM Calculator based on the PCTs present.

SEARs – indicates that the species, although not returned from the BAM-C or PMST was referenced in the SEARs as possibly affected.

Seven threatened flora and nine threatened fauna species were recorded within the project area, listed below. For the locations of the species credit threatened species recorded within construction envelope, refer to Section 6.3.5.

- White-flowered Wax Plant
- Guthrie's Grevillea
- Tall Velvet Sea-berry
- Wandering Pepper Cress
- *Pultenaea rubescens*
- Scrub Turpentine
- Cryptic Forest Twiner (assumed presence)
- White-throated Needletail
- Spotted-tailed Quoll
- Greater Glider
- Yellow-bellied Glider
- Brush-tailed Rock-wallaby
- Koala
- Long-nosed Potoroo

- Hastings River Mouse
- Grey-headed Flying-fox.

These species are discussed further in Section 13.2.2.

iii Migratory species

Thirteen species listed as migratory under the EPBC Act were predicted to occur in the project area based on database searches undertaken. Table 13.4 provides an assessment of the likelihood of these species using the habitat within the construction envelope.

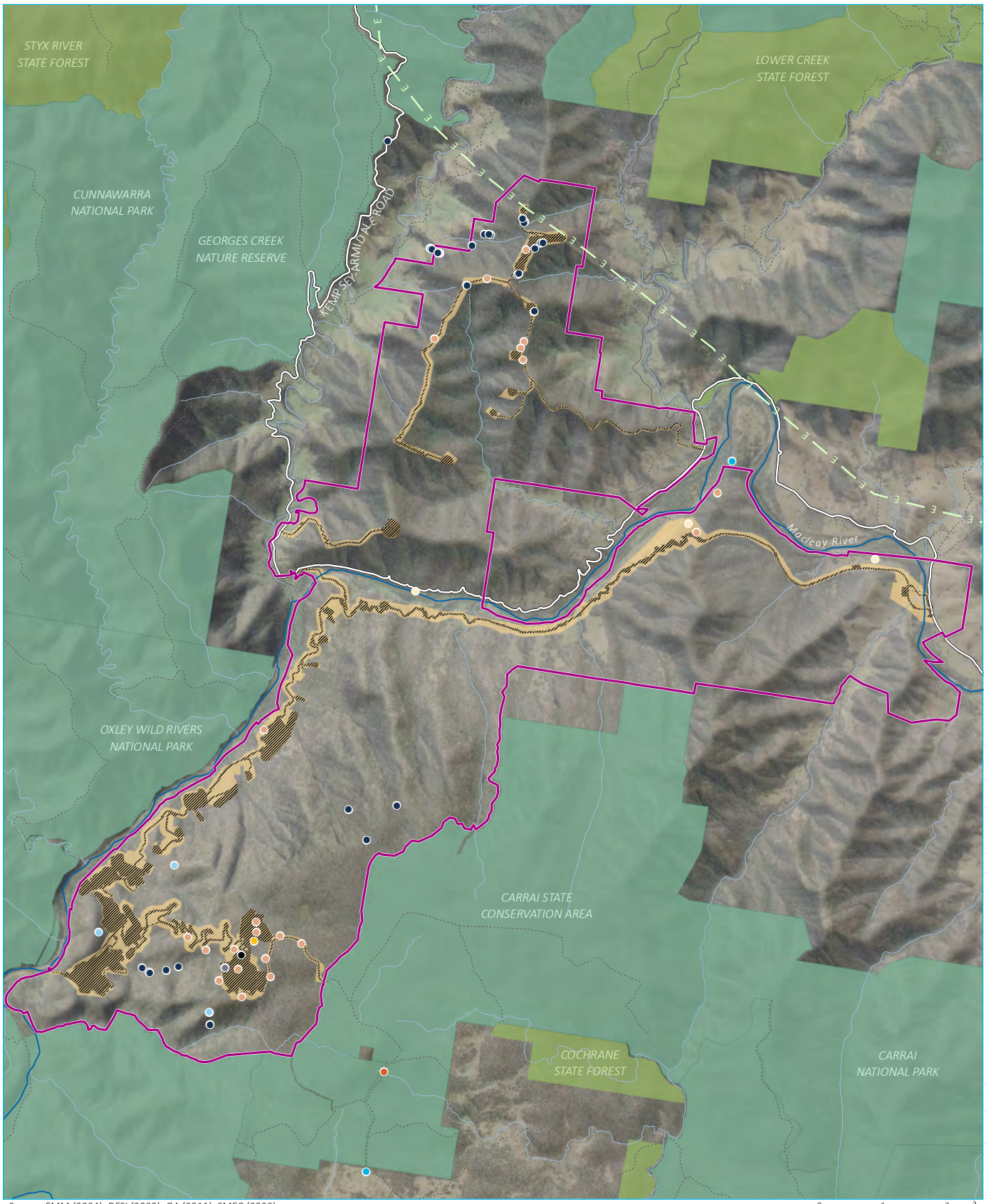
Table 13.4 Likelihood of occurrence for migratory species

Name (common and scientific)	Status	Source	Likelihood of occurrence
Black-faced Monarch *Monarcha melanopsis*	Migratory	PMST	Recorded. This species was recorded within the project area.
Spectacled Monarch *Monarcha trivirgatus*	Migratory	PMST	Moderate. Potential habitat was recorded in the project area. This species has been recorded within Oxley Wild National Park, located adjacent to the project area.
Common Sandpiper *Actitis hypoleaucos*	Migratory	PMST	Negligible. This species is a shoreland and coastal wetland species. The Project is outside the known species distribution.
Curlew Sandpiper *Calidris ferruginea*	Critically Endangered, migratory	PMST	Negligible. This species is a shoreland and coastal wetland species. The Project is outside the known species distribution.
Eastern Curlew *Numenius madagascariensis*	Critically Endangered, migratory	PMST	Negligible. This species is a shoreland and coastal wetland species. The Project is outside the known species distribution.
Fork-tailed Swift *Apus pacificus*	Migratory	PMST	Moderate. This species is mainly an aerial species and is likely to fly over the project area.
Oriental Cuckoo *Cuculus optatus*	Migratory	PMST	Negligible. Likely to be a vagrant species further south of QLD, where the majority of the records occur.
Latham's Snipe *Gallinago hardwickii*	Migratory	PMST	Moderate–high. Substantial wetland habitats are absent from the construction envelope but creek lines and the flood plains of the Macleay River constituting potential habitat are present. Historical species records occur within the project area.
Osprey *Pandion haliaetus*	Migratory	PMST	Low–Moderate. This species is largely coastal, preferring rocky shorelines, islands and reefs. Historical records occur along the Macleay River, it is considered likely they are from individuals moving through the area or juveniles dispersing. They are unlikely to use the project area for breeding.

Name (common and scientific)	Status	Source	Likelihood of occurrence
Pectoral Sandpiper *Calidris melanotos*	Migratory	PMST	Negligible. This species is a shoreland and coastal wetland species. The Project is outside the known species distribution.
Rufous Fantail *Rhipidura rufifrons*	Migratory	PMST	Recorded. This species was recorded within the project area.
Satin Flycatcher *Myiagra cyanoleuca*	Migratory	PMST	Recorded. This species was recorded within the project area.
Sharp-tailed Sandpiper *Calidris acuminata*	Migratory	PMST	Negligible. This species is a shoreland and coastal wetland species. The project is outside the known species distribution.
White-throated Needletail *Hirundapus caudacutus*	Migratory	PMST	Recorded. This species was recorded within the project area.
Yellow Wagtail *Motacilla flava*	Migratory	PMST	Negligible. Species is a vagrant and preferred wetland habitats are absent from the construction envelope.

Four listed migratory species under the EPBC Act were recorded within the project area, with four species that are likely to occur infrequently and sporadically listed below. Figure 13.1 shows the location of recorded migratory species that are listed under the EPBC Act.

- Migratory species recorded within the project area:
  - Black-faced Monarch
  - Satin Flycatcher
  - Rufous Fantail
  - White-throated Needletail.
- Migratory species likely to occur infrequently and sporadically:
  - Spectacled Monarch
  - Fork-tailed Swift
  - Latham's Snipe
  - Osprey.



Source: EMM (2024); DFSI (2020); GA (2011); SMEC (2022)

0 1 2 km

GDA 1994 MGA Zone 56

N

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Species sighting

- Black-faced Monarch
- Grey-headed Flying-fox
- Hastings River Mouse
- Satin Flycatcher
- Scrub Turpentine
- Spotted-tailed Quoll
- White-flowered Wax Plant
- White-throated Needletail
- Yellow-bellied Glider

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

EPBC listed ecosystem and migratory species records

Oven Mountain Pumped Hydro Energy Storage Project
Biodiversity development assessment report
OMPS Pty Ltd
Figure 13.1

EMM creating opportunities

13.2.2 Significant impact assessments

The following section contains the significant impact assessment for one EEC, seven threatened flora, nine threatened fauna and eight migratory species. An assessment of significance for these species, in accordance with the assessment criteria for critically endangered, endangered and vulnerable species (DoE, 2013b), is provided below.

i Endangered Ecological Communities

One endangered ecological communities (EEC) was recorded within the project area. PCT 762 align with Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions listed as an EEC under the EPBC Act. An assessment of significance for the removal of 0.3 ha of this EEC, in accordance with the assessment criteria for EECs (DoE, 2013b), is provided in Table 13.7. This assessment concluded that the Project is unlikely to result in a significant impact on the listed community as the EEC is considered to be of moderate condition (Class C2).

a Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions

The Commonwealth Approved Conservation Advice for the endangered Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions (DCCEEW, 2022) provides a general description of the community and describes its current status. Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions occurs on the floodplains of the eastern watershed of the Great Dividing Range, from mid NSW (Newcastle area) to just north of Gladstone in Queensland. Much of the community's original distribution has been cleared for agriculture, and most remaining patches are located on productive agricultural land and/or coastal areas where urban development is expected (DCCEEW, 2022).

The community is characterised by the dominance of myrtaceous trees specifically from the *Eucalyptus, Angophora, Corymbia, Lophostemon* and *Syncarpia* genera. Clearing may have reduced the canopy to scattered trees, however in its undisturbed state it varies from tall open forest to woodland with 40–60% crown cover (DCCEEW, 2022). A mid-layer of small trees (e.g. from the Melaleuca and Leptospermum genera) may be present with scattered to dense shrubs, and an understory that is generally more diverse and abundant than ecological communities on adjoining slopes (DCCEEW, 2022).

Section 4 of the Approved Conservation Advice (DCCEEW, 2022) lists clearing and selective harvesting, changed fire and hydrological regimes, grazing, invasive flora and fauna, climate change, disease, pathogens and dieback, and human disturbance as the primary impacts to this ecological community.

While the Approved Conservation Advice (ACA) (DCCEEW, 2022) as a whole was used to identify the presence of this ecological community within the construction envelope, Sections 2.1, 2.2 and Table 2 in the ACA contain specific criteria that must be addressed to determine the presence and condition of this ecological community. Section 2.1 and 2.2 in the ACA were used first, to generate a list of patches that have the potential to be the EEC.

The Key Diagnostic Characteristics from Section 2.1 of the Approved Conservation Advice (DCCEEW, 2022) are summarised below.

Table 13.5 Assessment key diagnostic criteria for Subtropical eucalypt floodplain forest and woodland

EEC key diagnostics	Project area assessment
It occurs in the New South Wales North Coast (NNC) and South Eastern Queensland (SEQ) IBRA bioregions, and on Curtis Island in the Brigalow Belt North IBRA Bioregion (BBN).	The Project occurs within the New South Wales North Coast (NNC) IBRA region.

EEC key diagnostics	Project area assessment
It occurs in the catchments of the eastern watershed of the Great Dividing Range, typically in their lower reaches.	The Macleay River is part of the eastern watershed of the Great Dividing Range. However, the site occurs along mid reaches of this waterway (not lower).
It occurs at elevations up to 250 m above sea-level (ASL), most typically below 50 m ASL.	The minimum elevation within the project area is 145 m AHD.
It occurs on alluvial landforms including river floodplains, riparian zones (e.g. along riverbanks, lake foreshores and creek lines), the floors of tributary gullies, floodplain pockets, alluvial flats, fans, terraces, and localised colluvial fans; as well as on localised depressions amongst low rises and on associated sites where water can pond.	Extensive alluvial landforms occur along the Macleay River, and adjacent riparian zones support alluvial flats. Localised colluvial fans and localised depressions amongst low rises. All patches are considered to meet this key diagnostic criteria.
It occurs on alluvial soils of various textures including silts, clay loams, sandy loams, gravel and cobbles.	The Macleay River floodplain contains various alluvial soils due to the varied nature of flow regimes along its course.
It does not typically occur on soils that are primarily marine or aeolian sands, but may occur on such substrates after they have been modified by fluvial activity.	The project area is located 70 km inland with the Macleay River comprised of fresh water conditions not considered to be marine or contain aeolian sands.
It occurs as a tall closed-forest, tall open-forest, closed forest, open forest, tall woodland, or woodland (Specht RL, 1970). The canopy has a crown cover of at least 20%.	The EEC is associated with tall open-forest that has had impacts from historical clearing.
It has a canopy dominated by one or a combination of Angophora, Corymbia, Eucalyptus, Lophostemon and/or Syncarpia tree species, but not dominated by *Eucalyptus robusta* (Swamp Mahogany). Other canopy tree species may be present, and in some areas rainforest trees may be prominent.	Canopy included a mixture of Eucalyptus, Corymbia and Angophora species and was not dominated by Swamp Mahogany.
A mid-layer (including a sub-canopy, and/or shrub-layer) may be present, sparse or absent; and fauna may be abundant or rare.	Mid-layer within the project area was open with only sparse shrub layer, generally comprised of weed species such as lantana.

Section 2.2 of the Approved Conservation Advice (DCCEEW, 2022) provides additional information to assist in identifying the ecological community. The key points are summarised below:

- The smallest patch size that can be identified is 0.5 ha, because the key diagnostic characteristics cannot reliably be identified for smaller areas.
- When it comes to defining a patch of the ecological community, allowances are made for 'breaks' of up to 30 m between areas that meet the key diagnostic characteristics.
- Where there is a break in the ecological community of 30 m or more then the gap indicates that separate patches are present. This includes breaks "due to a different type of vegetation" (DCCEEW, 2022, p. 14).

Using the above criteria, four potential patches of the EEC were identified. These four patches were then assessed against the conditions categories, classes and thresholds in Table 2 of the Approved Conservation Advice (DCCEEW, 2022) (Plate 13.1) to determine the condition class of the patches. Following this assessment all four patches were determined to be Class C2. This assessment is provided in Table 13.6 below.

Table 2: Condition categories, classes and thresholds

<table>
<tr><th colspan="2">Patch size thresholds →
Biotic thresholds ↓</th><th>Large patch
Patch size ≥2 ha</th><th>Small contiguous[4] patch ≥ 0.5 ha, within a larger area of native vegetation ≥ 5 ha</th><th>Small patch
Patch size ≥ 0.5 ha</th></tr>
<tr><th>Vegetation</th><th>Arboreal mammals</th><th colspan="3"></th></tr>
<tr><td>HIGH CONDITION
Ground cover richness[1] ≥ 10 native species per sample plot
AND
≥ 20 large native trees[2] per ha.
AND
≥ 80% of its total perennial understorey vegetation cover[3] comprises native species</td><td></td><td colspan="2">CLASS A1
Large or contiguous[4] patch, with high quality understorey and many large native trees</td><td>CLASS B1
Small patch, with high quality understorey and many large native trees</td></tr>
<tr><td rowspan="2">GOOD CONDITION
Ground cover richness[1] ≥ 6 native species per sample plot
AND
≥ 10 large native trees[2] per ha.
AND
≥ 50% of its total perennial understorey vegetation cover[3] comprises native species</td><td>AND
≥5 species of arboreal mammals[5] detected[6] in the patch.</td><td colspan="2">CLASS A2
Large or contiguous[4] patch, with good quality understorey, large native trees and evidence of many arboreal mammal species</td><td>CLASS B2
Small patch, with good quality understorey, large native trees and evidence of arboreal mammals</td></tr>
<tr><td></td><td colspan="2">CLASS B3
Large or contiguous[4] patch, with good quality understorey and large native trees</td><td>CLASS C1
Small patch, with good quality understorey and large native trees</td></tr>
<tr><td>MODERATE CONDITION
Ground cover richness ≥ 4 native species per sample plot[1]
AND at least one of:
≥ 6 very large native trees[7] per ha
AND/OR
≥ 30% of its total perennial understorey vegetation cover[3] comprises native species</td><td></td><td colspan="2">CLASS C2
Large or contiguous[4] patch, with moderate quality understorey and/or some very large native trees</td><td>Not nationally protected</td></tr>
<tr><td colspan="5">Notes
[1] Ground cover richness includes combined species richness of native grasses, forbs, ferns and sedges per 0.04 ha (20 x 20 m sample plot) on average.
[2] Large native trees are greater than 45 cm [diameter at breast height (dbh)]. This is used as a surrogate for tree hollows and other habitat values. These should be counted, and averaged across the patch as a whole. For larger patches, they can be counted in plots of at least 0.5 ha.
[3] Perennial understorey vegetation cover includes all vegetation below the canopy layer, from species with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs, shorter trees, juvenile canopy species, resprouting or suckering of the lower portions of canopy trees, and cryptograms; but it does not include annual plants, plant litter, or exposed soil.
[4] Contiguous means the patch is connected to, or in close proximity to (i.e., within 30 m of), one or more areas of native vegetation (i.e., an area where the total perennial vegetation cover is dominated (50% or more) by native plant species).
[5] For the purposes of this calculation, evidence of any number of micro-bat species (Microchiroptera) found in the patch counts as one species of arboreal mammal.
[6] Survey guidelines include DSEWPC (2011).
[7] Very large native trees are greater than 60 cm dbh. These should be counted, and averaged across the patch as a whole. For larger patches, they can be counted in plots of at least 0.5 ha (i.e., an average of 3 very large native trees per 0.5 ha plot).</td></tr>
</table>

Plate 13.1 Condition categories, classes and thresholds

Table 13.6 Key diagnostic characteristics per patch

Key diagnostic characteristics[5]	GEN-TEC-01	EAR-TEC-01	EAR-TEC-02	EAR-TEC-03
Ground cover richness	≥10	≥10	≥10	≥10
Very large trees/ha	30	30	30	10
Native perennial understorey vegetation cover %	6.84%	6.84%	6.84%	1.3%
Determination	**Class C2** **Despite being below understorey cover thresholds, all patches meet large tree and groundcover richness thresholds.**			

Table 13.7 Assessment of significance for Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions

Criteria	Discussion
Reduce the extent of an ecological community.	The impact area has been designed to avoid as much of the endangered ecological community (EEC) as practicable. The proposed activity would remove approximately 0.3 ha of the EEC in moderate (Class C2) condition.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.	The patches impacted on have moderate connectivity to other intact patches of the ecological community in the broader landscape. Impacts from the proposed works are mainly on the outer edges of patches adjacent to existing clearing. Some areas may be fragmented where access roads pass through patches; however, this will be limited to the width of the road. Due to the already fragmented patches existing within the project area and the small amount of clearance required for the access road. Further, extensive areas of the community adjacent to the disturbance footprint will ensure genetic exchange can continue to occur. The Project is unlikely to significantly fragment or isolate any occurrence of the community.
Adversely affect habitat critical to the survival of an ecological community.	No critical habitat, as defined under Section 207A of the EPBC Act, has been identified or included in the register of critical habitat for this species. Habitat critical to this EEC, as listed in the conservation advice (DCCEEW, 2022), is comprised of patches that are in the 'best' condition and those that represent parts of the EEC with the highest diversity, most intact structure and ecological functions. These are classified as Class A and Blass B (high and good condition). Patches within the disturbance footprint are considered to be of moderate condition (Class C2). This is still classified as habitat critical for this EEC if they occur in locations important for biodiversity or have the potential to recover or be restored. The patches located along the floodplain contains degrees of degradation from historical clearing, grazing and weed infestation, therefore unlikely to be considered habitat critical for this EEC. The activity is therefore unlikely to have a significant adverse impact on critical habitat for the community.

[5] Note that the patch data for GEN-TEC-01, EAR-TEC-01, and EAR-TEC-02 was based off one plot: EAR31. This is because this was the only plot undertaken within the vegetation zone that these three patches are located in (762_Moderate). Patch EAR-TEC-03 had no plot data within the patch so plot EAR14 was used as this plot was undertaken within the same vegetation zone that this patch is located in (762_Poor).

Criteria	Discussion
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.	Because the land use is effectively unchanged from the present, it is not expected to significantly alter the existing abiotic factors which currently exist within the area. The existing surface water drainage will remain as it is at present. Disturbed areas will be reinstated to match existing landforms, trenches will be backfilled with the previously excavated subsoil material and care will be taken to maintain separation between topsoil from subsoil during this process. Soil conditions would therefore remain largely unchanged. There is unlikely to be a significant change to abiotic factors for the community within or outside of the immediate area of direct impact.
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 Project will result in the reduction of 0.3 ha of the ecological community. The Project also has the potential to increase weeds within the project area that my affect the quality of the habitat of the community. Mitigation measures will be implemented to protect the community, these include: • weed control prior to construction works being undertaken, where possible • appropriate disposal and management of weeds during clearing works • collection of native seed for rehabilitation propagation • implementation of a weed monitoring program. Therefore, given the extent of the ecological community and the mitigation measures in place to protect the quantity and quality of remaining vegetation it is unlikely the Project will result in a substantial reduction in quality of the listed community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community.	With the impact mitigation and management proposed, the impact is unlikely to cause any substantial reduction in quality or integrity of the community outside of the area of direct impact.
Interfere with recovery of an ecological community	No recovery plan is required for this EEC as it is not considered to provide benefits to the conservation advice (DCCEEW, 2022). The Project could potentially contribute to the following EPBC-listed threatening processes: • land clearance • loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants • novel biota and their impact on biodiversity. Mitigation measures will be applied to minimise the risk of indirect impacts such as weed invasion and the introduction of pathogens. For instance, machinery will be cleaned between sites to reduce the chance of weed and pathogen spread. Removal of 0.3 ha would contribute to the land clearance key threatening process affecting the community and would thereby interfere with the recovery of this community.
Consideration of impacts from 2019–2020 bushfires.	This EEC occurs along the flood plans in the local area. The FRSM shows that large areas of the Macleay River flood plan were unburnt, with patches of potential areas that may contain the EEC as having a low to medium FESM severity class, therefore it is not considered that the EEC within the development footprint is critical to the survival of this EEC as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the activity is unlikely to significantly impact on this EEC.

ii Threatened flora

a White-flowered Wax Plant (Endangered)

Table 13.8 White-flowered Wax Plant (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	The number of distinct populations of White-flowered Wax Plant is unknown but is expected to be large given the wide distribution of the species. The species is distributed from Brunswick Heads in the north to Gerroa in the south. One individual was recorded within the Project area, outside of the construction envelope. The action would therefore not lead to a long-term decrease in the size of the population as no species are being impacted.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of individuals or potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	The Project is not considered to fragment a population, as only one species was recorded, and this was approx. 180 m from the disturbance footprint. The Project is also unlikely to interfere with seed dispersal as seeds are wind dispersed.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the White-flowered Wax Plant under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat that is critical to the survival of White-flowered Wax Plant is likely to include areas containing large populations, particularly those at the extremities of the species' distribution, that are likely to be important for breeding, dispersal, maintenance of genetic diversity, long-term evolutionary development and reintroduction. Habitat critical to the survival of this species is not considered to occur within the construction envelope. PCTs that this species is associated with are being cleared because of the proposed works, but these areas are not considered critical habitat.
Would the action disrupt the breeding cycle of a population?	The Project would not disrupt the breeding of this individual due to its distance from the proposed works (approx. 180 m away). The disturbance footprint that is situated in the vicinity, is considered unlikely to affect the breeding cycle between this plant and other potential individuals, as parts of the disturbance footprint are only around 20 m wide and this species' seeds are wind dispersed.
Would the action 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 will not impact on the single individual recorded or its proximal habitat. The Project will however remove habitat that this species is associated with. Within the IBRA sub-region that it was found, this species is associated with PCTs 3099, 3251, 3254, and 3464. These PCTs equate to PCT 1142, 1215, 1268, and 868 respectively. From these four PCTs, 126.4 ha will be cleared as part of the proposed works. The removal of this species' associated habitat has the potential to affect its recovery, though not to the extent that it would cause the species to decline. The Project is therefore unlikely to degrade remaining habitat so that it results in further decline of the species.

Criteria	Discussion
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect White-flowered Wax Plant and the Project is unlikely to introduce pathogens to the area.
Would the action interfere with the recovery of the species?	No recovery plans are listed on the Species Profile and Threats Database for White-flowered Wax Plant, however, a recovery plan from 1993 was found (Maria Matthes, Sharon Nash, 1993). The actions below are taken from this plan: • Negotiations to develop Conservation Agreements for unprotected populations, where possible • Liaison with agencies and landholders to make them aware of C. elegans, protection issues and the importance of its habitat • Fencing sites to protect from disturbance • Undertake research into population dynamics • Implement bush regeneration programs • Establish ex-situ cultivation for threatened populations • Implement a seed collection and storage program • Undertake research into genetic distinctiveness between and within populations • Undertake further survey of suitable habitats for new populations, and • Implement management plans for C. elegans. In addition to the above actions, a subset of the actions recommended in the Conservation Advice are provided below: • ensure land clearing, urban development, road widening and maintenance activities in areas where the White-flowered Wax Plant occurs do not have a significant adverse impact on the species • investigate the fire ecology of this species to determine if and when ecological burns are required and if necessary, implement an appropriate fire management regime. • ensure bush regenerators can identify this species and do not mistake it for the common exotic climber, Moth Plant. • undertake appropriate seed collection and storage. • undertake survey work in suitable and potential habitat to locate any additional populations/occurrences/remnants. • manage sites to prevent introduction of invasive weeds, which could become a threat to the White-flowered Wax Plant, using appropriate methods. The Project will not interfere with the identified recovery actions for the species. No individuals are being removed as a result of the Project.
Consideration of impacts from 2019–2020 bushfires.	FESM severity mapping of the area in which the individual was recorded is noted as unburnt. It is therefore likely that this species was not significantly impacted by the 2019 – 2020 bushfires. As no individuals, or critical habitat are being impacted because of the Project, it is considered that the development footprint habitat is not critical to the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to have a significantly impact the White-flowered Wax Plant

b Grevillea guthrieana (Endangered)

Table 13.9 Grevillea guthrieana (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	*Grevillea guthrieana* is known from three areas on the mid-north coast of New South Wales, namely the Carrai Plateau vicinity, near Mount Banda Banda, and east of Booral. The total number of individual plants was estimated to be more than 10,000 and the number of plants in all populations on the Carrai Plateau was estimated to be around 5,000 **(DoE, 2014a)**. The recorded population present within and adjacent to the construction envelope is additional to previously recorded subpopulations continuous but is considered to be part of the broader Carrai Plateau population. A minimal number of 1,292 individuals of the species were recorded in the project area, this species was observed in high numbers along steep cliff areas where accurate counts could not be safely obtained. 378 individuals recorded within the disturbance footprint that would be removed by the Project. This sub-population also extends to areas outside of the construction envelope. The size of the sub-population outside of the construction envelope is unknown. The Project is therefore likely to lead to a small long-term decrease in the size of a population of the species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of individuals or potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	The Project is unlikely to create a significant barrier to the operation of seed dispersal mechanisms as all recorded locations are in areas where only narrow bands of clearing for linear infrastructures such as access roads and powerline easements would be required. The relatively narrow breaks (up to 10 m and no greater than 100 m wide) in habitat created by these elements of the Project are unlikely to prevents seed dispersal or prevent cross-pollination of plants remaining on either side of the impacted areas. The Project is therefore unlikely to fragment an existing important population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the *Grevillea guthrieana* under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat that is critical to the survival of *Grevillea guthrieana* is likely to include areas containing large populations, particularly those at the extremities of the species' distribution, that are likely to be important for breeding, dispersal, maintenance of genetic diversity, long-term evolutionary development and reintroduction. The sub-population on the construction envelope is part of the broader Carrrai Plateau population that is estimated to consist of approximately 5,000 individuals. The affected plants comprise the north-east edge of the Carrai population and are therefore at an extremity of the species' distribution. As no critical habitat has been listed for this species, the Project is therefore likely to adversely affect part of an area of habitat critical to the survival of the species.
Would the action disrupt the breeding cycle of a population?	The clearing of individuals and habitat for the species due to the Project is unlikely to create a significant barrier to the movement of pollinators or the operation of seed dispersal mechanisms. The Project is therefore unlikely to significantly disrupt the breeding cycle of the remaining (at least 80% of the population) members of the Carrai population of the species.

Criteria	Discussion
Would the action 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 reduce available habitat by up to 2 ha. This reduction in habitat would result in a small long-term reduction (approximately 0.4 %) in the size of the Carrai population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	*Phytophthora cinnamomi* has been identified as a key threat to *Grevillea guthrieana.* Mitigation such as pathogen management will be established within the project area to prevent any introduction of diseases into the project area as part of the works.
Would the action interfere with the recovery of the species?	No recovery plans are available for *Grevillea guthrieana*. The actions below are a subset of those recommended in the Conservation Advice for the species: • ensure there is no inappropriate disturbance in areas where Grevillea guthrieana occurs, excluding necessary actions to manage the conservation of the species • investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible • develop and implement a management plan for the control of Lantana (Lantana camara) and Mist Flower (*Ageratina riparia*) in the region • if necessary, implement a management plan for the control and/or eradication of feral goats in the region • engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions • undertake appropriate seed collection and storage • suitably control and manage access on private land and other land tenure • minimise adverse impacts from land use at known sites. The Project will not interfere with most of the identified recovery actions for the species. Given the apparent, large size of the local population, and that Carrai population outside of the project area would be retained, it is unlikely however to interfere substantially with the recovery of the species.
Consideration of impacts from 2019–2020 bushfires.	FESM severity mapping of the Carrai Plateau where populations of this species occur were mapped as unburnt, with areas of low to medium FESM severity class. It is there likely that the population of this species was not significantly impacted by the 2019–2020 bushfires. This species also occurs in drainage ditches and creek lines which are less likely to burn due to their position in the landscape and higher soil moisture content. The loss of 378 individuals is not considered critical to the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the *Grevillea guthrieana*.

c Tall Velvet Sea-berry (Vulnerable)

Table 13.10 Tall Velvet Sea-berry (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The recorded population present in the construction envelope consists of a minimal count of 5,036 individuals. Areas along the transmission line contained steep wet slopes where this species was the dominant shrub cover. Accurate counts were undertaken where possible, however due to the sheer numbers of the species that were located outside of the disturbance footprint, the number provided here is the minimal for this species. 405 individuals of the species were recorded in the disturbance footprint and would be removed by the Project. This population also extends to areas outside of the construction envelope however the size of the is unknown. The populations recorded within the disturbance footprint is not considered a key source population for breeding or dispersal or for maintaining genetic diversity as this species was recorded in its 1000's within the construction envelope and observed to occur further downslope in high numbers outside of this area. In 2024, additional partial surveys as part of the offset surveys recorded an additional 99 individuals along creeks near the EAR. The population is not located near the limit of the species range, with large population known to occur within Oxley Wild Rivers National Park to the South and New England National Park to the North. The Project is therefore unlikely to lead to a long-term decrease in the size of an important population of the species.
Would the action reduce the area of occupancy of an important population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project may reduce area of occupancy of the species as defined by a 2 x 2 km grid applied to occurrence data as the presence of the species has only been confirmed in areas within and immediately adjacent to the construction envelopes. However, it may not result in an actual loss of the species from any 2 km x 2 km grid cell as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
Would the action fragment an existing important population into two or more populations?	The Project is unlikely to create a significant barrier to the operation of seed dispersal mechanisms as all recorded locations are in areas where only narrow bands of clearing for linear infrastructures such as access roads and powerline easements would be required. The relatively narrow breaks (up to 10 m to 100 m wide) in habitat created by these elements of the Project are unlikely to prevents seed dispersal or prevent cross-pollination of plants remaining on either side of the impacted areas. The Project is therefore unlikely to fragment an existing important population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for this species under the EPBC Act. Habitat critical to the survival of this species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). As no critical habitat for this species has been listed, the Project is therefore unlikely to adversely affect part of an area of habitat critical to the survival of the species.
Would the action disrupt the breeding cycle of an important population?	The clearing of individuals and habitat for the species due to the Project is unlikely to create a significant barrier to the movement of pollinators or the operation of seed dispersal mechanisms. The Project is therefore unlikely to significantly disrupt the breeding cycle of the remaining members of the local population of the species.

Criteria	Discussion
Would the action 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 reduce the local population by up to 405 individuals over an area of 4.2 ha. This population also extends to adjacent areas outside of the construction envelope however the size of the population outside of the construction envelope is unknown. This reduction in individuals and habitat could result in a long-term reduction in the size of the local population of the species.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The existing landscape contains many invasive species that are directly or indirectly harmful to the species, either through herbivory, competition or alteration of habitat. With the mitigation and management measures proposed, it is unlikely that any further species invasions will be facilitated by the Project. Therefore, the proposed impacts are considered unlikely to facilitate the spread of invasive species or their adverse impacts to the survival of the threatened species (either directly or indirectly).
Would the action interfere substantially with the recovery of the species?	No recovery plans or Listing Advice is available for Tall Velvet Sea-Berry. The actions below are a subset of those recommended in the Conservation Advice for the species: • undertake seed germination trials to determine the requirements for successful establishment • investigate fire ecology including response to different fire regimes in its habitat • monitor known populations to identify threats • undertake appropriate seed collection and storage • Implement national translocation protocols if establishing of additional populations is considered necessary and feasible • control access routes to suitable habitat and constrain public access to known sites on public land • ensure chemicals used to eradicate weeds do not adversely harm the threatened species • ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where *H. exalata* subsp. *velutina* occurs do not adversely impact on known populations. The Project will not interfere with most of the identified recovery actions for the species. The clearing of 405 individuals and associated habitat will adversely impact a known population and thereby interfere with the recovery of the species in the local context. Given the apparent, large size of the local population, it is unlikely however to interfere substantially with the recovery of the species.
Consideration of impacts from 2019–2020 bushfires.	The records for this species found on the Northern Line, where the FESM severity mapping has noted this area in the low to high severity class. All the records in this area are mapped in the low to medium severity class. FESM severity mapping of the majority of known populations where this species occur within the Oxley Wild Rivers National Park are located south of the Macleay River in areas mapped as unburnt, low to medium FESM severity classes. It is there likely that the population of this species was not significantly impacted by the 2019–2020 bushfires. This species also occurs in wetter habitats and creek lines which are less likely to burn due to their position in the landscape and higher soil moisture content. The loss of 7% of the recorded population within the construction envelope is not considered critical to the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact on Tall Velvet Sea-Berry.

d Wandering Pepper Cress (Endangered)

Table 13.11 Wandering Pepper Cress (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	Prior to the surveys conducted for the Project in 2021, Wandering Pepper Cress was not known or predicted to occur in the region, with the nearest areas where the species was then known to occur being located more than 200 km to the north. Targeted surveys in 2021 recorded a total of 192 mature plants and 123 juveniles across six sites in NSW and Queensland. This species has recently been recorded from 24 populations, mostly in Queensland. As of 2014, the largest known population contained 142 mature individuals (DoE, 2014b). The recorded population present within the project area consists of at least 1,577 plants most of which were mature at the time of survey. It is therefore likely to represent the largest known population of the species. The population in the construction envelope would also represent the most southerly known population, however, the EMM ecologist who found the species on site has also recently opportunistically recorded it growing further south, near Forster in April 2022 (Inaturalist refence https://www.inaturalist.org/observations/111387787). Two individuals of the species were recorded in the disturbance footprint and would be removed by the Project. The plants to be directly impacted on occur over an area of 2.5 ha, including polygons encompassing the recorded locations and intervening areas of suitable habitat. The Project is therefore unlikely to lead to a long-term decrease in the size of a population of the species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project may reduce area of occupancy of the species as defined by a 2 x 2 km grid applied to occurrence data as the presence of the species has only been confirmed in areas within and immediately adjacent to the construction envelopes. However, it may not result in an actual loss of the species from any 2 km x 2 km grid cell as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
Would the action fragment an existing population into two or more populations?	The Project would only result in narrow bands of clearing at the edge of areas containing the species and would not divide any area of habitat. The Project is therefore unlikely to create a significant barrier to the operation of pollination or seed dispersal mechanisms. The Project is therefore unlikely to fragment an existing population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the Wandering Pepper Cress under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat that is critical to the survival of Wandering Pepper Cress is likely to include areas containing large populations, particularly those at the extremities of the species' distribution, that are likely to be important for breeding, dispersal, maintenance of genetic diversity, long-term evolutionary development and reintroduction. Given the large population recorded within the project area and its location, approx. 140 km southeast of the closest population and 200 km south of the far northern NSW and southern Queensland populations, the habitat on and adjacent to the construction envelope may be considered critical habitat. As no critical habitat has been listed for this species, the Project is therefore unlikely to adversely affect part of an area of habitat critical to the survival of the species.

Criteria	Discussion
Would the action disrupt the breeding cycle of a population?	The clearing of individuals and habitat for the species due to the Project is unlikely to create a significant barrier to the movement of pollinators or the operation of seed dispersal mechanisms. The Project is therefore unlikely to significantly disrupt the breeding cycle of the remaining (approximately 80% of the population) members of the local population of the species.
Would the action 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 reduce available habitat by up to 2.5 ha. This reduction in habitat would result in a small reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Wandering Pepper Cress and the Project is unlikely to introduce pathogens to the area.
Would the action interfere with the recovery of the species?	No recovery plans are available for Wandering Pepper Cress. The actions below are a subset of those recommended in the Conservation Advice for the species: • ensure there is no inappropriate disturbance in areas where Wandering Pepper Cress occurs, excluding necessary actions to manage the conservation of the species • investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible • develop and implement a management plan for the control of weeds in the region • develop and implement a management plan for the control and eradication of rabbits in the region • engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions • undertake appropriate seed collection and storage • suitably control and manage access on private land and other land tenure • minimise adverse impacts from land use at known sites. The Project will not interfere with most of the identified recovery actions for the species. The clearing of two individuals and associated habitat will unlikely adversely impact the population within the project area and thereby interfere with the recovery of the species in the local context.
Consideration of impacts from 2019–2020 bushfires.	This species occurs along the flood plans of the Macleay River. The FRSM shows that large areas of the Macleay River flood plan were unburnt, with patches of potential areas that may contain this species as having a low to medium FESM severity class. As only two individuals out of the 1,577 recorded within the project area will be impacted on as part of the Project, it is not considered that the development footprint habitat is critical to the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to have a significant impact on the Wandering Pepper Cress.

e Assessment of significance: *Pultenaea rubescens* (Endangered)

Table 13.12 *Pultenaea rubescens*

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population of a species?	This is a newly discovered species that is only known to occur within the Carrai Plateau and Werrikimbe National Park. Surveys undertaken by EMM in 2022, 2023 and 2024 recorded a total of 595 individuals within the Carrai Plateau. 200 individuals have been recorded within Werrikimbe National Park (NSW TSSC, 2024) The disturbance footprint was redesigned to largely avoid impacts to this species. No individuals or suitable habitat for this species will be removed as part of the Project. 14 ha of habitat will not be impacted on within the project area, a further 36 ha is known to occur within the Carrai National Parks estate. It is estimated that there is maximum of 707 ha of unsurveyed habitat within the Carrai Plateau that could support this species. The impact is not considered to lead to a long-term decrease in the size of the population. As the Project will not reduce habitat for this species, is not considered to lead to a long-term decrease in the size of the population.
Would the action reduce the area of occupancy of a population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of individuals or potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	The subpopulation at the eastern end of the disturbance footprint has an existing track running through the middle of habitat that supports this species. While the details on the ecology of this species are not known, seeds in *Pultenaea* are dispersed locally by ants (NSW TSSC, 2024). The creation of this road is not considered to fragment this species as it is unlikely to interfere with the dispersal mechanism of this species within the subpopulation. The same is said for the subpopulation adjacent to the spoil pile. While this subpopulation is near the development footprint, a large part of the development is the access road, which is considered unlikely to affect the genetic flow of this subpopulation. The Project is located on the western edge of this species known distribution in the Carrai. Therefore, the Project is considered unlikely to fragment the population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the *Pultenaea rubescens* under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat that is critical to the survival of *Pultenaea rubescens* is likely to include areas containing large populations, particularly those at the extremities of the species' distribution, that are likely to be important for breeding, dispersal, maintenance of genetic diversity, long-term evolutionary development and reintroduction. Given the large population within the project area and its location a large distance north of the other population, the habitat within the project area may be considered critical habitat. The disturbance footprint has been redesigned to avoid all habitat where this species occurs, as such it is not considered that the Project will adversely affect potentially critical habitat for this species.
Would the action disrupt the breeding cycle of an important population?	The clearing of surrounding vegetation is unlikely to create a significant barrier to the movement of pollinators or the operation of seed dispersal mechanisms. The details on the ecology of this species are not known, however seeds in *Pultenaea* are dispersed locally by ants (NSW TSSC, 2024). This dispersal mechanism is unlikely to be impacted by the proposed works. The Project is therefore unlikely to significantly disrupt the breeding cycle of the local population of the species.

Criteria	Discussion
Would the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The disturbance footprint has been designed to avoid habitat for this species. The action is not considered to impact the availability or quality of habitat to the extent that the species is likely in decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	*Phytophthora cinnamomi* has been identified as a key threat to the *Pultenaea rubescens (Pultenaea parrisiae* subsp. *parrisiae).* Mitigation such as pathogen management will be established within the project area to prevent any introduction of diseases into the project area as part of the works.
Would the action interfere substantially with the recovery of the species?	No recovery plan is available for the *Pultenaea rubescens*. The actions below are a subset of relevant recommendations in the Conservation Advice for the species: • manage any changes to hydrology that may result in changes to the water table levels, increased run-off. The Project will incorporate relevant construction site management methodology into the CEMP to reduce impacts such as runoff into sensitive environmental areas, including habitat that supports threatened species. It is unlikely that the Project would interfere substantially with the recovery of the species.
Consideration of impacts from 2019–2020 bushfires.	FESM severity mapping of the majority of known populations where this species occur within the Carrai Plateau recorded by EMM were in areas mapped as low to medium FESM severity classes. This species also occurs in areas of wet habitat which are less likely to burn due to their position in the landscape and higher soil moisture content. As no loss of habitat will occur as part of the Project, impacts for the 2019 – 2020 bushfire are not considered critical to the survival of this species.
Conclusion	Based on the above assessment, the Project is unlikely to significantly impact the *Pultenaea rubescens*

f Assessment of significance: Scrub Turpentine (Critically Endangered)

Table 13.13 Scrub Turpentine (Critically Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	The number of distinct populations of Scrub Turpentine is unknown but is expected to be large given the wide distribution of the species. Occurrences of Scrub Turpentine are contiguous along the entire range of the species with no significant disjunctions. No formal estimate exists of the total population of the species however it is likely that that the number of mature individuals may be large (i.e. not <10,000) (TSSC, 2020a). The recorded population within the project area consists of approximately 72 plants, with none recorded within the disturbance footprint. The impacted habitat is contiguous with areas containing records of the species to the north-east. The size of the broader population is unknown however, the amount of contiguous potential habitat is very large. The Project is therefore unlikely to lead to a small to moderate long-term decrease in the size of a population of the species.

Criteria	Discussion
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of individuals or potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	The Project would only result in bands of clearing within the species' habitat that are not substantial in the context of the species' animal-assisted pollination and dispersal mechanisms. The Project is therefore unlikely to create a significant barrier to the operation of pollination or seed dispersal mechanisms. The Project is therefore unlikely to fragment an existing population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the Scrub Turpentine under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). There is insufficient data available for the regional Scrub Turpentine population to determine if habitat within and surrounding the construction envelope may be considered critical habitat. The individuals observed all were infected by myrtle rust and are already considered unlikely to survive or pollinate in the area. As no critical habitat has been identified for this species, the Project is therefore unlikely to adversely affect part of an area of habitat critical to the survival of the species.
Would the action disrupt the breeding cycle of a population?	The individuals recorded were all infected by myrtle rust, this causes populations to rabidly decline and impacts all life stages of the species (TSSC, 2020a).
Would the action 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 associated with any of the PCTs recorded within the project area. This species occurred within wetter, damper areas which the Project is avoiding where this species was recorded. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	The individuals recorded were all infected by myrtle rust, as such, the disease that impact the survival of this species is already present within the Project area.
Would the action interfere with the recovery of the species?	No recovery plans have been applied to Scrub Turpentine as the implement of priority actions and mitigation against key threats cannot be achieved.

Criteria	Discussion
Consideration of impacts from 2019–2020 bushfires.	The majority of the Scrub Turpentine records are found on the Northern Line, where the FESM severity mapping has noted this area in the low to high severity class. All the records in this area except one, are mapped in the low to medium severity class. This species occurs in rainforests and wet sclerophyll forests. These are less likely to burn due to their position in the landscape and higher soil moisture content. It is therefore likely that the population of this species was not significantly impacted by the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to significantly impact the Scrub Turpentine.

g Assessment of significance: Cryptic Forest Twiner (Endangered)

Table 13.14 Cryptic Forest Twiner (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	This species is not associated with any PCTs within the project area. Three Tylophora specimens were recorded in 2022 during the flora surveys. Samples were sent to the herbarium for confirmation but could not be confirmed due to lack of flowering part for identification. The known locations of this species were resurveyed in the flowering period in 2023 and 2024. Additional Tylophora specimens were recorded in 2024. Both survey efforts failed to observe this species in flower, which is the key distinguishing feature to identify this species from the more common Thin-leaved Twiner (*Tylophota paniculata*). Due to the lack of flowering specimens, samples were undertaken in 2024 for genetic analysis. Genetic analysis showed that the plants sampled from the Project area are genetically similar to both the Thin-leaved Twiner and Cryptic Forest Twiner. Based on the data analysis conducted to date, the species may not be clearly distinguishable based on commonly used plant genetic barcodes. Using the precautionary principle, the records within the construction envelope remain 45 individuals were recorded within the project area with six recorded within the disturbance footprint. These six species were recorded during the offset's surveys in 2024. The Project is therefore unlikely to lead to a long-term decrease in the size of a population of this species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project may reduce area of occupancy of the species as defined by a 2 x 2 km grid applied to occurrence data as the presence of the species has only been confirmed in areas within and immediately adjacent to the construction envelopes. However, it may not result in an actual loss of the species from any 2 x 2 km grid cell as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
Would the action fragment an existing population into two or more populations?	The Project would only result in narrow bands of clearing at the edge of areas containing the species and would not divide any area of habitat. The Project is therefore unlikely to create a significant barrier to the operation of pollination or seed dispersal mechanisms. The Project is therefore unlikely to fragment an existing population.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the Cryptic Forest Twiner under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). It is considered unlikely that the habitat within and surround the construction envelope is considered critical habitat for this species, as this species was not associated with any PCTs recorded. The Project is therefore unlikely to affect an area of habitat critical to the survival of the species.

Criteria	Discussion
Would the action disrupt the breeding cycle of a population?	The clearing of individuals and habitat for the species due to the Project is unlikely to create a significant barrier to the movement of pollinators or the operation of seed dispersal mechanisms. The Project is therefore unlikely to significantly disrupt the breeding cycle of this species.
Would the action 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 reduce available habitat by up to ha. This reduction in habitat would result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Cryptic Forest Twiner and the Project is unlikely to introduce pathogens to the area.
Would the action interfere with the recovery of the species?	No recovery plan is available for Cryptic Forest Twiner. The actions below are a subset of relevant recommended in the Conservation Advice for the species: • develop and implement a management plan for the control of invasive weeds in the region. The Project will incorporate relevant construction site management methodology into the CEMP to reduce impacts such as runoff into sensitive environmental areas, including habitat that supports threatened species. It is unlikely that the Project would interfere substantially with the recovery of the species.
Consideration of impacts from 2019–2020 bushfires.	The closest records of this species located to the north in Cunnawarra National Park, Thumb Creek State Forest and Mistake State Forest had FESM severity mapping as low to extreme FESM severity classes. This species was also recorded in the project area outside of the disturbance footprint. Due to the large area of potential habitat for this species and known individuals the occur outside of the development footprint, the Project is not considered to be impacting on critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to significantly impact the Cryptic Forest Twiner.

iii Threatened fauna

a Assessment of significance: Spotted-tailed Quoll (Endangered)

Table 13.15 Spotted-tailed Quoll (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	The Spotted-tailed Quoll has been recorded in the project area, primarily in the higher elevations near the upper reservoir. Risk of direct mortality of individuals of the species would be minimised through clearing protocols, however, it is possible that a small number of individuals could be affected. Spotted-tailed Quoll populations may be classified as being of importance to the long-term survival and recovery of the species if they are: • 'stronghold' populations within a region (i.e. areas of high abundance) • populations that are known to be genetically disparate • populations that, if lost, would cause a significant contraction in the species' range • populations that have been the focus of long-term research and hence have good base-line data that will increase the understanding of the species' ecology (DELWP, 2016). Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (DELWP, 2016). All habitats that are known to be occupied are considered important (DELWP, 2016). The locality of the construction envelope is not listed in the recovery plan as an important populations however it is moderately well connected at a landscape level with areas of listed important populations to the west (Walcha-Armidale) and north (Dorrigo Plateau) (DELWP, 2016). The Project will impact Spotted-tailed Quoll habitat by up to 244 ha. The habitat affected consists of woodland of PCTs associated with the species. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	Whilst the operation of the reservoirs will impede movement across the valleys around the inundation area, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the existing and proposed reservoirs. The narrow bands of clearing required for the access and transmission are unlikely to interfere with quoll movement since quolls are capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads). The Project is unlikely to fragment any existing quoll populations into multiple populations.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the Spotted-tailed Quoll under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.

Criteria	Discussion
Would the action disrupt the breeding cycle of a population?	The Project would affect possible den sites such as deep crevices, boulder piles and fallen logs. Removal of these features could temporarily disrupt the breeding cycle for a small proportion of the local population of the species.
Would the action 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 habitat by up to 224 ha. This impact in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Spotted-tailed Quoll and the Project is unlikely to introduce pathogens to the area.
Would the action interfere with the recovery of the species?	The National Recovery Plan for the Spotted-tailed Quoll lists objectives and actions for the species recovery (DELWP, 2016). The following is a subset of objectives relevant to the Project: • determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations • reduce the frequency of Spotted-tailed Quoll road mortality • reduce the rate of habitat loss and fragmentation on private land. The Project will have a minor adverse impact on habitat that may contribute to the ability of the species to move through the landscape. The Project is unlikely to increase road mortality. The clearing of 224.4 ha of habitat for the species would detract from the objective of reducing the rate of habitat loss and fragmentation on private land.
Consideration of impacts from 2019–2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area associated with the Macleay Gorges rocky cliffs and escapement habitat. The FESM severity mapped this area as unburnt to medium severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the Spotted-tailed Quoll.

b Assessment of significance: White-throated Needletail (Vulnerable)

Table 13.16 White-throated Needletail (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The White-throated Needletail is a migratory species that exists as a series of interconnected subpopulations with animals moving between widely dispersed summer foraging areas in the southern hemisphere and breeding sites in the northern hemisphere. The concept of an important population is not readily applicable to this species. For the purposes of this assessment important habitat has been used to assess whether or not an impact on an 'important population' is likely. Important habitat for the White-throated Needletail is likely to include productive landscapes with high flying insect activity, typically wetlands, open forests and woodlands. The dry forests and woodlands that are prevalent in the project area are likely to be marginal as habitat. The species is conspicuous, and the low density of local records suggests that the locality is not a stronghold for the species. The project area is not at or near the limit of the species' range. Therefore, the Project is unlikely to affect an important population of White-throated Needletail.
Would the action reduce the area of occupancy of an important population?	The Project is unlikely to affect an important population of White-throated Needletail. The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
Would the action fragment an existing important population into two or more populations?	Owing to the mobility of the species, the quality of the habitat and the location of the site within the species distribution area. It is unlikely to fragment an existing important population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for this species under the EPBC Act. Habitat critical to the survival of this species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). The White-throated Needletail is a migratory species with animals moving between widely dispersed summer foraging areas in the southern hemisphere and breeding sites in the northern hemisphere. Important habitat for the White-throated Needletail in Australia is likely to include productive landscapes with high flying insect activity, typically wetlands, open forests and woodlands. The dry forests and woodlands that are prevalent in the project area are likely to be marginal as habitat. The species is conspicuous when flying high over open habitat, and the moderate number of local records suggests that the locality is not a stronghold for the species. The project area is not at or near the limit of the species' range. Therefore, the Project is unlikely to affect critical habitat of the White-throated Needletail.

Criteria	Discussion
Would the action disrupt the breeding cycle of an important population?	The species does not breed in Australia. The potential habitat present in the impact area is of marginal suitability for the species. The Project is therefore unlikely to affect an important population of White-throated Needletail. The Project is not considered likely to disrupt the breeding cycle of an important population of the species.
Would the action 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 may reduce potential White-throated Needletail habitat by up to 363 ha. The Project is not likely to cause the species to decline, due to: • the condition of habitat present • availability of larger area of similar and higher quality habitat in the broader locality • the ability of the species to forage in fragmented landscapes (including agricultural landscapes) • the mobility of the species.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The existing landscape contains many invasive species that are directly or indirectly harmful to the species, either through predation, competition or alteration of habitat. With the mitigation and management measures proposed, it is unlikely that any further species invasions will be facilitated by the Project. Therefore, the proposed impacts are considered unlikely to facilitate the spread of invasive species or their adverse impacts to the survival of the threatened species (either directly or indirectly).
Would the action interfere substantially with the recovery of the species?	No Recovery Plan or Listing Advice has been created for the White-throated Needletail. The Project is unlikely to affect key habitat or otherwise interfere substantially with the recovery of the species.
Consideration of impacts from 2019–2020 bushfires.	This species is largely aerial and highly mobile. Impacts to potential roosting habitat within the development footprint is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to cause a significant impact to White-throated Needletail.

c Assessment of significance: Greater Glider (Endangered)

Table 13.17 Greater Glider (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	The Greater Glider has been recorded in the project area, primarily in the higher elevations near the upper reservoir. Risk of direct mortality of individuals of the species would be minimised through clearing protocols, however, it is possible that a small number of individuals could be affected. The Project will decrease Greater Glider habitat by up to 126 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.

Criteria	Discussion
Would the action fragment an existing population into two or more populations?	Whilst the operation of the reservoirs will impede movement across the valleys around the inundation area, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the existing and proposed reservoirs. The narrow bands of clearing required for the access and transmission are unlikely to interfere with glider movement since gliders are capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads). The Project is unlikely to fragment any existing Greater Glider populations into multiple populations.
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat (DECCW, 2022). The Greater Glider is sensitive to forest clearance (Tyndale-Biscoe, CH & Smith, RFC, 1969). Habitat critical to the survival is broadly defined as: • large contiguous areas of eucalypts forest, which contain mature hollow bearing trees and a diverse range of preferred food species • habitat connectivity • cool microclimate forest or woodland areas • areas identified as refuges under future climate change scenarios • short-term or long-term post fire refuges that allow species to persist, recover and recolonise burnt areas. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of a population?	All Greater Glider populations are considered important (DECCW, 2022). The removal of habitat could temporarily disrupt the breeding cycle for this species within the disturbance footprint.
Would the action 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 reduce available habitat by up to 126 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Greater Glider and the Project is unlikely to introduce pathogens to the area, following mitigation measures outlined in this BDAR.

Criteria	Discussion
Would the action interfere with the recovery of the species?	The Conservation Advice for the Greater Glider lists conservation and recovery actions for the species recovery (DECCW, 2022). The following is a subset of actions that may be relevant to the Project: • protect any unburnt habitat (within or adjacent to recently burnt landscapes) in order to support population recovery • protect and maintain sufficient areas of suitable habitat, including denning and foraging resources and habitat connectivity • protect hollow-bearing trees • develop and implement longer-term strategies to control predation by the European red fox and feral cat. The Project will have a minor adverse impact on habitat that may contribute to the ability of the species to move through the landscape. It is currently unknown how many suitable hollow bearing trees will be lost as part of the Project that is suitable for this species.
Consideration of impacts from 2019–2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area associated with the older growth forests. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the Greater Glider.

d Assessment of significance: Yellow-belled Glider (Vulnerable)

Table 13.18 Yellow-belled Glider (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	The Yellow-bellied Glider has been recorded in the project area, in the higher elevations near the upper reservoir. Risk of direct mortality of individuals of the species would be minimised through clearing protocols, however, it is possible that a small number of individuals could be affected. The Project will decrease Yellow-bellied Glider habitat by up to 126 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species.
Would the action reduce the area of occupancy of an important population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
Would the action fragment an existing important population into two or more populations?	No important populations have been identified within or near the Project area. Whilst the operation of the reservoirs will impede movement across the valleys around the inundation area, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the existing and proposed reservoirs. The narrow bands of clearing required for the access and transmission are unlikely to interfere with glider movement since gliders are capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads). The Project is unlikely to fragment any existing important Yellow-belied Glider populations into multiple populations.

Criteria	Discussion
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat (DoE, 2024a). The Yellow-bellied Glider is sensitive to forest clearance ((Tyndale-Biscoe, CH & Smith, RFC, 1969)). Habitat critical to the survival is broadly defined as: • large contiguous areas of eucalypts forest, which contain mature hollow bearing trees and a diverse range of preferred food species • habitat connectivity • cool microclimate forest or woodland areas • areas identified as refuges under future climate change scenarios • short-term or long-term post fire refuges that allow species to persist, recover and recolonise burnt areas. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of an important population?	No important populations have been identified within or near the Project area. The removal of habitat could temporarily disrupt the breeding cycle for this species within the disturbance footprint.
Would the action 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 reduce available habitat by up to 126 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Yellow-bellied Glider and the Project is unlikely to introduce pathogens to the area following mitigation measures outlined in this BDAR.
Would the action interfere substantially with the recovery of the species?	The Conservation Advice for the Yellow-bellied Glider lists conservation and recovery actions for the species recovery (DAWE, 2022a). The following is a subset of actions that may be relevant to the Project: • Construct artificial hollows in areas of low hollow availability, utilising appropriate nest boxes and/or chainsaw hollows, the latter of which have the potential to restore degraded habitat and may be used more by arboreal marsupials than nest boxes (Terry, Goldingay, & van der Ree, 2021). The Project will have a minor adverse impact on habitat that may contribute to the ability of the species to move through the landscape. It is currently unknown how many suitable hollow bearing trees will be lost as part of the Project that is suitable for this species.
Consideration of impacts from 2019-2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area associated with the older growth forests. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the Yellow-bellied Glider.

e Assessment of significance: Hastings River Mouse (Endangered)

Table 13.19 Hastings River Mouse (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	The Hasting River Mouse was recorded within the project area generally at higher elevations throughout each component of the Project. The habitat affected consists of areas containing dense vegetation for cover and that are contiguous with recorded locations. The approved NSW Recovery Plan (DECC, 2005) do not list important populations of this species, however, the Carrai Plateau within Oxley Wild Rivers National Park is one of the monitoring sites for Hastings River Mouse. The Project may therefore affect an important population of the Hastings River Mouse. The reduction in important habitat by 290 ha may result in a small a long-term decrease in the size of an important population of a species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project would reduce the area of occupancy of the species at a fine scale within the construction envelope but is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
Would the action fragment an existing population into two or more populations?	Whilst the operation of the reservoirs will impede movement across the valleys around the inundation area, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the existing and proposed reservoirs. The narrow bands of clearing required for the access and transmission are unlikely to interfere with Hastings River Mouse movement since this species is capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads).
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of the species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat critical for the survival of Hastings River Mouse includes open wet or dry sclerophyll forests and woodlands with native grass, sedges, rush, fern or heath understorey in the presence of shelter features such as tree root hollows, rock piles, boulders and fallen logs. 290 ha of habitat affected by the Project may be considered critical foraging habitat. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of a population?	The Project may disrupt the breeding cycle for a small proportion of the local population of the species that utilises habitat within and immediately adjacent to the construction envelope.
Would the action 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 reduce available habitat by up to 290 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.

Criteria	Discussion
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	*Phytophthora cinnamomi* has been identified as a key threat to habitat that supports Hastings River Mouse. Mitigation such as pathogen management will be established within the project area to prevent any introduction of diseases into the project area as part of the works.
Would the action interfere with the recovery of the species?	The Project will not interfere with any of the proposed recovery objectives, actions and performances criteria listed in the approved recovery plan for Hastings River Mouse (DECC, 2005). The recovery plan is set to expire in 2022, conservation actions listed in the Conservation Advice (TSSC, 2020b) are likely to adopt the following actions in a new recovery plan relevant to the Project: • protect unburnt areas or adjacent to recently burnt areas during the 2019–20 bush fires • invasive species • habitat loss, disturbance and modifications. The Project may interfere with likely objectives such as an increasing in habitat loss, disturbance and modification to 290 ha of habitat known to support this species.
Consideration of impacts from 2019–2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the Hastings River Mouse.

f Assessment of significance: Brush-tailed Rock-wallaby (Vulnerable)

Table 13.20 Brush-tailed Rock-wallaby (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	The Brush-tailed Rock-wallaby has been recorded throughout the project area, primarily in the higher elevations and in associated with areas off rocky habitat, cliffs and escarpments. Risk of direct mortality of individuals of the species would be minimised through clearing protocols, however, it is possible that a small number of individuals could be affected. Threatening processes likely to affect the Brush-tailed Rock-wallaby that may contribute to a long-term decrease in the size of the population as part of the Project include: • increase in predation by feral cat and European Red Fox • land clearance/clearing of native vegetation • invasion of native vegetation by environmental weeds (DECC, 2008). The locality of the Project is listed in the recovery plan as an important population (Macleay Gorges, the largest known population in NSW) and is well connected to habitat where larger colonies are present (DECC, 2008). The Project will impact on actual brush-tailed rock-wallaby denning and refuge (critical) habitat by approximately 0.03185 ha and habitat constraints up to 224 ha. The habitat affected consists of woodland of PCTs associated with the species. The Project area contains 6,170.96 ha of habitat constrains that will not be impacted on by the Project. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species.

Criteria	Discussion
Would the action reduce the area of occupancy of an important population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
Would the action fragment an existing important population into two or more populations?	The Project will impact on the most western and lowest in elevation colony within the project area. Connection to other colonies within the project area are to the east up slope. Observations within the project area as part of the Brush-tailed Rock-wallaby habitat assessment and targeted surveys recorded outlier records of younger males and potential connective mammal paths with some having evidence of Brush-tailed Rock-wallaby scats. The majority of critical habitat that supports this species will be retained within the project area. The project area supports an estimated 20–25 colonies containing a minimum of 132 individuals. The actual brush-tailed rock-wallaby denning and refuge (critical) habitat to be impacted on is part of the Macleay Gorges. Actual brush-tailed rock-wallaby denning and refuge (critical) habitat within the Project area runs along the Carrai plateau, with cliffs and rocky habitat that support refuge areas running to the north-east of the project area and north -south within the project area. Where the proposed road between the lower reservoir with the upper reservoir is to be constructed, there is a break in the rocky escarpment approximately 500 m wide. It is considered that the construction of the access road between the two reservoirs is likely to directly and indirectly impact on the one colony within the development footprint. During construction the colonies located to the north and south of the disturbance footprint could potentially become temporarily fragmented due to indirect disturbance during construction activities. The creation of the access road is not considered to cause a permanent fragmentation as once construction ends, this road would only be used for maintenance and inspection purposes, therefore having minimal traffic flow. The narrow bands of clearing required for the access are unlikely to interfere with Brush-tailed Rock-wallaby movement since wallabies are capable of traversing narrow tracts of cleared land between forested areas. The Project is unlikely to fragment any existing Brush-tailed Rock-wallaby populations into multiple populations.
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to survival of the species includes rocky refuge habitat, foraging habitat and commuting routes between the two (DECC, 2008). The Project will remove actual brush-tailed rock-wallaby denning and refuge (critical) habitat for one colony of Brush-tailed Rock-wallaby that contains a minimal of two individuals. The Project is therefore considered to have an adverse impact that affects an area of habitat critical to the survival of the species for this colony.
Would the action disrupt the breeding cycle of an important population?	Brush-tailed Rock-wallabies typically have low migration rates between colonies and low recolonisation rates (TSSC, 2003). While males are known to move between colonies within their home range to access females, females are largely sedentary over a smaller home range (DPE, 2023). The loss of the colony within the development footprint may have an impact on nearby colonies for gene flow.
Would the action 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 on habitat constrains by up to 224.4 ha and 0.03185 ha of actual brush-tailed rock-wallaby denning and refuge (critical) habitat. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining 6,170.96 ha of habitat constrains or result in any further decline of the remaining sub-population within the Project area by emplacing the mitigation measures as detailed within this BDAR on the completion of the construction phase.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Indirect impacts from increases of predatory and pest animal species could result from an increase of human activity and creation of roads adjacent to colonies that could lead to greater predator incursions. The Project will implement a pest and predator monitoring program to ensure the works do not result in a significant increase in numbers. The Project will also design and implement a predator control program that will be implemented, in conjunction with DPIE, to control feral animals.

Criteria	Discussion
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Brush-tailed Rock-wallaby and the Project is unlikely to introduce pathogens to the area.
Would the action interfere substantially with the recovery of the species?	The National Recovery Plan for the Brush-tailed Rock-wallaby lists objectives and actions for the species recovery (DECC, 2008). The following is an object that may be relevant to the Project: • determine and manage threat to the Brush-tailed Rock-wallaby and its habitat. The Project will have an impact on critical habitat that supports the most western and lowest in elevation colony within the project area.
Consideration of impacts from 2019-2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area associated with the Macleay Gorges rocky cliffs and escapement habitat. The FESM severity mapped this area as unburnt to medium severity classes. Aerial surveys undertaken in 2022 throughout the Oxley Wild Rivers National Park Recorded over 70 new colonies, some in areas that were mapped as extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project will have an adverse impact on critical habitat for this species for one colony.

g Assessment of significance: Koala (Endangered)

Table 13.21 Koala (Endangered)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of a population?	There is a historical record of Koalas from 1980 in the locality surrounding the construction envelope within the Carrai State Conservation Area. Koala scats were found in one location, northern side of the Macleay River near the proposed bridge crossing. No evidence of Koala was recorded south of the Macleay River during targeted surveys. It is likely to occur at low density in the more intact woodland and forest and may utilise habitat in more disturbed and fragmented parts of the construction envelope, at least intermittently for dispersal between more intact areas of habitat. Risk of direct mortality of individuals of the species would be low due to the implementation of clearing protocols. The Project will decrease Koala habitat by up to 58 ha. The habitat affected consists of woodland, scattered trees and derived shrubland of PCTs associated with the species. Grassland areas are considered to be of low value to this species. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species.
Would the action reduce the area of occupancy of the species?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project is unlikely to reduce area of occupancy of the species as defined a 2 x 2 km grid applied to occurrence data as it will not result in the complete loss of potential habitat from any individual grid cell.
Would the action fragment an existing population into two or more populations?	Whilst the Project will impede movement immediately around the construction area of components north of the Macleay River, the Project would not isolate these areas as they would remain directly connected via large areas of continuous forest and woodland. The narrow bands of clearing required for the access road and powerline are unlikely to interfere with Koala movement since Koalas are capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads) or impact significantly on any heavily vegetated areas of riparian corridors outside of the inundation area. The Project is unlikely to fragment any existing Koala populations into multiple populations.

Criteria	Discussion
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the Koala under the EPBC Act. Habitat critical to the survival of a species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). The national recovery plan for the Koala states that the following are key factors in evaluating whether habitat is critical to the survival of Koalas: a) whether the habitat is used during periods of stress (examples flood, drought or fire) b) whether the habitat is used to meet essential life cycle requirements (e.g. foraging, breeding, social behaviour, dispersal) c) the extent to which the habitat is used by important populations d) whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development e) whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements f) whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation g) any other way in which habitat may be critical to the survival the species (DAWE, 2022b). There is insufficient data available for the regional Koala population to determine if the large expanse of forest within and surrounding the construction envelope may be considered critical habitat. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of a population?	The Project may disrupt the breeding cycle for a small proportion of the local population of the species that utilises habitat within and immediately adjacent to the construction envelope.
Would the action 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 reduce available habitat by up to 58 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action introduce disease that may cause the species to decline?	Koalas carry a range of diseases including chlamydial disease, Koala retrovirus, and Koala herpesvirus infections, and infestation of trypanosomes, and sarcoptic mange (DAWE, 2022b). The Project is unlikely to introduce these or any other pathogens or parasites to the area.

Criteria	Discussion
Would the action interfere with the recovery of the species?	The National Recovery Plan for the Koala (DAWE, 2022b). lists four overarching objectives for the species' recovery: 1. The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased. 2. The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased. 3. Metapopulation processes are maintained or improved. 4. Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management. The clearing of 58 ha of habitat for the species may detract from objective 1 or 2 due to a small reduction in the local Koala population.
Consideration of impacts from 2019-2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to significantly impact the Koala.

h Assessment of significance: Long-nosed Potoroo (Vulnerable)

Table 13.22 Long-nosed Potoroo (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	The Long-nosed Potoroo was recorded within the project area, above 750 m elevation at the upper reservoir and above 550 m at the transmission line. The Project would lead to a decrease in the habitat available for the species by up to 89 ha. The habitat affected consists of areas of PCTs where this species was recorded in that contain dense vegetation for cover and that are contiguous with recorded locations. An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The conservation advice for the Long-nosed Potoroo lists nine important populations in NSW but states that the list is indicative rather than exhaustive and that there are likely important populations that have not been identified to date. The habitat of the project area is contiguous with several areas that are known to contain important populations in Oxley Wild Rivers National Park (DAWE, 2022c). The Project may therefore affect an important population of the Long-nosed Potoroo. The reduction in important habitat by 89 ha may result in a small a long-term decrease in the size of an important population of a species.
Would the action reduce the area of occupancy of an important population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project would reduce the area of occupancy of the species at a fine scale within the construction envelope but is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.

Criteria	Discussion
Would the action fragment an existing important population into two or more populations?	Whilst the operation of the reservoirs will impede movement across the valleys around the inundation area, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest and woodland encircling the inundation areas of the proposed reservoirs. The narrow bands of clearing required for the access and transmission line are unlikely to interfere with Long-nosed Potoroo movement since Long-nosed Potoroo are capable of traversing narrow tracts of cleared land between forested areas. The Project will not create any major barriers to movement (such as large roads).
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of the species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Habitat critical for the survival of Long-nosed Potoroo includes a range of vegetation types such as rainforest, wet and dry woodland, scrubland and coastal heathlands often near creeks or gullies. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of an important population?	The Project may disrupt the breeding cycle for a small proportion of the local population of the species that utilises habitat within and immediately adjacent to the construction envelope.
Would the action 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 reduce available habitat by up to 89 ha. This reduction in habitat could result in a small long-term reduction in the size of the local population of the species. The Project is unlikely to degrade remaining habitat or result in any further decline of the remaining population.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Site hygiene protocols will be in place during construction to minimise the risk of introduction of invasive species. The Project is unlikely facilitate further invasions of harmful species.
Would the action interfere substantially with the recovery of the species?	No recovery plan, threat abatement plan, or conservation advice is available for the Long-nosed Potoroo.
Consideration of impacts from 2019–2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project could significantly impact the Long-nosed Potoroo.

i Assessment of significance: Grey-headed Flying-fox (Vulnerable)

Table 13.23 Grey-headed Flying-fox (Vulnerable)

Criteria	Discussion
Would the action lead to a long-term decrease in the size of an important population of a species?	The Grey-headed Flying-fox was recorded either feeding and/or commuting over the project area. The Project would lead to a decrease in the habitat available for the species by up to 363 ha. The habitat affected consists of treed areas of PCTs associated with the species. An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The Grey-headed Flying-fox exists as a series of interconnected subpopulations with animals moving between widely dispersed roosting and breeding sites. The concept of an important population is not readily applicable to this species. For the purposes of this assessment important habitat has been used to assess whether or not an impact on an 'important population' is likely. Important habitat for the Grey-headed Flying-fox is likely to include camp sites used for roosting and breeding and extensive areas of forest and woodland, particularly those that contain tree species that flower or fruit in winter when food resources for the species are generally scarce. Potential roosting habitat exists in riparian vegetation adjacent to the Macleay River, however, no camp sites have been recorded in or adjacent to the project area. The nearest known camp site is at Bellbrook, approximately 30 km to the east but this camp has not been occupied during surveys undertaken since 2013 and the nearest recently occupied known sites are in Armidale and Kempsey (National Flying-fox monitoring viewer https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf). The project area is not near the limit of the species' distribution. Spring foraging resources are considered to be critical to the survival of the species and winter-flowering resources are also considered to be important (DECCW, 2009). Part of the construction envelope is dominated by Spotted Gum (*Corymbia maculata*) and other areas are dominated or co-dominated by Forest Red Gum (*Eucalyptus tereticornis*). Spotted Gum typically flowers in winter and early spring and Forest Red Gum has a variable flowering season that sometimes often includes winter and spring. These areas may constitute important foraging habitat for the species (OEH, 2016b). The Project may therefore affect an important population of the Grey-headed Flying-fox. The reduction in important habitat by 363 ha may result in a small a long-term decrease in the size of an important population of a species.
Would the action reduce the area of occupancy of an important population?	The IUCN recommends standardization of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Project would reduce the area of occupancy of the species at a fine scale within the construction envelope but is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.
Would the action fragment an existing important population into two or more populations?	Due to the mobility of this species, and its ability to traverse large areas of highly modified landscapes, the Project is unlikely to fragment an existing important population into two or more populations.

Criteria	Discussion
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of the species may also include areas not listed on the Register of Critical Habitat if they are necessary for: • activities such as foraging, breeding, roosting, or dispersal • the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • the reintroduction of populations or recovery of the species or ecological community (DoE, 2013b). Spring foraging resources are considered to be critical to the survival of the species (DoE, 2024b). The loss of roosting habitat has also been identified as a threat to Grey-headed Flying-foxes (DECCW, 2009). Roosts are typically located near water, such as lakes, rivers or the coast in vegetation including rainforest patches, stands of Melaleuca, mangroves and riparian vegetation (DECCW, 2009). No roosting habitat has been recorded in the project area however riparian vegetation along the Macleay River in the construction envelope has characteristics typical of roost sites for the species. 3.7 ha of riparian vegetation (PCT 1106) would be impacted by the Project. No critical habitat for this species has been identified, as such the Project is not considered to adversely affect habitat critical to the survival of this species.
Would the action disrupt the breeding cycle of an important population?	No camp sites (roosting and breeding habitat) for the Grey-headed Flying-fox were identified within or near to the construction envelope. The nearest known camp site is at Bellbrook, approximately 30 km to the east but this camp has not been occupied since 2013. The nearest roost sites known to be occupied recently are more than 50 km from the construction envelope. Due to the distance of the construction envelope from known roosting and breeding sites, it is unlikely to significantly disrupt the breeding cycle of an important population of the species.
Would the action 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 reduce available foraging habitat by up to 363 ha and could result in a small reduction in the size of the local population of the species. The Project is not likely to cause the species to decline significantly, due to the small proportion of available habitat likely to be impacted.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The existing landscape contains invasive species that are directly or indirectly harmful to the species through predation, competition or alteration of habitat. Given the management measures proposed, it is unlikely that any further species invasions will be facilitated by the Project. Therefore, the proposed impacts are considered unlikely to facilitate the spread of invasive species or their adverse impacts to the survival of the Grey-headed Flying-fox (either directly or indirectly).
Would the action interfere substantially with the recovery of the species?	No recovery plan, threat abatement plan, or conservation advice is available for the Grey-headed Flying-fox. However, there is a Draft National Recovery Plan, which provides several actions (DECCW, 2009). The following is a subset of these actions, targeting actions relevant to the Project which have not been specifically addressed above: • Enhance winter and spring foraging habitat for Grey-headed Flying-foxes. • 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. 363 ha of the potential habitat for the species which would be impacted contains substantial winter and spring foraging habitat resources. Minimising collision and electrocution hazards to animals will be considered in the design of the overhead powerline, including the spacing and configuration of conductors. The resulting design is unlikely to pose a significant electrocution risk to Grey-headed Flying-foxes. The Project may detract from the recovery of the species due to the removal of winter and spring foraging habitat. Due to the small proportion of available habitat likely to be impacted, the Project is not considered to substantially interfere with the recovery of the Grey-headed Flying-fox.

Criteria	Discussion
Consideration of impacts from 2019–2020 bushfires.	Suitable habitat to support this species is considered to the widespread throughout the project area. The FESM severity mapped this area as unburnt to extreme severity classes. As large areas of suitable habitat to support this species will not be impacted as part of the Project, the Project is not considered to impact critical habitat for the survival of this species as part of impacts from the 2019–2020 bushfires.
Conclusion	Based on the above assessment, the Project is unlikely to cause a significant impact to the Grey-headed Flying-fox.

iv Migratory species

As for threatened species, migratory species predicted to occur by the PMST were assessed in terms of their likelihood of occurring in the disturbance footprint. Four listed migratory species under the EPBC Act were recorded within the project area, with four species that are likely to occur infrequently and sporadically, these are:

- Migratory species recorded within the project area:
  - Black-faced Monarch (*Monarcha melanopsis*)
  - Satin Flycatcher (*Myiagra cyanoleuca*)
  - Rufous Fantail (*Rhipidura rufifrons*)
  - White-throated Needletail *(Hirundapus caudacutus).*
- Migratory species likely to occur infrequently and sporadically:
  - Spectacled Monarch (*Monarcha trivirgatus*)
  - Fork-tailed Swift (*Apus pacificus*)
  - Latham's Snipe (*Gallinago hardwickii*)
  - Osprey (*Pandion haliaetus*).

An assessment of significance was prepared for the relevant species in accordance with the assessment criteria for migratory species (DoE, 2013b) is in Table 13.24. The Project is unlikely to result in a significant impact on migratory species as the disturbance footprint.

Table 13.24 Assessment of significance for migratory species

Criteria	Discussion
1. Substantially modify important habitat	An area of 'important habitat' for a migratory species is defined as: a) 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 b) habitat that is of critical importance to the species at particular life-cycle stages, and/or c) habitat utilised by a migratory species which is at the limit of the species range, and/or d) habitat within an area where the species is declining (DoE, 2013b). Important sites have not been identified for any of these species. The habitat in the project area was only observed to contain either low numbers or species migrating through the area. It is not located in a region likely to support an ecologically significant proportion of the population of any of the species. It is unlikely to contain any features of particular importance to these species and is not in an area where any of the species are known to be in decline. Therefore, the Project will not modify important habitat for migratory species.
2. Result in invasive species becoming established in an area of important habitat	The construction envelope is unlikely to contain important habitat for these species. The Project is therefore unlikely to result in invasive species becoming established in an area of important habitat. Vegetation clearing and topsoil stripping have potential to lead to weed invasion in surrounding habitat, unless adequately mitigated. Measures to control weeds in retained habitats of the construction envelope will be undertaken to prevent weed establishment in retained habitat. With the proposed mitigation measures, the impact of the Project on invasive species would be minimal.
3. Seriously disrupt the lifecycle of ecologically significant proportion of population	The construction envelope is unlikely to support an ecologically significant proportion of any population of the species. Therefore, the lifecycle of an ecologically significant proportion of the species will not be disrupted.
Conclusion	The Project is unlikely to result in a significant impact on migratory species as: • the area does not contain important habitat for the species • it will not disrupt the life cycle of an ecologically significant proportion of any population.

13.3 Biosecurity Act 2015

The list of priority weeds of the North Coast that were recorded within the project area and duty information is described in Table 13.25.

Table 13.25 Priority weeds

Weed	Duty
Blackberry (*Rubus fruticosus species aggregate*)	Prohibition on certain dealings. Must not be imported into the state, sold, bartered, exchanged or offered for sale. All species in the *Rubus fruiticosus* species aggregate have this requirement, except for the varietals Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree.
Blue Heliotrope (*Heliotropium amplexicaule*)	Regional Recommended Measure. Exclusion zone: whole region excluding the core infestation area of Clarence Valley Council and Port Macquarie-Hastings Council.
Cat's Claw Creeper (*Dolichandra unguis-cati*)	Prohibition on certain dealings. Must not be imported into the state, sold, bartered, exchanged or offered for sale.

Weed	Duty
Fireweed (*Senecio madagascariensis*)	Prohibition on certain dealings. Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Lantana (*Lantana camara*)	Prohibition on certain dealings. Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Madeira Vine (*Anredera cordifolia*)	Prohibition on certain dealings. Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Tropical Soda Apple (*Solanum viarum*)	Control Order. Tropical Soda Apple Control Zone: Whole of NSW.

Tropical Soda Apple has a control order that requires landholders to notify the local control authority when this species is present on their land. Landowner are required to destroy the plant(s) and control any movement of plant material and/or seed outside of the infected area.

Blue Heliotrope has a regional recommended measure where plants should be eradicated from the land. Mitigation measures may be required for areas where this species occurs.

Blue Heliotrope, Blackberry, Cat's Claw Creeper, Fireweed, Lantana and Madeira Vine are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. These species must not be imported into NSW or sold. In addition, there is a regional recommended measure for land managers in the central tablelands to mitigate the risk of new weeds being introduced to, and spread from, their land. These plants should not be bought, sold, grown, carrier or released into the environment. Conservation areas, natural environments and primary production lands should be protected that are free of priority weeds. The biodiversity management plan for the Project would directly address the control of these weed species.

14 Conclusion

This BDAR has been prepared in accordance with the BAM (DPIE, 2020a) biodiversity-related SEARs issued by DPE and the associated agency-specific assessment requirements.

Biodiversity surveys within the disturbance footprint were undertaken during 2020, 2021, 2022, 2023 and 2024. These were carried out in parallel with and informed the evolution of the development footprint design. This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable.

The Project recorded four threatened ecological communities (BC Act), four threatened flora species and nine threatened fauna species credit species within the development footprint.

The Project requires 9,056 ecosystem credits to compensate for impacts on native PCTs and ecosystem credit species. In addition to ecosystem credits, the Project also requires a total of 52,377 species credits. OMPS will compensate for these residual impacts through the implementation of a biodiversity offset strategy.

The BDAR has also considered impacts on species and ecological communities listed under the EPBC Act. The Project will have an adverse direct impact 2.5 ha of habitat for Wandering Pepper Cress, and 0.00594 ha actual Brush-tailed Rock-wallaby denning and refuge (critical) habitat within the development footprint is, however, it is unlikely to significantly impact the local population of both species. As the Project is being assessed in accordance with the bilateral agreement made between the NSW and the Commonwealth under Section 45 of the EPBC Act, impacts on this listed ecological community and species will be compensated through the implementation of the biodiversity offset strategy.

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