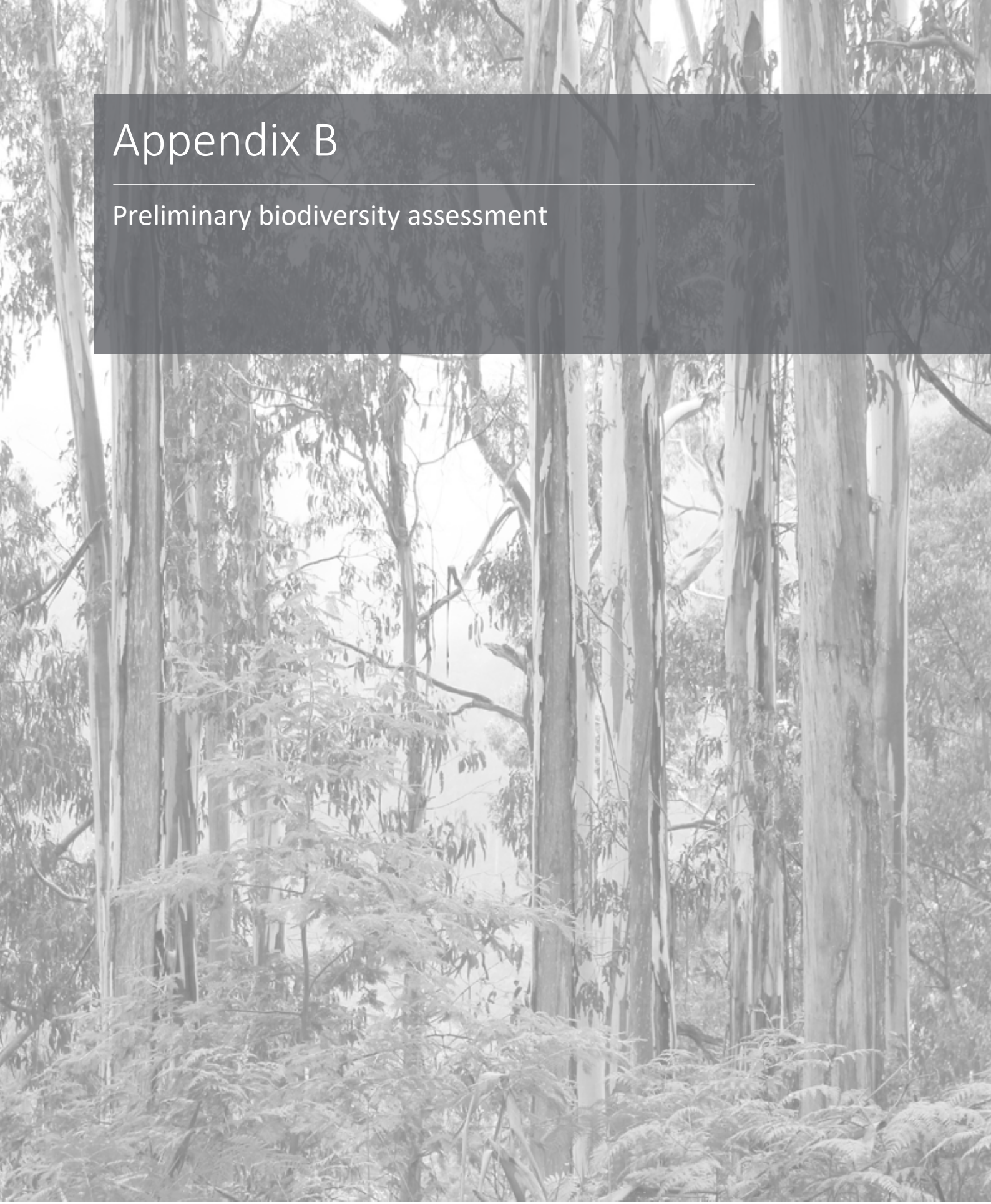


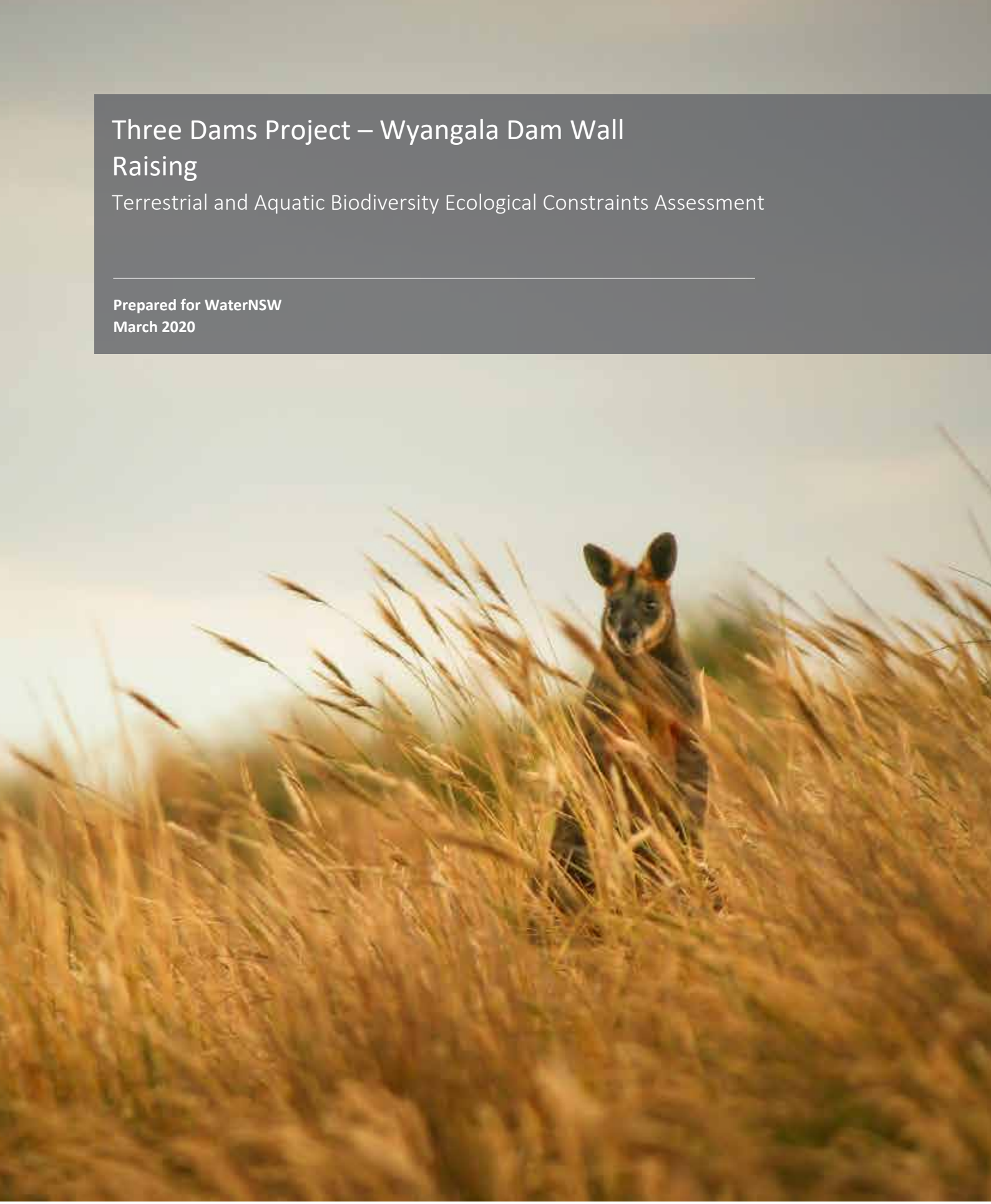
Appendix B

Preliminary biodiversity assessment

Three Dams Project – Wyangala Dam Wall Raising

Terrestrial and Aquatic Biodiversity Ecological Constraints Assessment

Prepared for WaterNSW
March 2020



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Three Dams Project – Wyangala Dam Wall Raising

Terrestrial and Aquatic Biodiversity Ecological Constraints Assessment

Report Number

J190822 RP3

Client

WaterNSW

Date

12 March 2020

Version

v3 Final

Prepared by

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12 March 2020

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12 March 2020

Executive Summary

ES1 Project description

Three Dams, namely Wyangala, Dungowan and Mole River, have been declared as critical State Significant Infrastructure (CSSI) projects under the NSW *Environmental Planning and Assessment Act 1979.* These CSSI projects require approval from the NSW Minister for Planning and Public Spaces and are likely to require approval by the Commonwealth Minister for the Environment. An Environmental Impact Statement is required for each project application. If Commonwealth approval is required, it is likely that it would occur via an accredited process.

The need to deliver the dams is critical to the State's drought recovery process and needs to be completed to the highest standard in relation to the assessment and delivery. Each dam is to be constructed rapidly to create security for the various town water supplies and associated industries reliant on the delivery of water for viability.

This Ecological Constraints Assessment has been prepared by EMM Consulting Pty Limited (EMM) specifically for the Wyangala Dam wall raising project. Wyangala Dam is located approximately 30 km south east of Cowra in NSW. The project includes:

- raising of the embankment dam and full supply level (FSL) by up to 10 metres (m);
- raising the height of the intake towers by up to 10 m;
- taking down and reinstalling the two access bridges at the raised dam crest level;
- widening of the spillway towards the south by about 110 m to provide sufficient flood discharge capacity to cater for the peak probably maximum flood (PMF) discharge;
- constructing a 6 m tall 150 m long embankment across a saddle at approximately 600 m northeast of the existing embankment; and
- relocating services and structures affected by the raised FSL.

The purpose of this preliminary assessment is to establish existing environment of the project using desktop review and preliminary field survey, undertake a preliminary assessment of project design elements and likely impacts requiring consideration and provide recommendations for future assessment and design of the project.

ES2 Existing environment

ES2.1 Landscape features

Wyangala Dam is in the NSW South Western Slopes Interim Biogeographic Regionalisation of Australia (IBRA) region and Inland Slopes IBRA subregion. The study area spans seven BioNet NSW Landscapes (Wyangala Hills, Upper Lachlan Channels and Floodplains, Lachlan Gorge, Dalton Hills, Mandurama Slopes, Woodstock Basalts, Gunning Hills) (formerly Mitchell landscapes).

The Wyangala Dam is located in the Lachlan River catchment and includes both the Lachlan and Abercrombie Rivers. It includes 48 major waterways (3rd or higher stream order), which feed into the catchment. No important wetlands, coastal wetlands, Ramsar wetlands or local wetlands are located within or immediately adjacent to the project footprint.

ES2.2 Native vegetation

For the current Wyangala Dam the extent of inundation under the full supply level extends approximately 14 km in and east-west direction. Vegetation within the study area is impacted by previous land use, including agriculture and the construction of the existing Wyangala Dam. Numerous feral sheep and goats were sighted within the study area during preliminary field surveys. As a result, current native vegetation within the study area is frequently already disturbed, and in addition the area is under severe drought stress.

Regional vegetation mapping predicts that 22 native plant community types (PCT's) occur within the project footprint. Rapid preliminary field surveys identified that the study area generally supports the PCTs mapped, but that boundaries often did not align with regional vegetation mapping. In the regional mapping substantial areas were mapped as derived grassland (PCT 796), but these were observed to frequently have regenerating saplings, and, where this occurs, will likely need to be reassigned to other PCT's. Field vegetation mapping will be required to determine PCTs and appropriate vegetation zones, and vegetation plots will be required to assess vegetation integrity.

Much of the native vegetation is likely to be part threatened ecological community, *White Box Yellow Box Blakely's Red Gum Woodland*, listed as endangered under the *Biodiversity Conservation Act 2016* (BC Act), and *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Box Gum Woodland). Impacts on this threatened ecological community will be a key consideration for assessment.

Another threatened ecological community, commonly known as Grey Box Grassy Woodlands, have been observed as being present within the study area, though the mapped extent that would be impacted is relatively low.

Two other threatened ecological communities, *Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia, in the NSW South Western Slopes Bioregion* and *Natural Temperate Grassland of the South Eastern Highlands*, were identified as potentially occurring within the study area during background research. However, these communities are considered unlikely to occur at this stage. Field survey will be required to confirm this.

ES2.3 Threatened species

From database searches and a preliminary Biodiversity Assessment Method (BAM, OEH 2017) assessment a total of 49 threatened native flora species and 37 threatened native fauna species listed as species credit species, and thus requiring offsets under the NSW Biodiversity Offset Scheme (BOS), were predicted to occur within 10 km of the project footprint. A preliminary assessment was made of the likelihood of these species occurring, with a precautionary approach utilised if there was uncertainty as to whether habitat or the species may occur on site. After this process was conducted a total of 26 threatened flora species, and 28 threatened fauna species were identified as candidate species requiring target survey, expert reports, or assumption of presence under the BAM.

ES2.4 Migratory species

A total of 11 migratory species listed under the EPBC Act have been identified with potential to occur, with eight assessed as moderate to high likelihood of occurrence.

ES2.5 Aquatic species and habitats

The downstream environment may be affected by greater capture of flows. Background research identified one threatened ecological aquatic community downstream of Wyangala Dam which may be affected: *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River,* listed as an Endangered Ecological Community (EEC) under the *Fisheries Management Act 1995* (FM Act). This EEC occurs downstream from the Wyangala Dam to the confluence with the Murrumbidgee River where it culminates in the Great Cumbung Swamp. Future assessments will need to determine if there is potential for any changes in water availability that may impact on this EEC.

A total of 48 major and 257 minor streams (3rd order or less) were identified as likely to be impacted by the increased inundation area.

A total of seven threatened aquatic species listed under the FM Act and/or the EPBC Act were identified through background research, with six considered to be moderate to high potential to occur.

ES2.6 Groundwater-dependent ecosystems

The Groundwater Dependent Ecosystems Atlas predicted that five PCTs may be present in the downstream aquatic study area that could represent terrestrial GDEs. Of the predicted terrestrial GDEs, PCT 268 may represent Box Gum Woodland. One aquatic GDE, *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River,* is downstream of Wyangala Dam and will require consideration.

No databases are available in NSW which catalogue the presence of subterranean fauna, and a brief literature review for the aquatic study area didn't not return evidence of stygofauna. However, the principal geology within the project footprint is the Wyangala Granite, comprising of a foliated porphyritic biotite granite, while the valley downstream is undifferentiated quaternary alluvium. It is possible that these geologies will support subterranean fauna where they intersect groundwater aquifers.

Further assessment of groundwater availability and changes to groundwater following construction will need to be undertaken to inform a more detailed GDE assessment. Further assessment of whether the aquatic study area supports aquatic and/or subterranean GDEs will also be required as part of the EIS stage.

ES3 Summary

A number of potential impacts and biodiversity constraints have been identified in this report. While the key components of the project are largely fixed, the final design solution and operation will be based on an iterative design and assessment process that will be carried out as part of the EIS. Where feasible, design should consider biodiversity values present and seek to minimise impacts to these values.

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Abbreviations and acronyms

Abbreviation/acronym	Definition
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BCD	NSW Biodiversity and Conservation Division
BC Regulation	Biodiversity Conservation Regulation 2017
BCF	Biodiversity Conservation Fund
BOM	Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
CSSI	Critical State significant infrastructure
DIWA	Directory of Important Wetlands in Australia
DAWE	Department of Agriculture, Water and the Environment
DoEE	Department of the Environment and Energy (now DAWE)
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	*Environment Protection Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
GDEs	Groundwater-dependant ecosystems
IBRA	Interim Biogeographic Regionalisation of Australia
KTP	Key threatening processes
LGA	Local Government Area
MNES	Matters of national environmental significance
OEH	Office of Environment and Heritage
PCT	Plant community type
PMST	Protected Matters Search Tool
SAII	Serious and irreversible impacts
SEARs	Secretary's Environmental Assessment Requirements
TEC	Threatened Ecological Community
VIS	Vegetation Information System
EPI	Environmental planning instruments

1 Introduction

1.1 Project overview

The passing of the NSW *Water Supply (Critical Needs) Act 2019* on 14 November 2019 has declared '3 Dams' to be critical State significant infrastructure (CSSI) under the provisions of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The '3 Dams' are Wyangala, Dungowan and Mole River dams. These CSSI projects require approval from the NSW Minister for Planning and Public Spaces, and applications for the projects are required to be accompanied by an environmental impact statement (EIS) that has been prepared in accordance with environmental assessment requirements issued by the Secretary of the NSW Department of Planning, Industry and Environment (DPIE); referred to as Secretary's Environmental Assessment Requirements (SEARs).

It is possible that the 3 Dams will also require approval by the Commonwealth Minister for the Environment under the provisions of the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). If so, it is likely that the Commonwealth would accredit the assessment process of the EP&A Act, meaning that the EIS prepared under the EP&A Act would be used to form the basis of the assessment under the EPBC Act.

The need to deliver the dams is critical to the State's drought recovery process and needs to be completed to the highest standard in relation to the assessment and delivery. Each dam is to be constructed rapidly to create security for the various town water supplies and associated industries reliant on the delivery of water for viability.

This Ecological Constraints Assessment has been prepared by EMM Consulting Pty Limited (EMM) specifically for the Wyangala Dam wall raising project. Wyangala Dam is located approximately 30 km south east of Cowra in NSW. The project includes:

- raising of the embankment dam and full supply level (FSL) by up to 10 metres (m);
- raising the height of the intake towers by up to 10 m;
- taking down and reinstalling the two access bridges at the raised dam crest level;
- widening of the spillway towards the south by about 110 m to provide sufficient flood discharge capacity to cater for the peak probably maximum flood (PMF) discharge;
- constructing a 6 m tall 150 m long embankment across a saddle at approximately 600 m northeast of the existing embankment; and
- relocating services and structures affected by the raised FSL.

1.2 Purpose of this preliminary assessment report

The purpose of this preliminary assessment report is to:

- establish existing environment of the project using desktop review and preliminary field survey;
- undertake a preliminary assessment of project design elements and likely impacts requiring consideration; and
- provide recommendations for future assessment and design of the project.

1.3 Study area

The terminology outlined in Table 1.1 is used throughout this report.

Table 1.1 Project terminology

Term	Definition / description
Inundation area	Area between new and existing full supply level (FSL).
Project footprint	Inundation area plus operational and construction footprints (if known).
Project area	A nominal 10 km buffer surrounding the project footprint.
Terrestrial study area	Project footprint plus a nominal 50 m buffer. This area was subject to field survey.
Aquatic study area	Project footprint plus areas subject to potential downstream impacts.

The PMF level will involve additional temporary flooding when these events occur. This may occur within the defined study area where slopes are steep but may occur outside of the study area in areas with gentler gradients.

2 Legislative context

2.1 NSW Environmental Planning and Assessment Act 1979

The NSW EP&A Act and Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) form the statutory framework for environmental assessment and planning approval in NSW. Implementation of the EP&A Act is the responsibility of the Minister for Planning and Public Spaces, statutory authorities and local councils.

Wyangala Dam wall raising project has been declared CSSI in accordance with the provisions of Schedule 3 of the *Water Supply (Critical Needs) Act 2019*. As a result, the Wyangala Dam wall raising project may be carried out without obtaining development consent under Part 4 of the EP&A Act. However, the project is subject to Division 5.2 of the EP&A Act, which requires the preparation of an EIS and the approval of the NSW Minister for Planning and Public Spaces.

Secretary's Environmental Assessment Requirements (SEARs) will be issued by DPIE for the project following submission of the scoping report. The SEARs identify matters which must be addressed in the EIS and essentially form its terms of reference.

Under section 5.22(2) of the EP&A Act, environmental planning instruments (EPIs), including SEPPs, do not apply to CSSI. In addition, under sections 5.23 and 5.24 of the EP&A Act, certain approvals under separate NSW legislation are not be required for CSSI projects (section 5.23) or would be required to be issued consistent with the planning approval, if granted, (section 5.24).

For SSI projects, including CSSI projects, use of the Biodiversity Assessment Method (BAM, OEH 2017) is mandatory unless a waiver is sought. Full assessment of impacts to biodiversity is likely to be required in accordance with the BAM, with a biodiversity development assessment report (BDAR) required at the EIS stage. This assessment identifies potential ecological values that may require consideration during preparation of the BDAR and the EIS.

2.1.1 State Environmental Planning Policy No 44 – Koala Habitat Protection

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) aims to encourage the conservation and management of natural vegetation areas that provide habitat for Koalas (*Phascolarctos cinereus*) to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of population decline.

As the Wyangala Dam Wall Raising Project is CSSI, all environmental planning instruments (including SEPP44) do not apply. Nonetheless, the BDAR will need to consider whether Koalas will be impacted by the project.

2.2 Commonwealth Environment 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 matters of national environmental significance (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); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, a person proposing to take an action that may or will have a significant impact on MNES is to refer the action to the Commonwealth Department of Agriculture, Water and Environment (DAWE; formerly the Department of Environment and Energy) for determination as to whether or not it is a controlled action. The Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE 2013), outline a 'self-assessment' process including detailed criteria to assist persons in deciding whether or not a referral may be required, and if the proposed action may have a significant impact on MNES. If deemed a controlled action the project is assessed under the EPBC Act and a decision made by the Commonwealth Minister for the Environment as to whether or not to grant approval.

At this stage, it is assumed referral of the Wyangala Dam wall raising project will be undertaken under the EPBC Act, due to the potential presence of threatened species and ecological communities.

Currently, there is no bilateral agreement between the Commonwealth of Australia and the State of NSW accrediting the Biodiversity Offsets Scheme (BOS) or the BAM (OEH 2017). A bilateral agreement has been drafted, but the date for gazettal of the agreement is unknown at this stage; though, on 20 November 2019 the NSW Executive Council passed the amending regulation that will allow for the Commonwealth to endorse the BOS and BAM, and it is understood that the bilateral will thus be enacted once there signoff from the Commonwealth Minister for the Environment.

If available, WaterNSW will seek assessment under the bilateral agreement. If the bilateral agreement is not available, WaterNSW will seek accreditation of the BAM (OEH 2017) during the referral process.

2.3 NSW Biodiversity Conservation Act 2016

The NSW *Biodiversity Conservation Act 2016* (BC Act) details mechanisms 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 NSW Biodiversity Conservation Regulation 2017 (BC Regulation), established the BAM (OEH 2017) and BOS, 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 (TECs) and their habitats and determine offset requirements.

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

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

For CSSI projects, use of the BAM is mandatory unless a waiver is sought. Given the presence of substantial native vegetation and threatened species in the study area, assessment of impacts to biodiversity will be required in accordance with the BAM for the Wyangala Dam wall raising project.

2.4 NSW Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, and threatened species, populations and ecological communities. It regulates the conservation of fish, aquatic 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. 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. Key fish habitat is defined in sections 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI 2013).

Assessment under the FM Act will be required for the Wyangala Dam wall raising project due to the potential for impacts to aquatic species and habitats within, and downstream of, the project footprint.

2.5 NSW Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides physical definition of a waterway, and other waterbodies, pertinent to this assessment:

> 'watercourse means a river, creek or other natural stream of water (whether modified or not) flowing in a defined channel, or between banks, notwithstanding that the flow may be intermittent or seasonal or the banks not clearly or sharply defined, and includes –
>
> (a) a dam that collects water flowing in any such stream; and
>
> (b) a lake through which water flows; and
>
> (c) a channel into which the water of any such stream has been diverted; and
>
> (d) part of any such stream; and
>
> (e) the floodplain of any such stream –…'

Specific guidance relating to the assessment of groundwater-dependant ecosystems (GDEs) are provided within The *NSW State Groundwater Dependent Ecosystems Policy* (DLWC 2002) and *Risk assessment guidelines for groundwater dependent ecosystems: Volume 1 – The conceptual framework* (Serov *et al*. 2012).

3 Methods

3.1 Background research

3.1.1 Database searches

In order to inform project context, information regarding vegetation communities, flora and fauna species was obtained from publicly available databases.

Background research included a review of the *State Vegetation Type Map: Central West / Lachlan Region Version 1.4. VIS_ID 4468* (OEH 2016). Plant community types (PCTs) mapped within the study area were reviewed to determine potential alignment with TECs listed under the EPBC Act, BC Act or FM Act.

Ecological database searches were undertaken to compile background information and assess ecological records, allowing us to determine the likelihood of occurrence of threatened species and communities within the study area. Databases included:

- BioNet Atlas of NSW Wildlife (Bionet);
- DAWE Protected Matters Search Tool (PMST) for MNES;
- Vegetation Information System (VIS) Classification 2.1 database;
- Freshwater threatened species distribution maps (DPI Fisheries);
- Key Fish Habitat maps (DPI Fisheries);
- Preliminary determinations for threatened species and communities listed under the BC Act and EPBC Act;
- Groundwater Dependant Ecosystems Atlas (Bureau of Meteorology (BOM));
- Australian Ramsar Wetlands: Internationally Important Wetlands (DAWE); and
- Directory of Important Wetlands: Nationally Important Wetlands (DAWE).

Database searches were completed for the locality, defined as an area within a 10 km buffer of the study area; however, with regard to the aquatic assessment, more extensive buffers (up to 50 km) were considered if threatened aquatic species were considered likely to move throughout the catchment.

A preliminary BAM assessment was also undertaken to generate a list of candidate species and entities required to be considered for further assessment during development of a Biodiversity Development Assessment Report (BDAR).

3.1.2 Literature review

The following reports were also reviewed during the background research component:

- Fish Stocking (DPI 2019);
- PrimeFact 145: Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River (DPI 2006);
- PrimeFact: Macquarie Perch (DPI 2016); and
- Lachlan Valley Priority Catchment Water Security – Preliminary Business Case (WaterNSW 2017).

3.2 Groundwater-dependent ecosystems

A search was performed on the Groundwater Dependent Ecosystems Atlas (BOM 2020) for potential GDEs occurring downstream of the proposed dam. The search area comprised a 50 m buffer on the downstream aquatic study area (ie 1 km downstream of the proposed dam). A literature review was also conducted, specific to subterranean aquatic GDEs.

GDEs considered in this assessment included:

- aquatic ecosystems that rely on the surface expression of groundwater. This includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs;
- terrestrial ecosystems that rely on the subsurface presence of groundwater. This includes all vegetation ecosystems; and
- subterranean ecosystems. This includes cave and aquifer ecosystems.

Although GDEs would likely be present within the inundation area, these were not included in the assessment as these ecosystems would be removed by the proposed dam and therefore would no longer be groundwater dependent. Upstream GDEs were also not included as impacts are not expected to occur in this area.

3.3 Field survey

A preliminary field survey of the study area was undertaken between 27 January and 31 January 2020. The preliminary field survey included:

- rapid verification of regional vegetation mapping (in particular for communities that may meet BC Act or EPBC Act TEC definitions);
- an initial habitat assessment for terrestrial threatened species, focusing on threatened species which can be readily excluded based on geographic or habitat constraints; and
- where relevant, an assessment of potential aquatic habitat (including key fish habitat).

The field survey was rapid in nature and did not involve detailed assessment of native vegetation, threatened species habitat or aquatic environments. The results detailed in this report provide an overview of the biodiversity values in the study area and project footprint and the potential impacts arising from the Wyangala Dam wall raising project. No ancillary sites such as laydown areas, construction compounds or camps, if required, were investigated. This assessment should not be relied upon for the purposes of detailed impact assessment.

4 Existing environment

4.1 Landscape features

The Wyangala Dam wall raising project is located in the NSW South Western Slopes Interim Biogeographic Regionalisation of Australia (IBRA) region and Inland Slopes IBRA subregion, and spans seven BioNet NSW Landscapes (Wyangla Hills, Upper Lachlan Channels and Floodplains, Lachlan Gorge, Dalton Hills, Mandurama Slopes, Woodstock Basalts, Gunning Hills) (formerly Mitchell landscapes; Figure 4.1).

The Wyangala Dam wall raising project is located in the Lachlan River catchment and on the Lachlan River. The study area intersects buffers of 305 waterways, including 48 major waterways (3rd order or above) and 257 minor waterways (Figure 4.1). No important wetlands (wetlands listed on the Directory of Important Wetlands in Australia (DIWA)), coastal wetlands listed under the State Environmental Planning Policy (Coastal Management) 2018, Ramsar wetlands or local wetlands (any wetland that is not identified as an important wetland) are located within or immediately adjacent to the study area.

4.2 Native vegetation

Vegetation within the study area is impacted by previous land use, including agriculture and the construction of the existing Wyangala Dam. As a result, native vegetation is partially cleared, and remnant vegetation is subject to moderate to high levels of disturbance. Field surveys revealed that the area is under severe drought stress, making vegetation assessment and plant identification difficult in some cases. Numerous feral sheep and goats were sighted within the study area. Assigning communities to PCT's or by threatened community determinations was hampered by both the drought conditions and very high grazing pressure.

OEH (2016) predicts that 22 native PCTs occur within the project footprint (Figure 4.2). Field surveys determined that mapped vegetation within the study area often does not align with regional mapping, with the study area generally supporting the PCTs mapped by OEH (2016), but the delineation of PCTs boundaries requiring further assessment. Furthermore, it was noted that approximately half of areas mapped as derived grassland (PCT 796, Table 4.1) had regenerating saplings, and thus, although in a disturbed state, have moved past being grasslands and would now align with a different PCT.

PCTs, and their alignment with TECs listed under the EPBC Act or BC Act, are listed in Table 4.1.

Table 4.1 Plant Community Types mapped within the project footprint (OEH 2016)

Plant Community Type (PCT)	Conservation status		Extent within project footprint (ha)	Candidate for SAII
	EPBC Act	BC Act		
Cleared or Non-native	-	-	251.6	-
5 – River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion	-	-	108.4	-
76 – Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	E	E	0.3	-
*80 – Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	E	E	2.6	-
84 – River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	-	-	1.1	-
85 – River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	-	-	40.5	-
185 – Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	-	-	9.0	-
186 – Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion	-	CE	1.9	Yes
217 – Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	-	CE	4.5	Yes
266 – White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	CE	E	350.2	Yes
267 – White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	CE	E	1.5	Yes
268 – White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion	CE	E	481.8	Yes
272 – White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	-	-	36.7	-
277 – Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	CE	E	68.9	Yes
279 – Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	CE	E	4.0	Yes
282 – Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion	CE	E	108.9	Yes
289 – Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion	-	-	5.9	-
331 – Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion	-	-	6.6	-

Table 4.1 Plant Community Types mapped within the project footprint (OEH 2016)

Plant Community Type (PCT)	Conservation status		Extent within project footprint (ha)	Candidate for SAII
	EPBC Act	BC Act		
339 – Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion	-	-	78.0	-
342 – Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion	CE	E	1.2	Yes
**796 – Derived grassland of the NSW South Western Slopes	CE	E	374.5	Yes
1177 – Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion	-	-	5.5	-
Total native vegetation			**1691.8**	
Total for project footprint			**1943.4**	

Notes: E = Endangered, CE = Critically Endangered
* PCT 80 aligns within the vegetation information database to two separate TECs that may occur in the area. However, as it is considered unlikely that this will align to *Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia, in the NSW South Western Slopes Bioregion* CEEC, the listing provided in the table is for Grey Box Grassy Woodlands.
** Whilst PCT 796 is designated in the Vegetation Information System as being associated with one TEC, the areas currently mapped may actually be associated with multiple TEC's.

Twelve of the PCTs mapped within the project footprint may form part of four TECs:

- PCTs 76 and 80 may be equivalent to *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*, listed as endangered under both the BC Act and the EPBC Act as *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (Grey Box Grassy Woodlands). Assuming that the mapped extent is correct, it is currently estimated that 2.9 ha would be impacted by inundation.

- PCTs 80, 186 and 217 may be equivalent to *Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia, in the NSW South Western Slopes Bioregion*, listed as critically endangered under the BC Act, but not listed under the EPBC Act. Initial field survey suggests that the vegetation in the study area is unlikely to meet the requirements for this TEC, however this cannot be definitively ruled out until detailed vegetation assessments are completed.

- PCTs 266, 267, 268, 277, 279, 282, 342 and 796 may be equivalent to *White Box Yellow Box Blakely's Red Gum Woodland*, listed as endangered under the BC Act, *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* listed as critically endangered under the EPBC Act (Box Gum Woodland). OEH (2016) maps 1,391 ha of Box Gum Woodland in the project footprint (inclusive of PCT 796); this represents 82% of all mapped vegetation. Box Gum Woodland is currently being considered for listing as critically endangered under the BC Act, with a preliminary determination in place. Box Gum Woodland is also listed as a candidate entity for SAII, meaning that impacts on this threatened ecological community will need to be considered in more detail as a part of the BDAR and EIS.

- A fourth TEC *Natural Temperate Grassland of the South Eastern Highlands*, which is listed as critically endangered under the EPBC Act, came up via the Commonwealth PMST. Wyangala Dam is within the outer range within which the community may occur. PCT 796 is the PCT that would most likely be associated with this TEC, should it occur (it is not listed as being associated in the vegetation information system database). From preliminary field survey it is considered highly unlikely that this TEC is present, due to the presence of sapling regeneration in multiple areas, and the likelihood that high grazing pressure has constrained recovery in areas without sapling regeneration. Field assessment will be needed to confirm occurrence.

4.3 Threatened species

4.3.1 Habitat assessment

The habitat assessment, undertaken during the field survey detailed in Section 3.3, identified that much of the study area is highly disturbed, largely due to pressures from grazing and weed infestations. Numerous feral sheep and goats were sighted during the field assessment, and invasive species such as Serrated Tussock (*Nassella trichotoma*) and St John's Wort (*Hypericum perforatum*) are widespread throughout the study area.

The habitat is under significant stress from drought conditions, causing widespread dieback in every vegetation layer. Dieback was observed in mature trees and regenerating saplings, in many areas the shrub layer was desiccated or dead, and ground cover was either sparse or absent across much of the site.

These pressures have reduced the habitat features in the study area that would support fauna species. There was little woody debris or hollow logs present at most of the sites visited, likely due to collection of firewood. Regardless, across many of the sites visited, numerous hollows were observed in mature trees and there were some rocky areas with granite boulders. Some sites had an intact layer of leaf litter and woody debris still present.

4.3.2 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 (OEH 2017), 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 Main Works survey area, based on the PCTs present, is provided in Table 4.2.

Table 4.2 Ecosystem credit species predicted to occur within the study area

Scientific name	Common name	Conservation status	
		EPBC Act	BC Act
Birds			
Anthochaera phrygia	Regent Honeyeater	CE	CE
Artamus cyanopterus cyanopterus	Dusky Woodswallow		V
Botaurus poiciloptilus	Australasian Bittern	E	E
Calidris ferruginea	Curlew Sandpiper	CE	E
Callocephalon fimbriatum	Gang-gang Cockatoo		V
Calyptorhynchus lathami	Glossy Black-Cockatoo		V
Certhionyx variegatus	Pied Honeyeater		V

Table 4.2 Ecosystem credit species predicted to occur within the study area

Scientific name	Common name	Conservation status	
		EPBC Act	BC Act
Chthonicola sagittata	Speckled Warbler		V
Circus assimilis	Spotted Harrier		V
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V
Daphoenositta chrysoptera	Varied Sittella		V
Ephippiorhynchus asiaticus	Black-necked Stork		E
Epthianura albifrons	White-fronted Chat		V
Falco hypoleucos	Grey Falcon		E
Glossopsitta porphyrocephala	Purple-crowned Lorikeet		V
Glossopsitta pusilla	Little Lorikeet		V
Grantiella picta	Painted Honeyeater	V	V
Haliaeetus leucogaster	White-bellied Sea-Eagle		V
Hamirostra melanosternon	Black-breasted Buzzard		V
Hieraaetus morphnoides	Little Eagle		V
Lathamus discolor	Swift Parrot	CE	E
Leipoa ocellata	Malleefowl	V	E
Lophochroa leadbeateri	Major Mitchell's Cockatoo		V
Lophoictinia isura	Square-tailed Kite		V
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)		V
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)		V
Neophema pulchella	Turquoise Parrot		V
Ninox connivens	Barking Owl		V
Ninox strenua	Powerful Owl		V
Pachycephala inornata	Gilbert's Whistler		V
Petroica boodang	Scarlet Robin		V
Petroica phoenicea	Flame Robin		V
Polytelis swainsonii	Superb Parrot	V	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)		V
Rostratula australis	Australian Painted Snipe	E	E
Stagonopleura guttata	Diamond Firetail		V
Stictonetta naevosa	Freckled Duck		V
Tyto novaehollandiae	Masked Owl		V
Mammals			
Chalinolobus picatus	Little Pied Bat		V

Table 4.2 Ecosystem credit species predicted to occur within the study area

Scientific name	Common name	Conservation status	
		EPBC Act	BC Act
Dasyurus maculatus	Spotted-tailed Quoll	E	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V
Miniopterus orianae oceanensis	Eastern Bent-wing Bat		V
Nyctophilus corbeni	Corben's Long-eared Bat	V	V
Petaurus australis	Yellow-bellied Glider		V
Phascolarctos cinereus	Koala	V	V
Pseudomys novaehollandiae	New Holland Mouse	V	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Reptiles			
Suta flagellum	Little Whip Snake		V
Varanus rosenbergi	Rosenberg's Goanna		V

Notes: V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered, P = Preliminary Determination

4.3.3 Species credit species

Species credit species are threatened species that cannot be reliably predicted to occur based on habitat surrogates. For the purposes of the BAM (OEH 2017), species credit species require detailed assessment and, if present, additional offsets to ecosystem credits.

An assessment of habitat suitability for threatened species credit species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017). For those threatened species credit species predicted to occur, for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the study area. The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are provided below.

i Flora species

Background research identified 49 threatened flora species credit species have been previously recorded and/or are predicted to occur within the project area. To develop a list of flora species credit species requiring further assessment, an assessment was undertaken in accordance with Step 2 and Step 3 of Section 6.4 of the BAM (OEH 2017), as shown in Appendix A.1. This assessment identified 26 flora species credit species requiring further assessment (Table 4.3).

Table 4.3 Candidate flora species credit species requiring further assessment

Scientific name	Common name	Conservation status		SAII
		EPBC Act	BC Act	
Acacia ausfeldii	Ausfeld's Wattle		V	-
Acacia meiantha		E	E	Yes

Table 4.3 Candidate flora species credit species requiring further assessment

Scientific name	Common name	Conservation status		SAII
		EPBC Act	BC Act	
Ammobium craspedioides	Yass Daisy	V	V	-
Austrostipa wakoolica	A spear-grass	E	E	-
Bossiaea fragrans		CE	CE	Yes
Caladenia arenaria	Sand-hill Spider Orchid	E	E	Yes
Caladenia concolor	Crimson Spider Orchid	V	E	Yes
Cullen parvum	Small Scurf-pea		E	-
Dichanthium setosum	Bluegrass	V	V	-
Diuris tricolor	Pine Donkey Orchid		V	-
Eucalyptus alligatrix subsp. *alligatrix*		V	V	Yes
Euphrasia arguta		CE	CE	Yes
Grevillea wilkinsonii	Tumut Grevillea	E	E	Yes
Lepidium hyssopifolium	Aromatic Peppercress	E	E	-
Leucochrysum albicans var. *tricolor*		E		-
Persoonia marginata	Clandulla Geebung	V	V	-
Philotheca ericifolia		V		-
Pomaderris queenslandica	Scant Pomaderris		E	-
Prasophyllum petilum	Tarengo Leek Orchid	E	E	-
Prasophyllum sp. *Wybong*	Tarengo Leek Orchid	CE		Yes
Pultenaea humilis	Dwarf Bush-pea		V	-
Senecio garlandii	Woolly Ragwort		V	-
Swainsona recta	Small Purple-pea	E	E	-
Swainsona sericea	Silky Swainson-pea		V	-
Tylophora linearis		E	V	-
Zieria obcordata	Obcordate-leafed Zieria	E	E	Yes

Notes: V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered, P = Preliminary Determination

Further targeted surveys will be required for these species.

Nine species considered to have a moderate to high likelihood of occurrence in the terrestrial study area are listed as candidate SAII entities meaning that impacts to these species have the potential to be serious and irreversible.

ii Fauna species

Background research identified 37 threatened fauna species credit species have been previously recorded and/or are predicted to occur within the project area. To develop a list of fauna species credit species requiring further assessment, an assessment was undertaken in accordance with Step 2 and Step 3 of Section 6.4 of the BAM (OEH 2017), as shown in Appendix A.2. This assessment identified 31 fauna species credit species requiring further assessment (Table 4.4).

Table 4.4 Candidate fauna species credit species requiring further assessment

Scientific name	Common name	Conservation status		SAII
		EPBC Act	BC Act	
Amphibians				
Crinia sloanei	Sloane's Froglet		V	-
Litoria booroolongensis	Booroolong Frog	E	E	-
Birds				
Anthochaera phrygia	Regent Honeyeater	CE	CE	Yes
Burhinus grallarius	Bush Stone-curlew		E	-
Calidris ferruginea	Curlew Sandpiper	CE	E	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo		V	-
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	-
Haliaeetus leucogaster	White-bellied Sea-Eagle		V	-
Hamirostra melanosternon	Black-breasted Buzzard		V	-
Hieraaetus morphnoides	Little Eagle		V	-
Lathamus discolor	Swift Parrot	CE	E	Yes
Lophochroa leadbeateri	Major Mitchell's Cockatoo		V	-
Lophoictinia isura	Square-tailed Kite		V	-
Ninox connivens	Barking Owl		V	-
Ninox strenua	Powerful Owl		V	-
Polytelis swainsonii	Superb Parrot	V	V	-
Tyto novaehollandiae	Masked Owl		V	-
Insects				
Synemon plana	Golden Sun Moth	CE	E	Yes
Keyacris scurra	Key's Matchstick Grasshopper NOTE: Provisional (preliminary) listings.	E	E	-
Mammals				
Cercartetus nanus	Eastern Pygmy-possum		V	-
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes
Miniopterus orianae oceanensis	Eastern Bent-wing Bat		V	Yes
Myotis macropus	Southern Myotis		V	-

Table 4.4 Candidate fauna species credit species requiring further assessment

Scientific name	Common name	Conservation status		SAII
		EPBC Act	BC Act	
Petauroides volans	Greater Glider	V		-
Petaurus norfolcensis	Squirrel Glider		V	-
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E	Yes
Phascogale tapoatafa	Brush-tailed Phascogale		V	-
Phascolarctos cinereus	Koala	V	V	-
Reptiles				
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	-
Delma impar	Striped Legless Lizard	V	V	-
Hoplocephalus bitorquatus	Pale-headed Snake		V	-

Notes: V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered, P = Preliminary Determination

Further targeted surveys will be required for these species.

Seven species considered to have a moderate to high likelihood of occurrence in the terrestrial study area are listed as candidate SAII entities meaning that impacts to these species have the potential to be serious and irreversible.

4.4 Migratory species

Background research identified 11 migratory species listed under the EPBC Act have been previously recorded and/or are predicted to occur within the project area. A likelihood of occurrence assessment was undertaken to evaluate the likelihood of each of these migratory species occurring in the study area based on the PCTs and associated habitats likely to be present (Appendix A.3). A total of eight migratory species were assessed as moderate to high likelihood of occurrence in the study area (Table 4.5).

Table 4.5 Migratory species considered a moderate to high likelihood of occurrence in the study area

Scientific name	Common name	Conservation status
		EPBC Act
Apus pacificus	Fork-tailed Swift	Mi
Hirundapus caudacutus	White-throated Needletail	Mi
Myiagra cyanoleuca	Satin Flycatcher	Mi
Actitis hypoleucos	Common Sandpiper	Mi
Calidris acuminata	Sharp-tailed Sandpiper	Mi
Calidris ferruginea	Curlew Sandpiper	Mi
Calidris melanotos	Pectoral Sandpiper	Mi
Gallinago hardwickii	Latham's Snipe	Mi

Note: Mi = migratory

4.5 Aquatic species and habitats

Background research identified the presence of one aquatic community of ecological significance within, or adjacent to, the study area (Figure 4.3). The *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River*, listed as an endangered ecological community (EEC) under the FM Act, occurs downstream from the Wyangala Dam to the confluence with the Murrumbidgee River where it culminates in the Great Cumbung Swamp. The aquatic community is characterised by meandering channels, wide floodplains, anabranches and effluent creeks which provide a wide range of habitats for fish and invertebrates, including pools, runs or riffles, backwaters and billabongs, in-stream woody habitat, and aquatic plants.

With regard to key fish habitat, and in alignment with the FM Act objective to 'conserve key fish habitats', permanent and semi-permanent freshwater habitats must be considered for assessment if they intersect areas of impact. These habitats include rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank, but do not include small ephemeral headwater creeks and gullies (ie 1st and 2nd order streams; Strahler 1952) or farm dams constructed on these systems. In addition, waterways need to be assessed for "sensitivity", and "suitability for fish passage" (DPI 2013). The key fish habitat map for the Cowra Local Government Area (LGA) indicates that the majority of the waterways within, and adjacent to, the study area are considered to contain key fish habitat (DPI 2020, as defined under the FM Act and in accordance with DPI (2013) (Figure 4.3).

Only one site within the Lachlan River, downstream of the existing dam wall, was assessed during the field survey, and was characterised by shallow (~1 m), slow-flowing water within a defined channel comprising clayey sediment on the banks. Decaying vegetation was present within the waterway and exotic willows and poplars were also present along the banks. The riparian vegetation community was dominated by River Red Gum (*Eucalyptus camaldulensis*), River Oak (*Casuarina cunninghamiana*) and rushes (*Juncus* sp.). In the vicinity of the Lachlan River site, a 7th order waterway, a Type 1 waterway type was assigned, in accordance with DPI (2013), as the waterway is identified as "*protected or threatened species habitat or area of declared 'critical habitat' under the FM Act*" (DPI 2013). It is also likely that this section of the Lachlan River provides "*Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 m in length, or native aquatic plants*" (DPI 2013). A waterway class of Class 1 was assigned likely due to the presence of "*…permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'*" (DPI 2013).

Background research identified seven threatened aquatic species listed under the FM Act and/or the EPBC Act that have been previously recorded and/or are predicted to occur within, or adjacent to, the locality. A likelihood of occurrence assessment was undertaken to evaluate the likelihood of each of these threatened aquatic species occurring in the study area based on the aquatic habitats likely to be present (Appendix A.4). A total of six threatened aquatic species were assessed as having a moderate to high likelihood of occurrence within, or adjacent to, the study area (Figure 4.3). The remaining threatened aquatic species was assessed as being of low potential to occur. A summary of threatened aquatic species with a moderate to high likelihood of occurrence within, or adjacent to, the study area is provided in Table 4.6.

Only the Murray-Darling Basin population of Eel-tailed Catfish (*Tandanus tandanus*) and the western population of the Southern Purple-spotted Gudgeon (*Mogurnda adspersa*) are considered to be threatened; although these species are relatively widespread throughout other areas of NSW (DPI 2015, DPI 2017). While there has been large-scale reduction in the range of the Southern Pygmy Perch (*Nannoperca australis*) since European settlement, populations have recently been discovered in tributaries of the upper Lachlan and upper Murray River catchments (DPI 2013). The Silver Perch (*Bidyanus bidyanus*) is listed under both Commonwealth and State legislation due to populations having undergone, or likely to undergo in the future, a substantial reduction in numbers across an increasingly restrictive geographic distribution (DoEE 2013). Recent research indicates that there may be at least two distinct forms of Macquarie Perch (Murray-Darling Basin form from western rivers; Hawkesbury-Nepean systems form, eastern rivers). Overall, there has been a significant decline in the distribution and abundance of Macquarie Perch throughout NSW (DPI 2016). With regard to the Murray Cod (*Maccullochella peelii*), there is currently limited publicly available data on the distribution of this species and therefore Figure 4.3 does not present any distribution data, relative to the study area.

Table 4.6 Threatened aquatic species considered a moderate to high likelihood of occurrence in the study area

Scientific name	Common name	Conservation status	
		EPBC Act	FM Act
Bidyanus bidyanus	Silver Perch	CE	V
Maccullochella peelii	Murray Cod	V	-
Macquaria australasica	Macquarie Perch	E	E
Mogurnda adspersa	Southern Purple-spotted Gudgeon	-	E
Nannoperca australis	Southern Pygmy Perch	-	E
Tandanus tandanus	Murray-Darling Basin population of Eel-tailed Catfish	-	EP

Note: V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered

In addition to listed species, it is considered that the Platypus (*Ornithorhynchus anatinus*) may also occur and could potentially be impacted upon. Whilst this species is not currently listed there are indications that this species is in decline, and thus it may warrant consideration of potential impacts.

4.6 Groundwater-dependent ecosystems

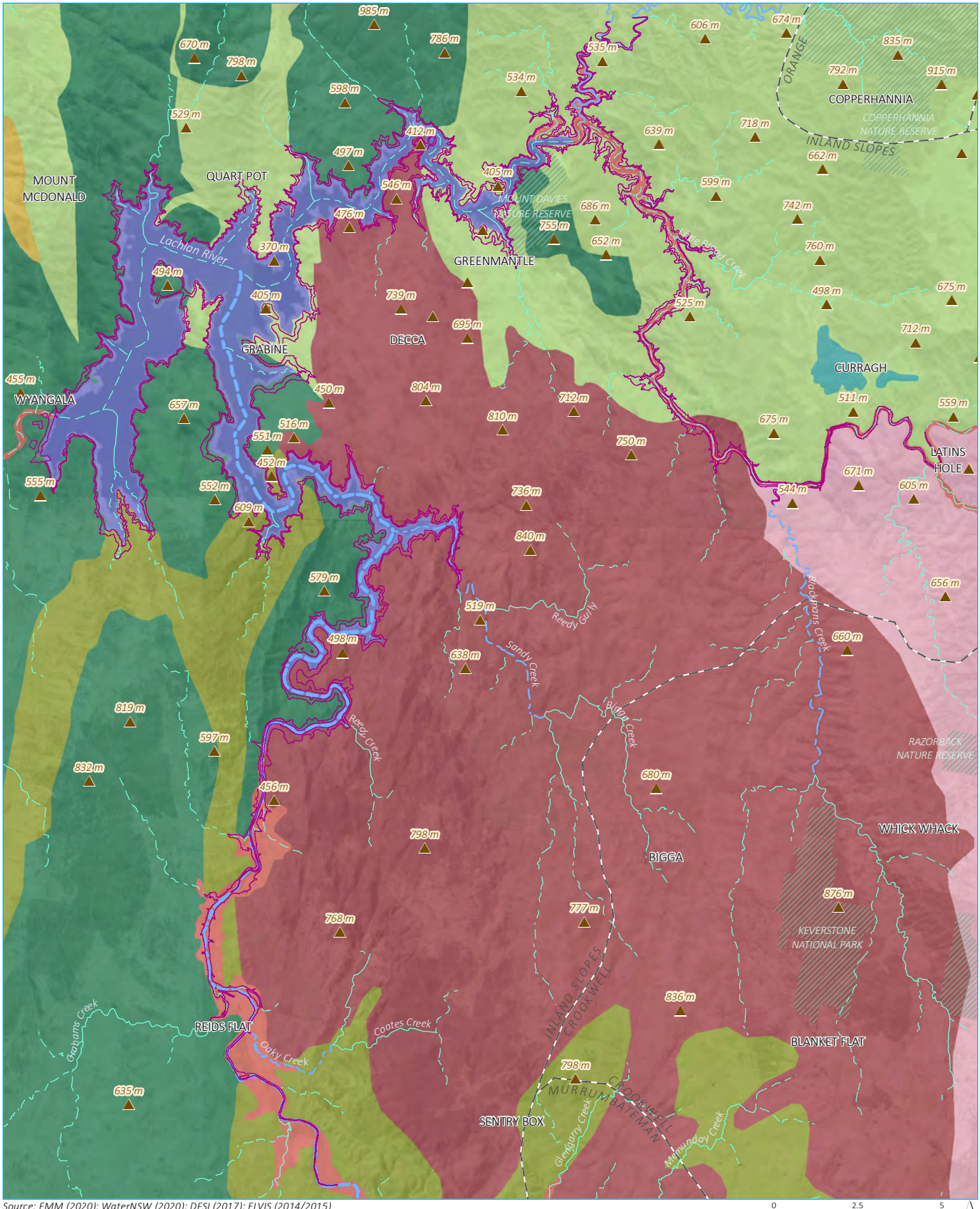
The Groundwater Dependent Ecosystems Atlas (BOM 2020) predicted that five PCTs may be present in the downstream aquatic study area that could represent terrestrial GDEs. Of the predicted terrestrial GDEs, PCT 268 may represent Box Gum Woodland. One aquatic GDE was predicted, *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River,* and is downstream of Wyangala Dam.

Table 4.7 Potential GDEs in the downstream aquatic study area

GDE type	Potential GDE
Aquatic	The Lachlan River is predicted to be a permanent, connected, variable gaining/losing stream, including flow through wetlands.
Terrestrial PCTs	5 - River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion
	185 - Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
	268 - White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western 282 - Blakely's Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
	272 - White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
	342 - Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion
Subterranean	Data not available in NSW.

No databases are available in NSW which catalogue the presence of subterranean fauna, and a brief literature review for the aquatic study area didn't not return evidence of stygofauna. However, the principal geology within the project footprint is the Wyangala Granite, comprising of a foliated porphyritic biotite granite, while the valley downstream is undifferentiated quaternary alluvium. It is possible that these geologies will support subterranean fauna where they intersect groundwater aquifers.

Further assessment of groundwater availability and changes to groundwater following construction will need to be undertaken to inform a more detailed GDE assessment. Further assessment of whether the aquatic study area supports aquatic and/or subterranean GDEs will also be required as part of the EIS stage.



Source: EMM (2020); WaterNSW (2020); DFSI (2017); ELVIS (2014/2015)

*Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.

0 2.5 5 km

GDA 1994 NSW Lambert

N

\\emmsvr1\emm\Jobs\2019\J190822 - 3 Dams\GIS\02_Maps_ConstraintsAssessment_Ecology\WD_ECO001_LandscapeFeatures_20200225_05.mxd 26/02/2020

KEY

- Project footprint
- IBRA7 sub-regions
- Spot height
- NPWS reserve

Strahler stream order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

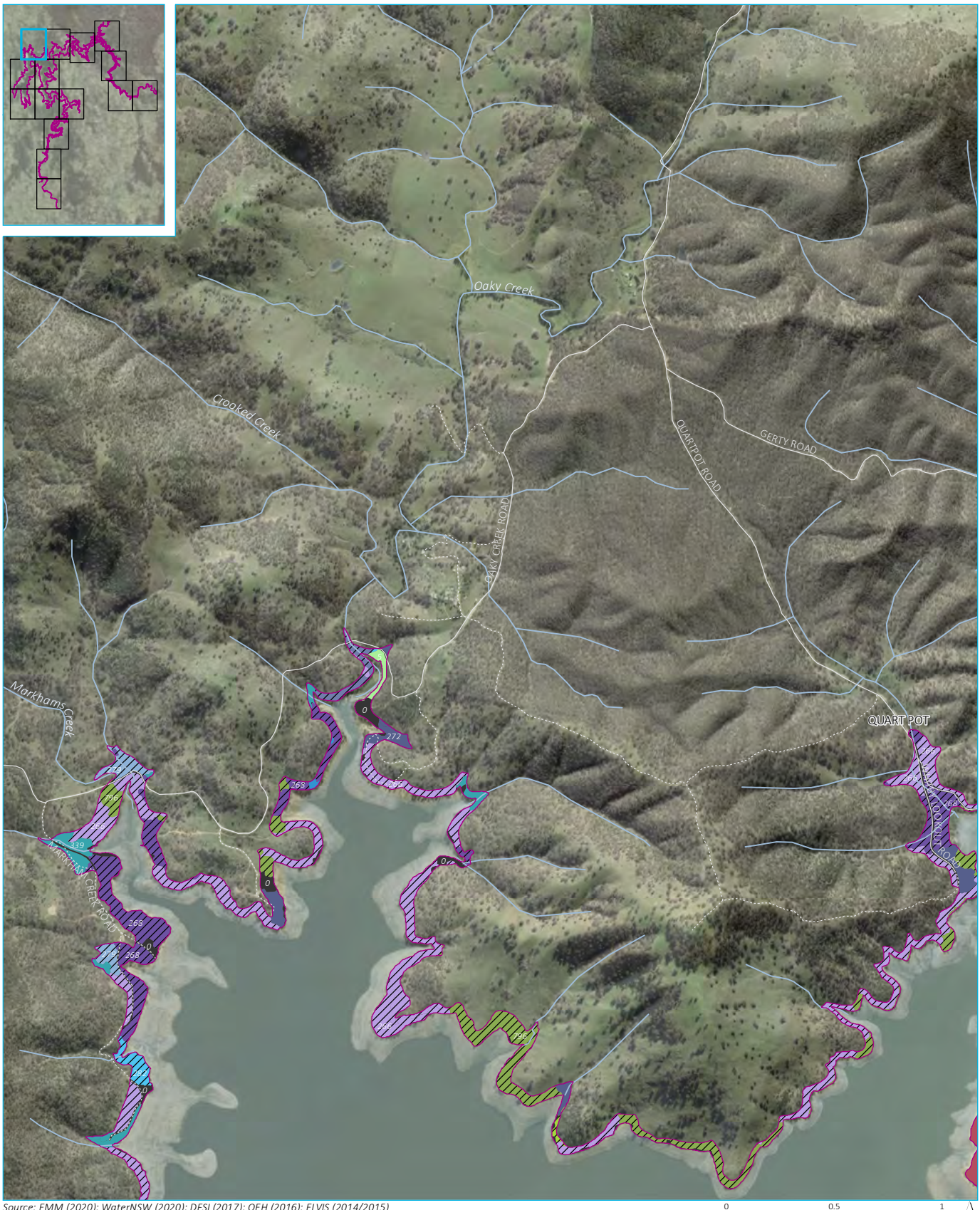
Mitchell landscape
- NSS Upper Slopes
- NSS Upper Slopes Basalts
- NSS Upper Slopes Granites
- SEH Canobolas
- SEH Crookwell

- SEH Monaro
- SEH Murrumbateman Granites
- SEH Orange
- Water

Landscape features

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.1

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT1177 | Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion
- PCT217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT277 | Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- PCT279 | Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT76 | Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2a

EMM creating opportunities

Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

KEY

- Project footprint
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT1177 | Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion
- PCT217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT342 | Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes

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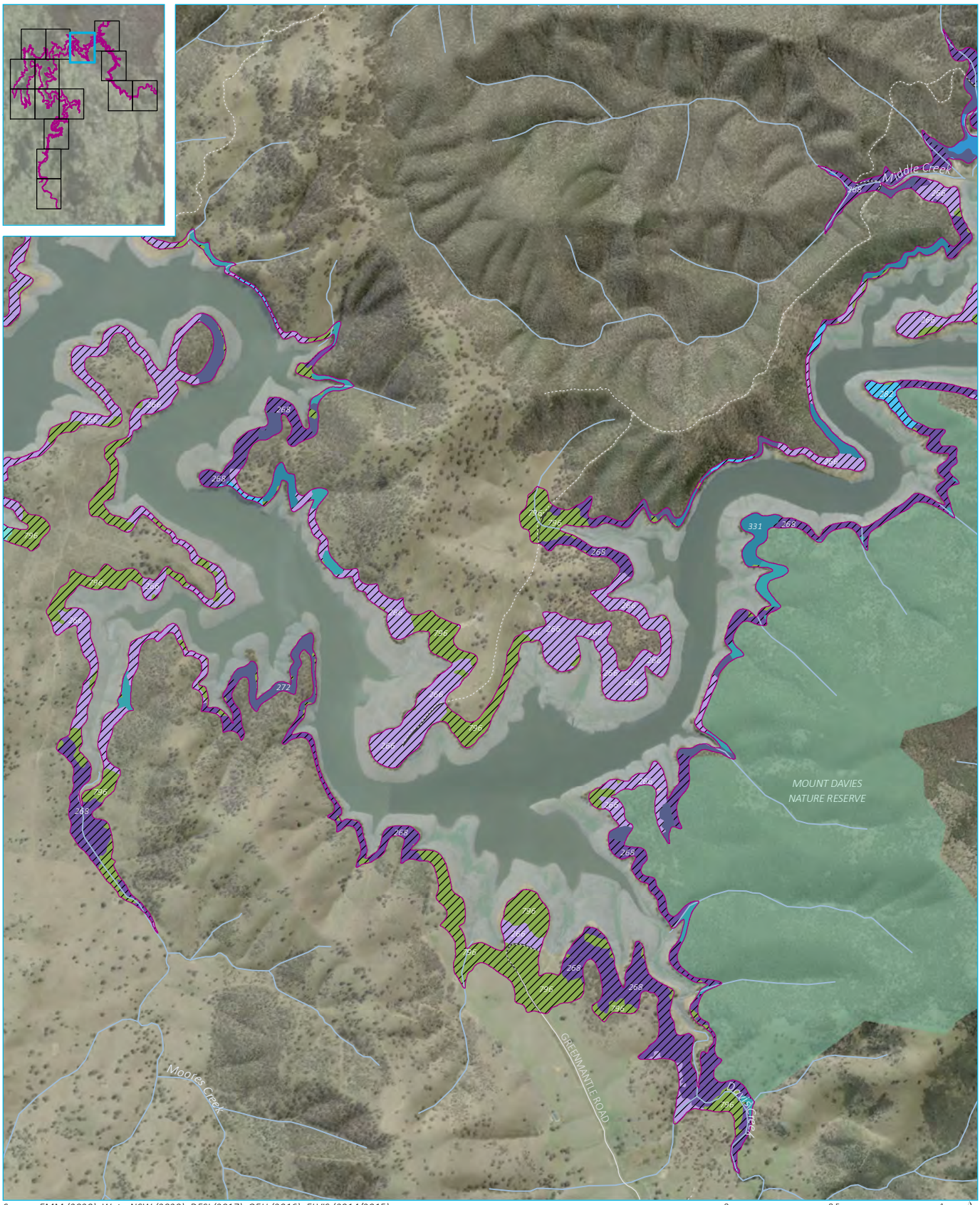
Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2b

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Local road
- Vehicular track
- NPWS reserve
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT331 | Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT342 | Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes

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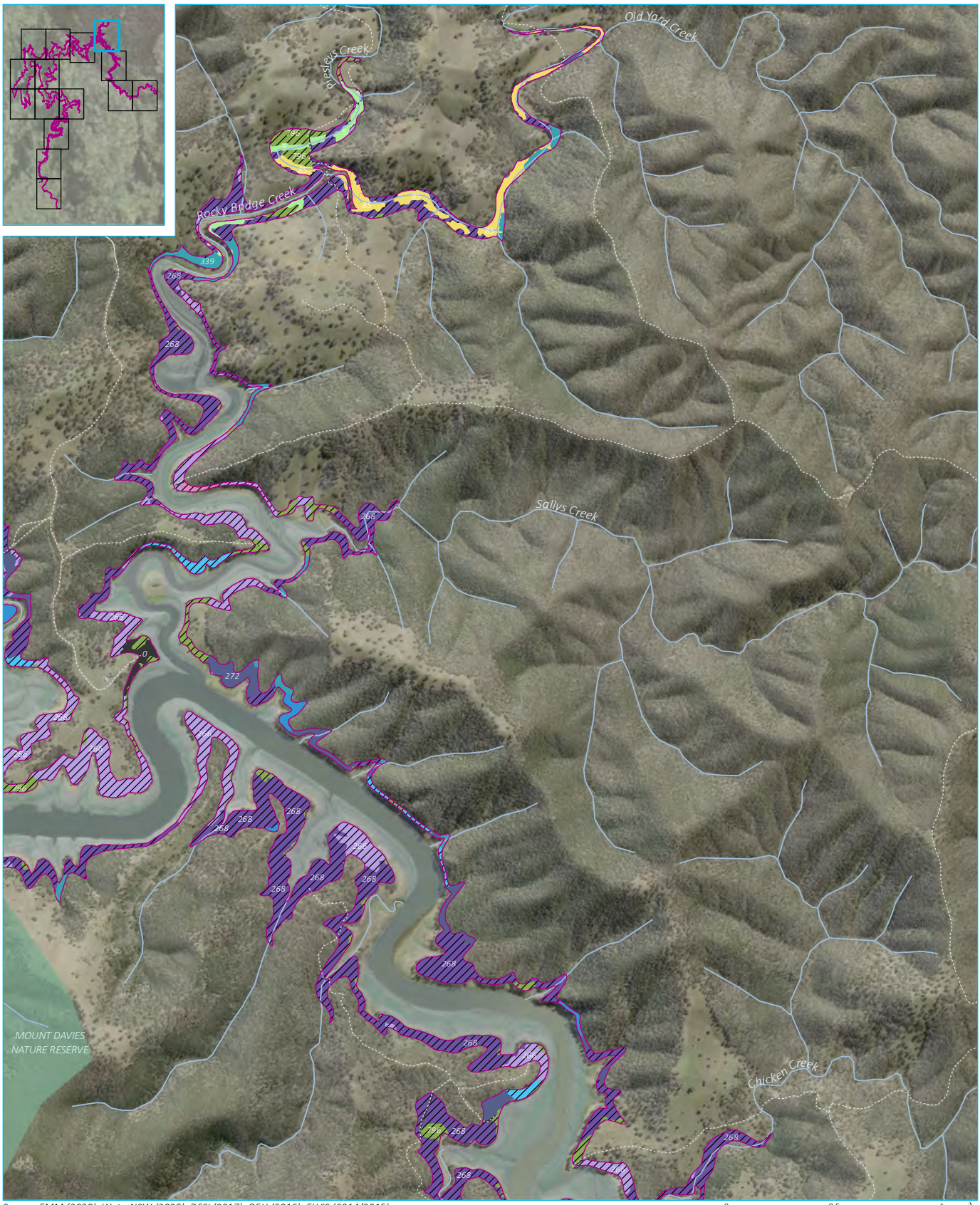
Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2c

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

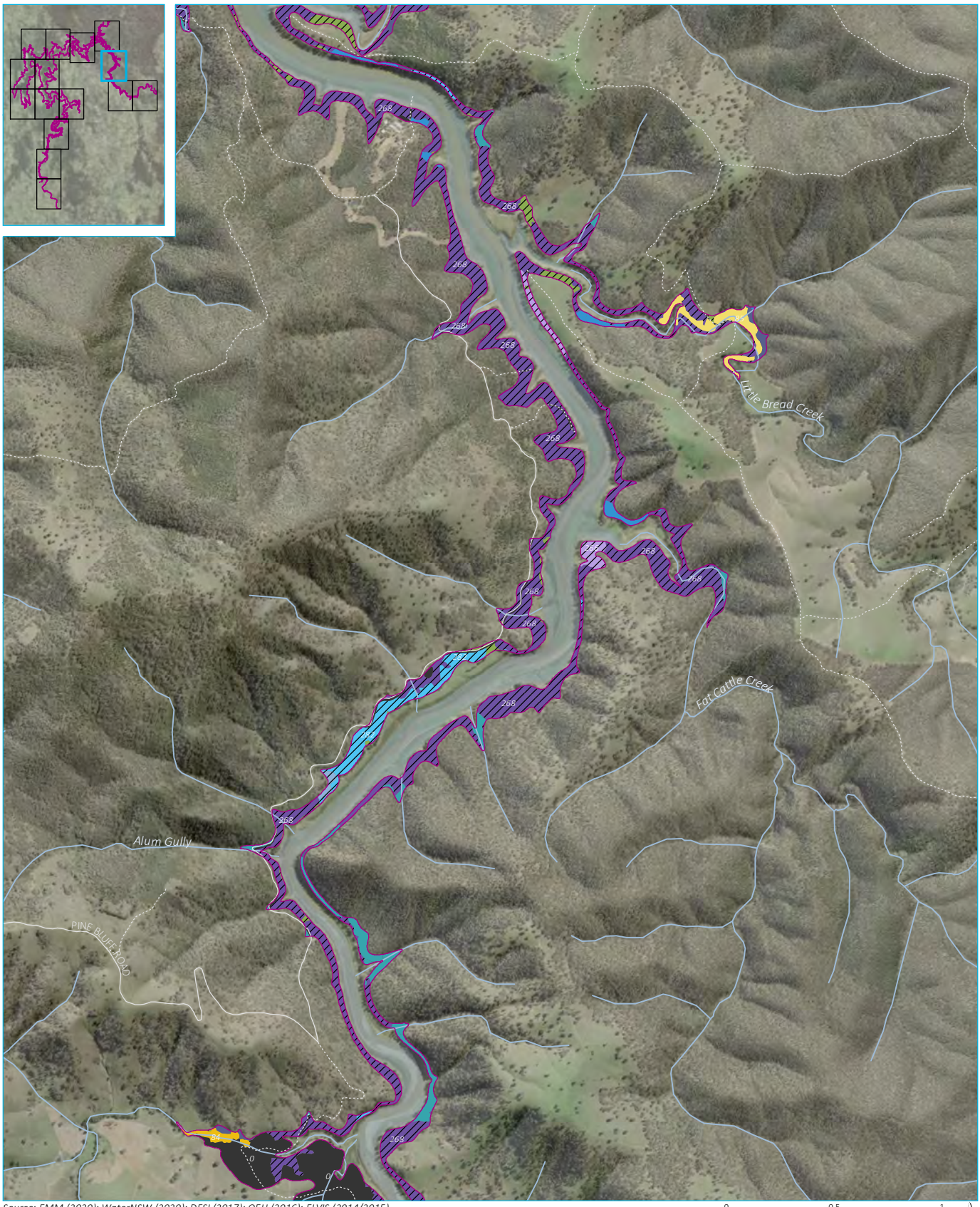
- Project footprint
- Local road
- Vehicular track
- NPWS reserve
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT186 | Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT279 | Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT85 | River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2d

EMM creating opportunities

\\emmsvr1\emm\Jobs\2019\J190822 - 3 Dams\GIS\02_Maps_ConstraintsAssessment_Ecology\WD_EC0002_PCTMapping_20200226_05.mxd 26/02/2020



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT279 | Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT84 | River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion
- PCT85 | River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion

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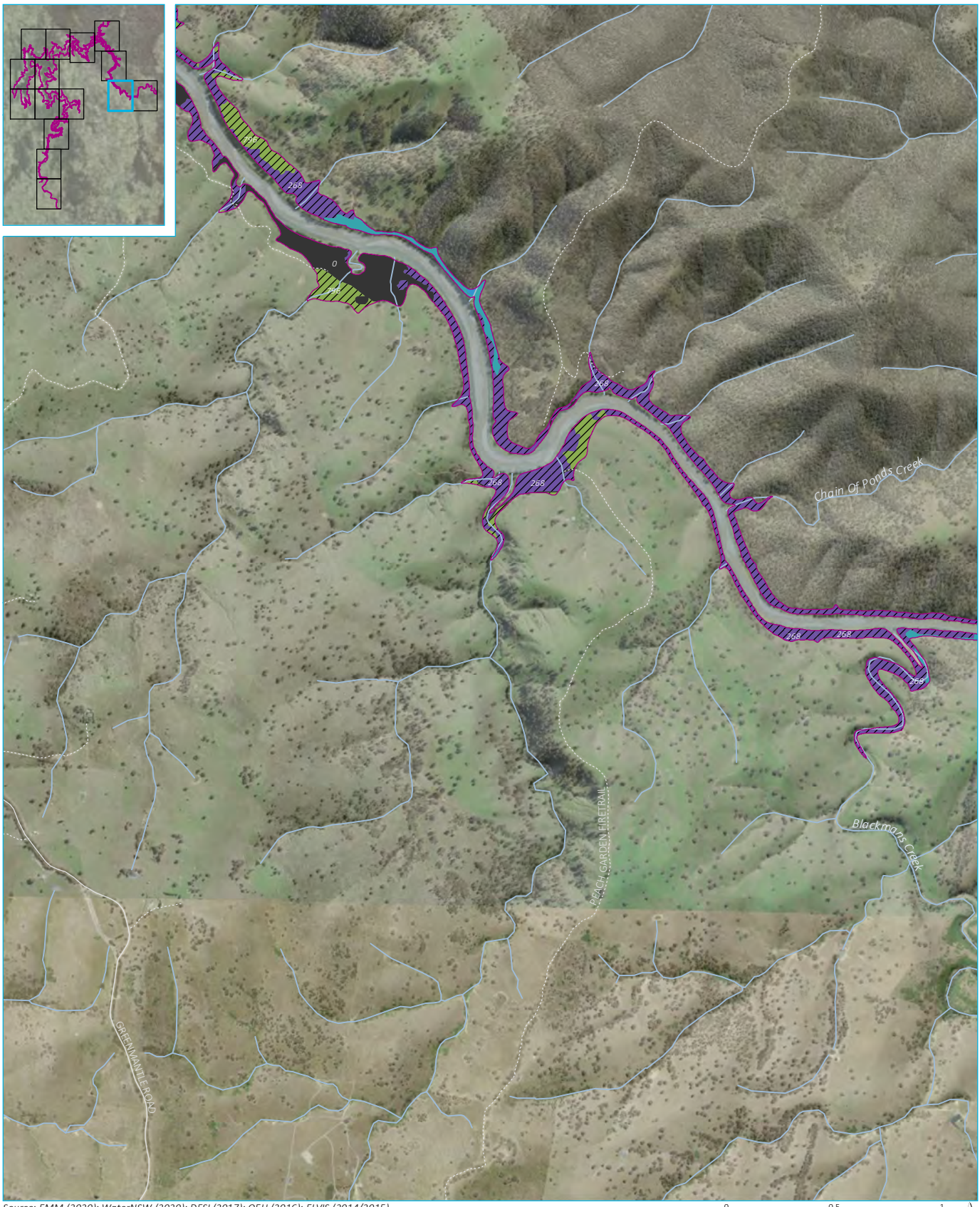
Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2e

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

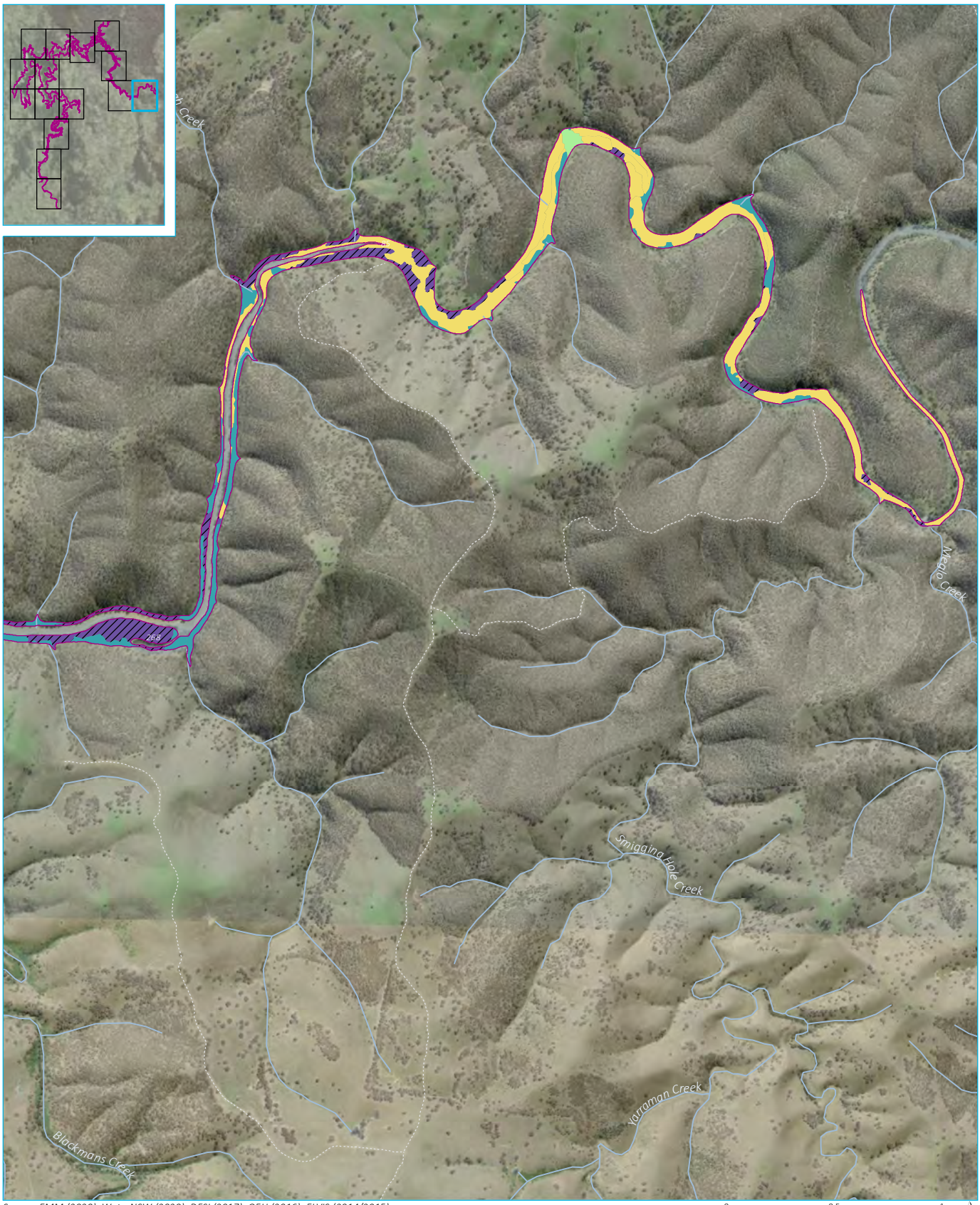
KEY

- Project footprint
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2f

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT85 | River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2g

EMM creating opportunities

Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

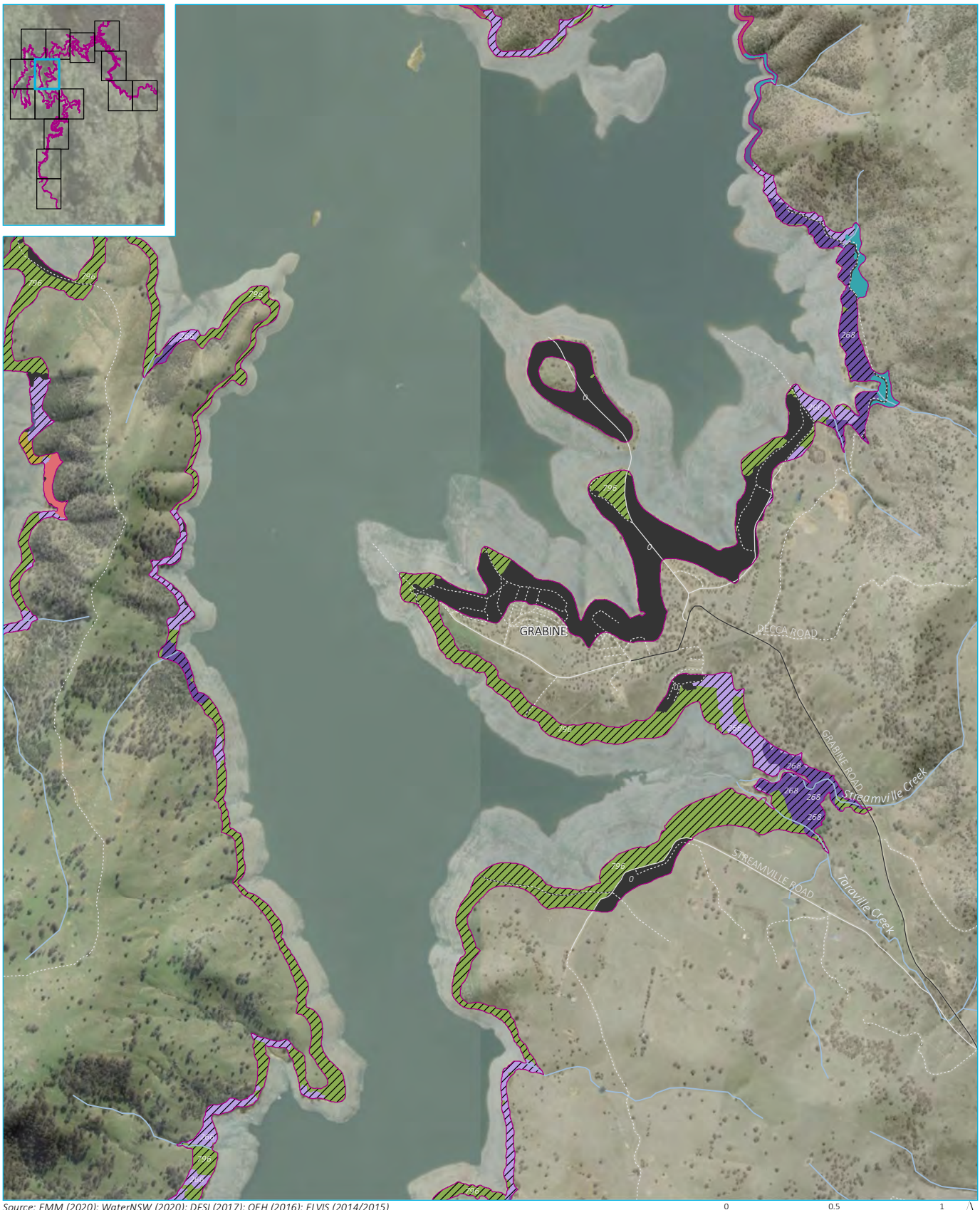
KEY

- Project footprint
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT1177 | Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion
- PCT185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT279 | Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT80 | Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2h

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT1177 | Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion
- PCT185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT80 | Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2i

EMM creating opportunities

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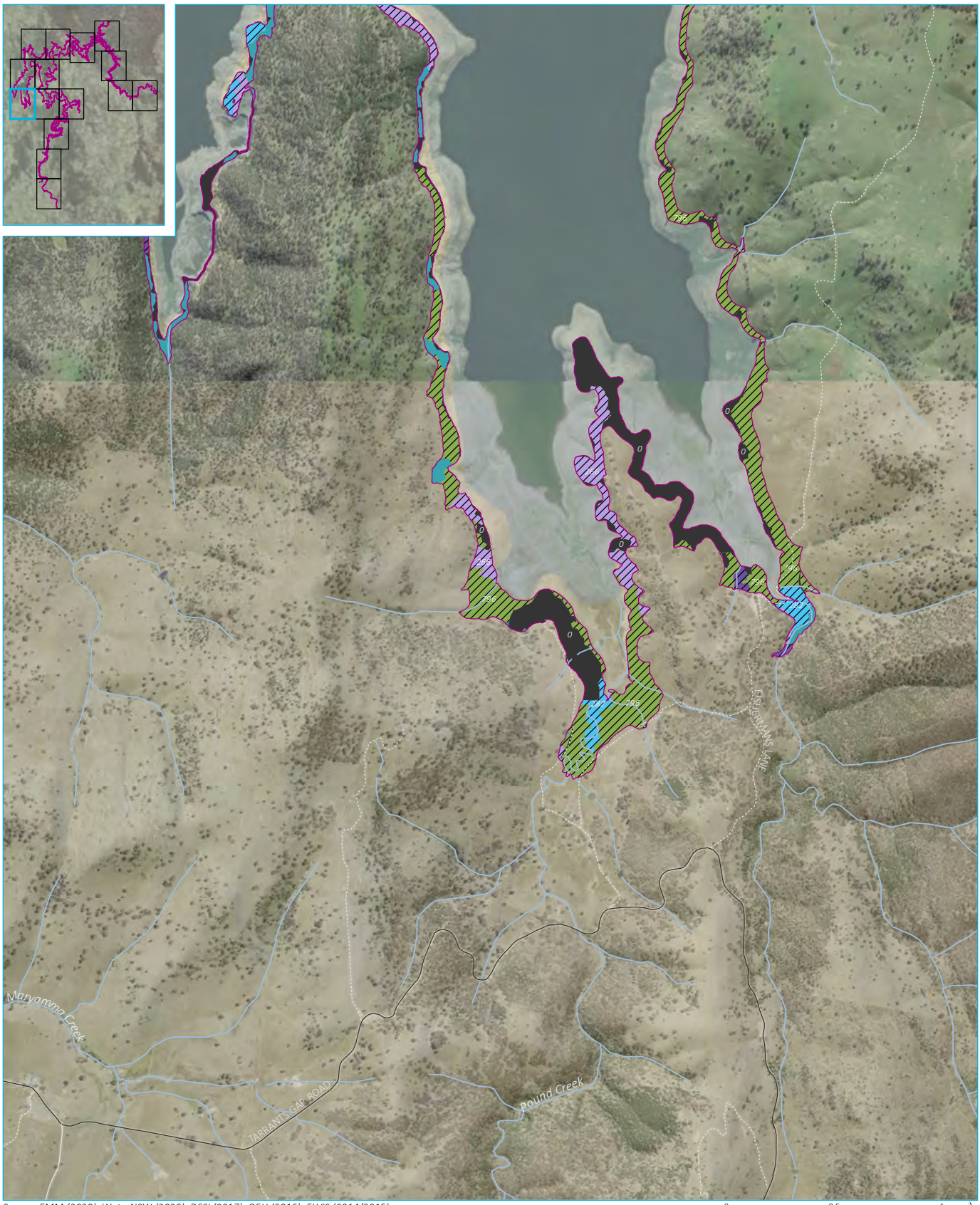

Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT186 | Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT342 | Mugga Ironbark - mixed box woodland on hills in the Cowra - Boorowa - Young region of the NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2j

creating opportunities

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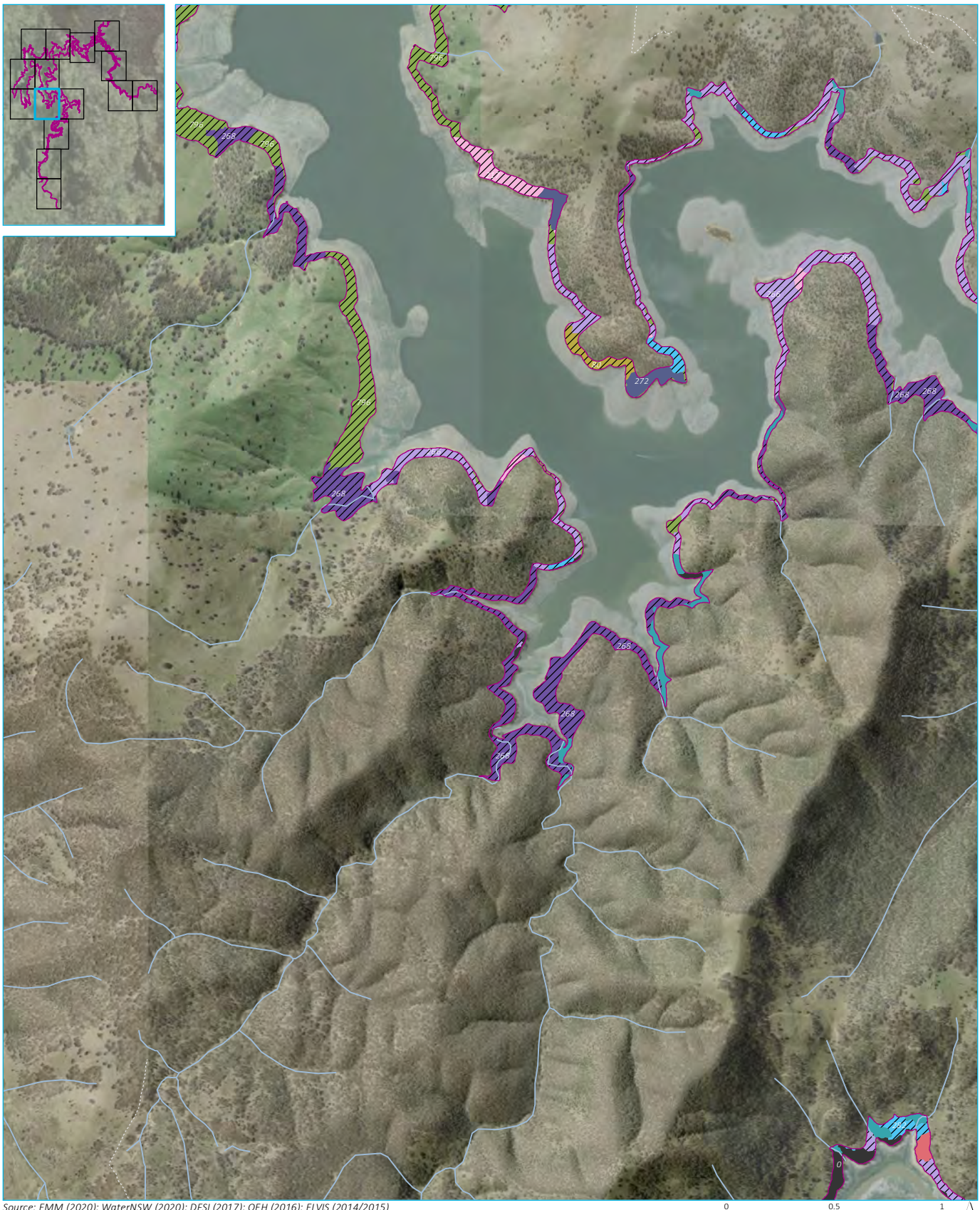

Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes
- PCT80 | Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2k

EMM creating opportunities

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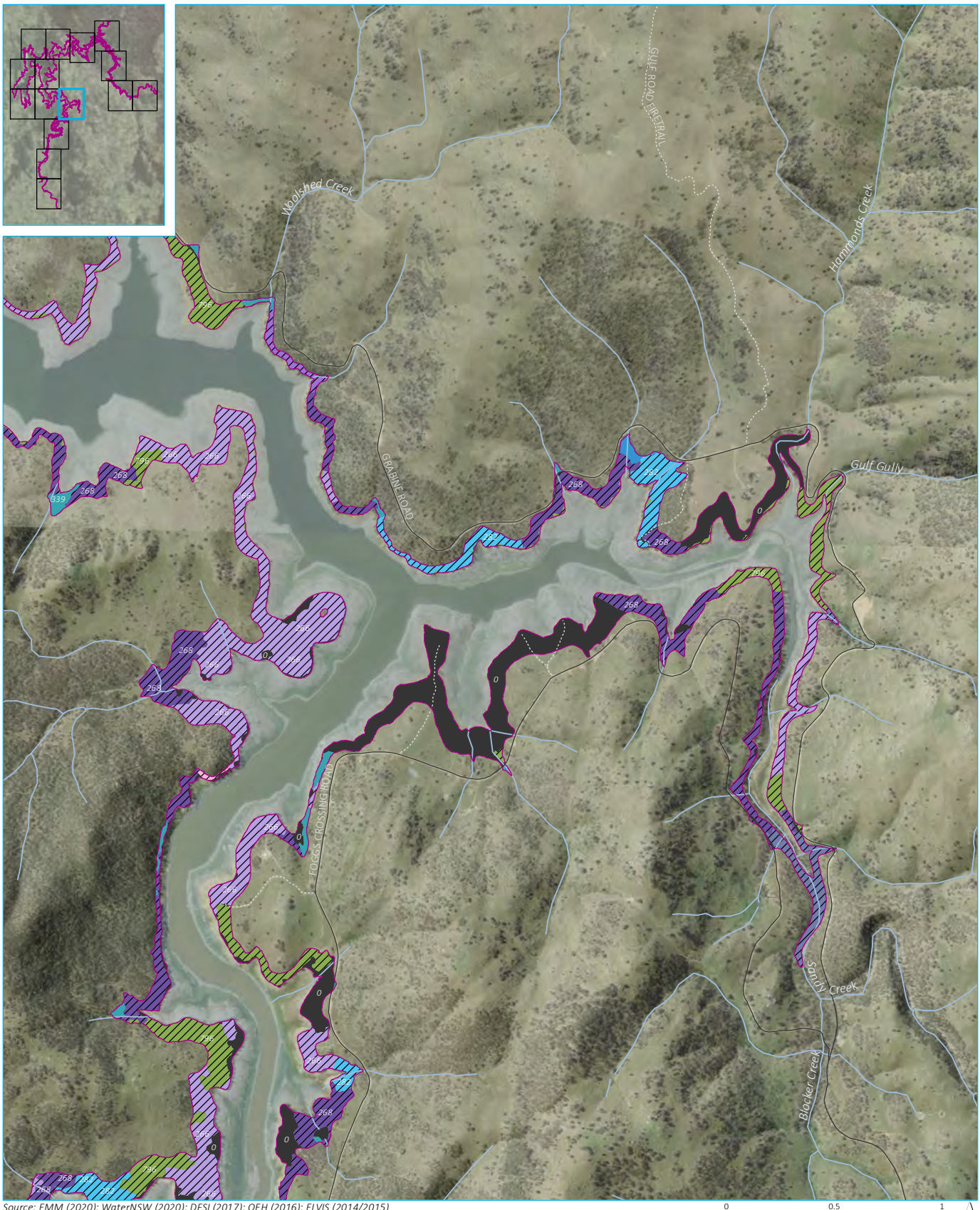

Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Main road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT217 | Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT267 | White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT277 | Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT289 | Mugga Ironbark - Inland Scribbly Gum - Red Box shrub/grass open forest on hills in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT331 | Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2l

EMM creating opportunities

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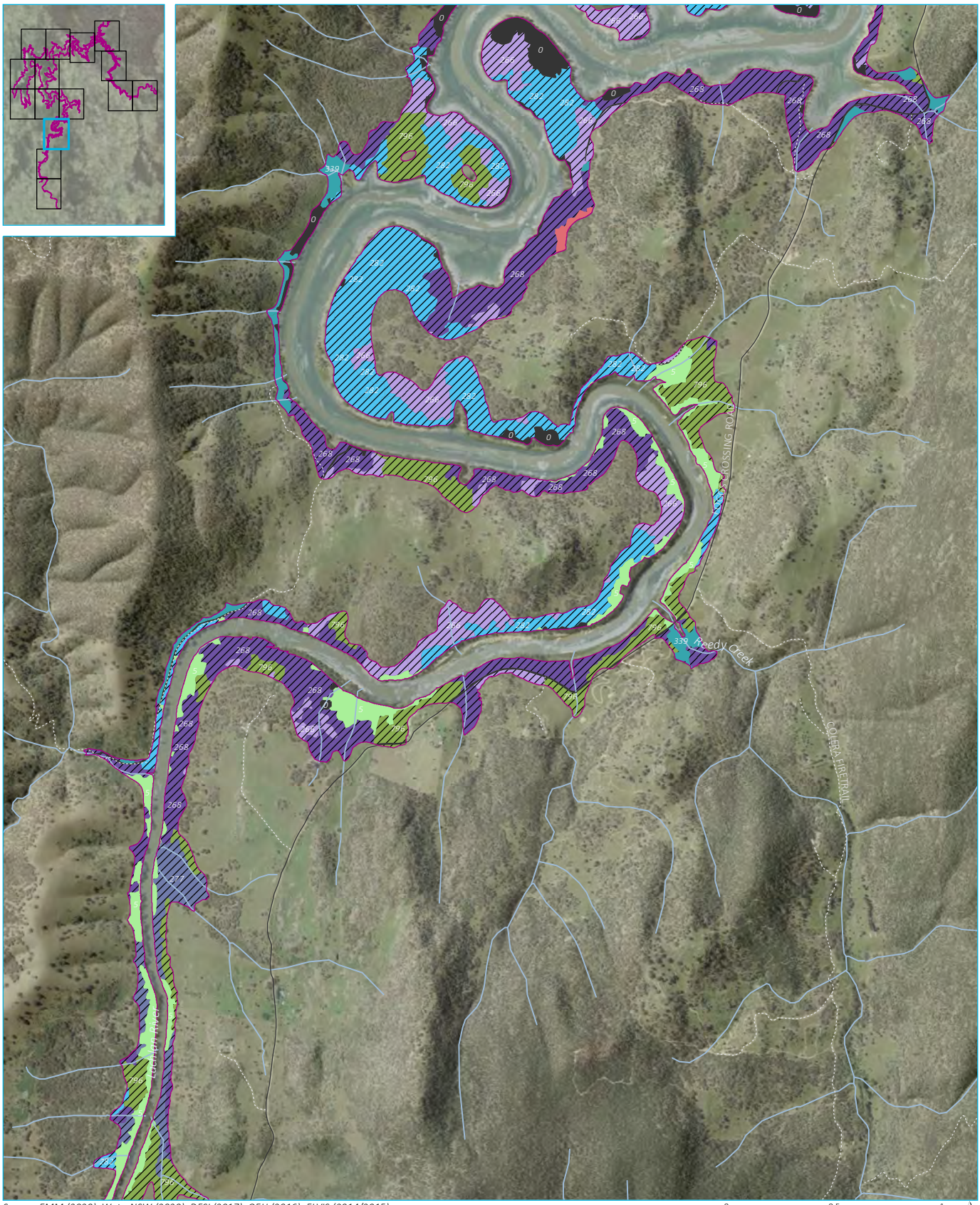


Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

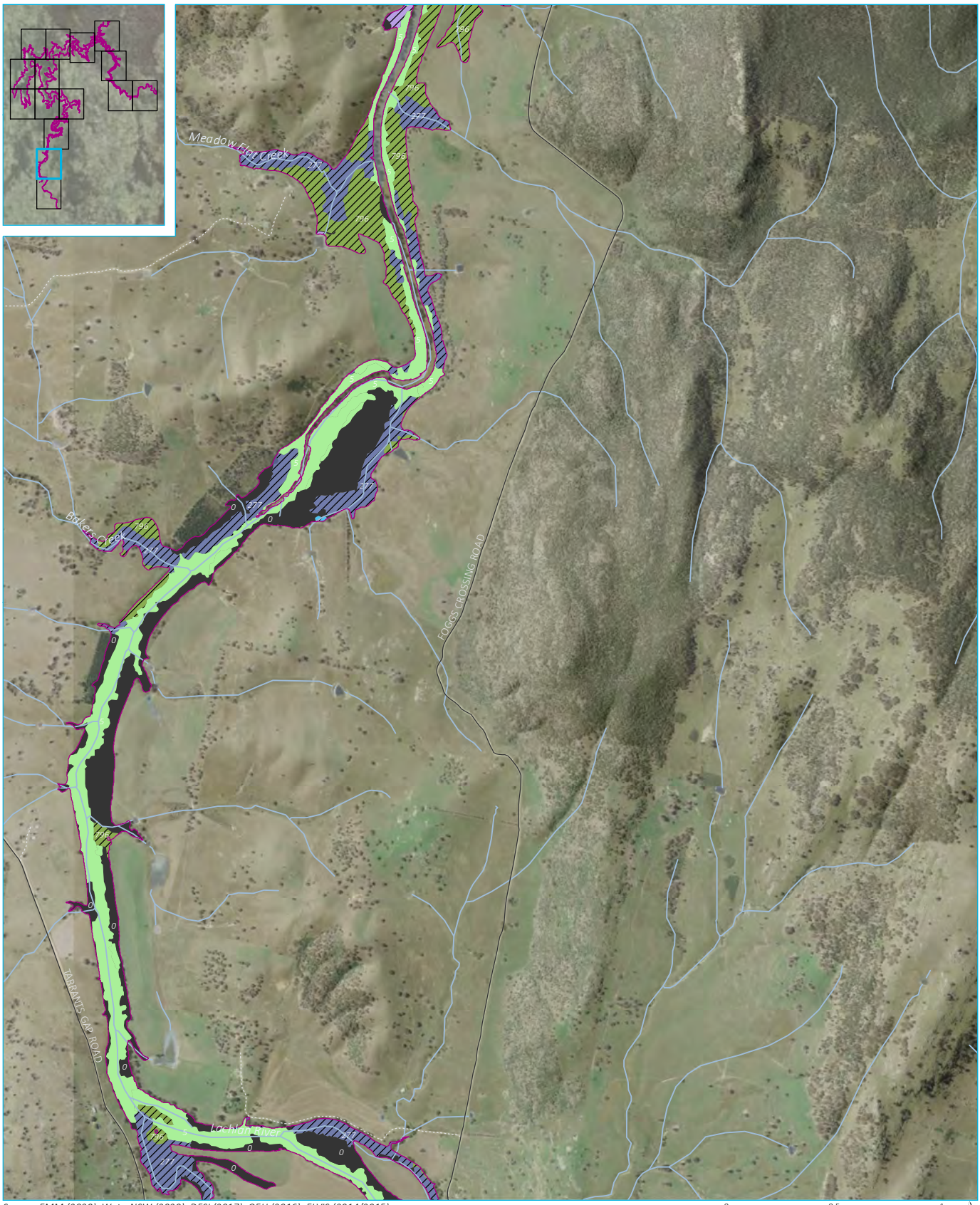
KEY

- Project footprint
- Main road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT185 | Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT277 | Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT339 | Tumbledown Red Gum - Black Cypress Pine - Red Stringybark - Currawang shrubby low woodland on Wyangala granite and metasediments of the Wyangala Dam region, NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2m

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

KEY

- Project footprint
- Main road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT268 | White Box - Blakelys Red Gum - Long-leaved Box - Nortons Box - Red Stringybark grass-shrub woodland on shallow soils on hills in the NSW South Western Slopes Bioregion
- PCT272 | White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT277 | Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- PCT282 | Blakelys Red Gum - White Box - Yellow Box - Black Cypress Pine box grass/shrub woodland on clay loam soils on undulating hills of central NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes

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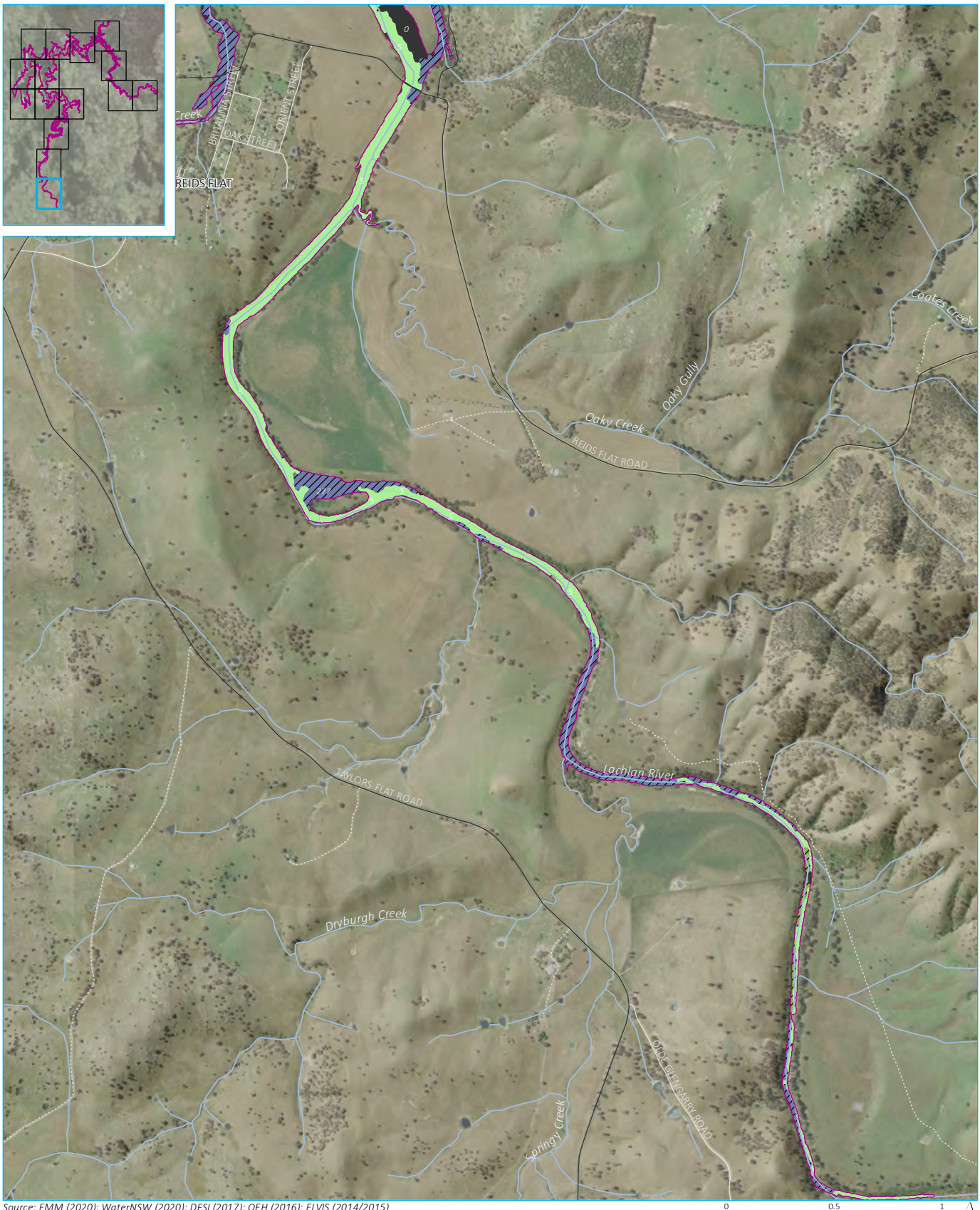
Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.2n

EMM creating opportunities



Source: EMM (2020); WaterNSW (2020); DFSI (2017); OEH (2016); ELVIS (2014/2015)

**Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.*

0 0.5 1 km

GDA 1994 NSW Lambert

N

KEY

- Project footprint
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Potential threatened ecological community
- PCT | Not Native
- PCT266 | White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion
- PCT277 | Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- PCT5 | River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
- PCT796 | Derived grassland of the NSW South Western Slopes

Plant community type mapping

Wyangala Dam Wall Raising Project
Environmental
constraints assessment
Figure 4.2o

EMM
creating opportunities

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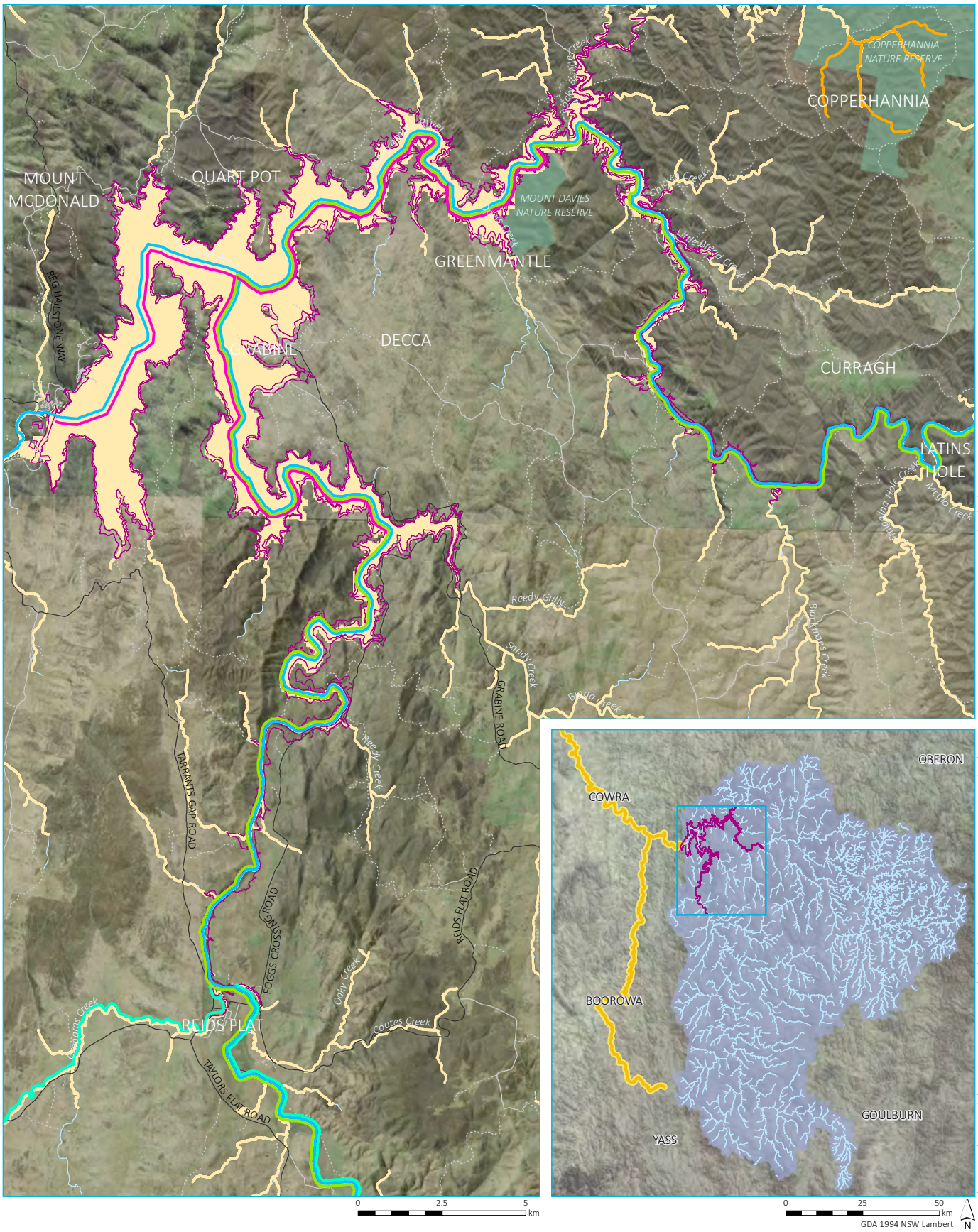

Source: EMM (2020); WaterNSW (2020); DFSI (2017); ELVIS (2014/2015); DPI (2009, 2013); BoM (2011)
*Inundation area should be considered approximate only. It is based on current limited available spatial data and is subject to future verification.

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KEY

- Project footprint
- Main road
- Local road
- Vehicular track
- Watercourse (Strahler stream order 3 and above)
- NPWS reserve
- Wyangala Dam catchment (refer to inset)
- Key fish habitat
- Aquatic EECs (refer to inset)

Aquatic species

- Eel Tailed Catfish
- Macquarie Perch
- Purple Spotted Gudgeon
- Silver Perch
- Southern Pygmy Perch

Aquatic habitat and species

Wyangala Dam Wall Raising Project
Environmental constraints assessment
Figure 4.3

EMM creating opportunities

5 Discussion

This ecological constraints assessment report provides a summary of the biodiversity values present within the study area of the Wyangala Dam wall raising project. Data has been collated based on background research and preliminary field surveys

5.1 Potential impacts

The main impacts of the Wyangala Dam wall raising project will be associated with direct impacts arising from the clearing works for construction of the project, including inundation of upstream environments between the existing FSL and the new FSL resulting from the dam wall raising. Potential direct impacts rising from the project include:

- impact on an estimated 1,692 ha of native vegetation, including TECs;
- impact on threatened species habitat; and
- disturbance/inundation of waterways.

In addition to the direct impacts arising from the project, a number of indirect, prescribed and uncertain impacts, as described in the BAM (OEH 2017), may also result, including:

- increased noise, vibration and dust levels during construction, resulting in disturbance of fauna species, and potential consequent abandonment of habitat, or changes in behaviour (including breeding behaviour);
- erosion and sedimentation from construction works;
- lighting for night works during construction, resulting in potential disturbance to fauna species and changes in occupancy or behaviour;
- increase in weeds and pathogens, resulting in degradation of retained native vegetation and habitat;
- increase in predatory and pest animal species, resulting in increased predation and competition and a consequent reduction in populations;
- impediment to fish passage;
- changes in flow regimes downstream of the Dam, resulting in impacts to aquatic systems, species and habitats; and
- potential for alteration in hydrogeology for any GDEs present.

Measures to avoid, minimise and mitigate impacts will need to be considered during design and further environmental assessment undertaken as a part of the EIS. Any residual impacts will need to be offset.

5.2 Offsets

Any residual impacts arising from the project, after all measures to avoid, minimise and mitigate impacts have been considered, will need to be offset. Under the NSW BOS proponents have several options for meeting an offset liability (Plate 5.1). Offset requirements for the project would be determined in consultation with relevant agencies is recommended including DAWE, NSW Biodiversity and Conservation Division (BCD) and DPI Fisheries.

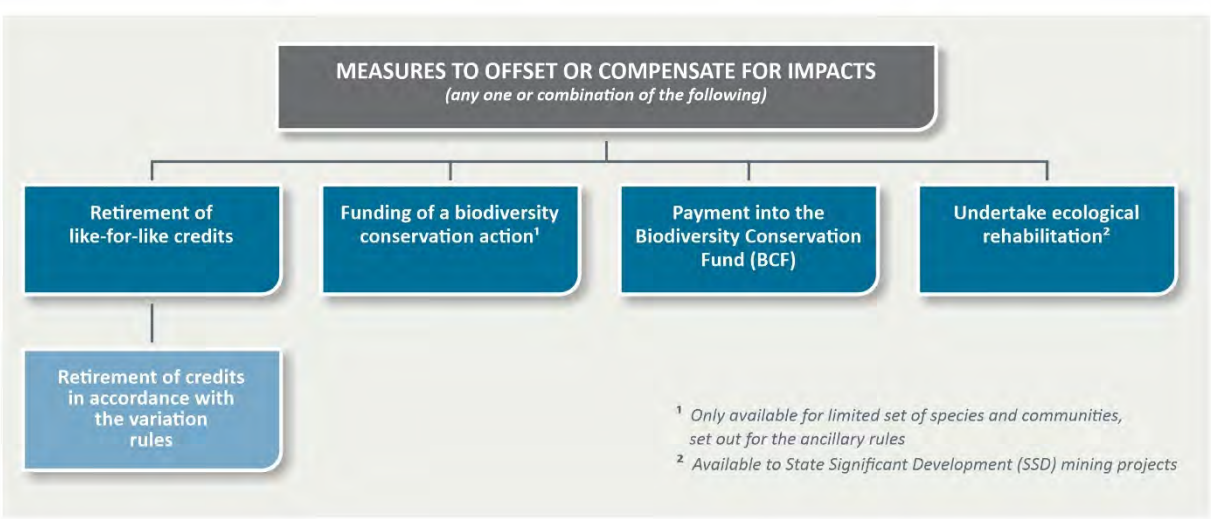

Plate 5.1 Options for meeting an offset liability

5.3 Constraints and opportunities

Using the information outlined above EMM has identified and summarised constraints and opportunities for the project requiring consideration in future design and assessment (Table 5.1).

Table 5.1 Key biodiversity constraints and opportunities

Item	Discussion
TECs listed under the BC and EPBC Act	The presence of large areas of Box Gum Woodland (Section 4.2) (1,391 ha) within the project footprint will require consideration during design to avoid and minimise impacts. Detailed vegetation mapping, including assessment against EPBC Act and BC Act condition thresholds, will be required at EIS phase. Presence of TECs will be considered during detailed design and in discussions with approval agencies. There are not opportunities to avoid impacts for the inundation but will seek to avoid impacts for other components of the project, such as ancillary infrastructure.
Threatened species including SAII candidate entities	Background research indicates that the study area may support various potential candidate SAII entities (see Table 4.3and Table 4.4). The Minister must be satisfied that all measures to avoid and minimise impacts to SAII entities have been considered. The SAII entity concept is about protecting threatened species and threatened ecological communities that are most at risk of extinction from potential development impacts or activities. For SSI projects, the Minister is required to take impacts to SAII entities into consideration and must determine whether there are any additional and appropriate measures that will minimise SAII. Target threatened flora and fauna surveys will be performed, where possible, as part of the EIS for candidate SAII entities. Early discussion with relevant agencies is recommended.

Table 5.1 Key biodiversity constraints and opportunities

Item	Discussion
Preliminary determination for Box Gum Woodland and Key's Matchstick Grasshopper	White Box Yellow Box Blakely's Red Gum Woodland, currently listed under the BC Act as endangered, has been nominated for listing as critically endangered with a preliminary determination made. Key's Matchstick Grasshopper has a preliminary determination for listing as an Endangered species. Regular checking of new listings under the BC Act and EPBC Act is recommended. Assessment of potential impacts and offsets for uplisted communities and species would be required.
Threatened aquatic ecological communities (FM Act)	The Lachlan River endangered ecological community is located downstream of the Wyangala Dam. Any changes to operational requirements associated with the raising of the dam wall may reduce the amount of water that is available for environmental flow release and ecosystem maintenance. Surface and groundwater modelling and a water balance assessment should be undertaken as well as an assessment of the impact to this EEC resulting from changes in flows. Field surveys may be required.
Aquatic ecosystem impacts	Background research (Section 4.5) indicates that aquatic species listed under the EPBC Act and/or FM Act have the potential to occur within, or adjacent to, the study area. Further survey and assessment of direct and indirect negative (and positive) impacts for these species is likely to be required. Reduction in surface water flow downstream has the potential to impact any surface waterbodies and/or subterranean fauna if there is a degree of ground-surface water interaction. Further assessment to understand GDEs, and quantify these impacts, is likely to be required. In-field survey, and discussion with DAWE and DPI Fisheries, will need to be undertaken to investigate the presence of threatened aquatic species. Surface and groundwater modelling and a water balance assessment should be undertaken as well as, at a minimum, a desktop assessment of the likelihood of occurrence of, and impact to, aquatic GDEs. The desktop assessment may provide recommendations that further field survey is undertaken. Measures and /or installation of fish passageways are likely to be required.
Impact of drought on ability to conduct ecological assessments	There is a risk that due to the ongoing drought, vegetation within the study area will be drought affected and the ability to conduct BAM plots impacted, with the quality of vegetation reduced. In addition, detectability of some threatened species may be reduced or may be minimal (eg frog species not vocalising, nomadic bird species not currently present in the survey area, or flora species not detectable due to lack of reproductive material). It may be necessary to assume presence for some threatened species credit species, which will need to be determined through the EIS assessment process and in consultation with BCD.
Project design, including ancillary facilities and sites for sourcing construction materials	At this stage, the full design of the project is yet to be determined including the location and area for any ancillary facilities within the study area. Where feasible, design should consider biodiversity values present and seek to minimise impacts to these values. It is recommended that the placements of ancillary facilities occur in already cleared areas wherever feasible. It is recommended to prioritise sourcing materials from existing quarries (which have approvals in place). If this is not possible, look to minimise biodiversity impacts as much as possible when siting quarry or borrow pits.

6 Future assessment

To adequately assess the biodiversity impacts arising from the project a number of assessments will be required as a part of the EIS for the Wyangala Dam project. Based on the current understanding of project areas to be impacted, the anticipated assessment requirements are outlined in Table 6.1.

Table 6.1 Future assessment requirements

Assessment requirement	Potential scope of works
Detailed vegetation mapping	• Detailed vegetation mapping, including mapped of PCTs and vegetation zones (based on condition) will be required.
Vegetation plot survey	• Completion of vegetation plots, as per the BAM. At this stage it is unknown how many plots will be required as it will depend on both the number and extent of vegetation zone, which are a combination of PCT and condition. Based on a number of assumptions about the number of vegetation zones that may be mapped, and their size, it has been estimated that 285 BAM plots may be required. Depending on the results of mapping vegetation zones this estimate may be higher or lower than the number of plots actually required.
Threatened species surveys – flora	• Targeted flora surveys, undertaken in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH 2016), will be required for the 26 candidate flora species credit species outlined in Section 4.3.3i. • Surveys should be undertaken in accordance with seasonal surveys requirements (Appendix B.1). A preliminary assessment indicates that October is an optimal time to for undertaking these surveys, with 20 out of 26 species able to be surveyed during this period. Additional surveys may be required for Sand-hill Spider Orchid (*Caladenia arenaria*) and the Crimson Spider Orchid (*Caladenia concolor*) in September, the Small Scurf-pea (*Cullen parvum*), Bluegrass (*Dichanthium setosum*) and Euphrasia arguta in December, and Clandulla Geebung (*Persoonia marginata*) in March. • Some species may not be able to be surveyed within the required project timeframes due to seasonality or other constraints. In accordance with the NSW Biodiversity Assessment Method (BAM) in instances where a species cannot be surveyed within the required timeframes during BDAR and EIS preparation, these species must be assumed present for the BDAR. Further surveys can be undertaken during the response to submissions or post-approval (as a part of the management plan process), and prior to construction, and addressed in a revised BDAR. If prepared post-approval, modification to the Project Approval is likely to be required.

Table 6.1 Future assessment requirements

Assessment requirement	Potential scope of works
Threatened species surveys – fauna	• Targeted fauna surveys undertaken in accordance with NSW and Commonwealth survey guidelines will be required for the 31 candidate fauna species credit species outlined in Section 4.3.3, apart from Curlew Sandpiper, Regent Honeyeater, and Swift Parrot which have important habitat mapped, and survey is not required. This will include: – diurnal bird surveys for two species (Bush Stone-curlew, Gang-gang Cockatoo); – hollow bearing tree and targeted nest searches for seven species (Glossy Black-Cockatoo, White-bellied Sea-Eagle, Black-breasted Buzzard, Little Eagle, Major Mitchell's Cockatoo, Square-tailed Kite, Superb Parrot); – call playback and spotlighting for five species (Barking Owl, Powerful Owl, Masked Owl, Greater Glider, Pale-headed Snake); – small mammal trapping for one species (Eastern Pygmy-possum); – arboreal mammal trapping for one species (Squirrel Glider); – remote camera surveys for two species (Brush-tailed Rock-wallaby, Brush-tailed Phascogale); – targeted Koala surveys, using a combination of the Regularized Grid Based (RGB) Spot Assessment Technique (SAT), acoustic recording devices (for calling males) or Koala detection dogs; – acoustic surveys for three microbats species (Large-eared Pied Bat, Eastern Bent-wing Bat, Southern Myotis); – habitat assessment and nocturnal searches (visual encounter surveys (VES)) for amphibians for two species (Sloane's Froglet, Booroolong Frog); – insect flying / mating surveys for two species (Golden Sun Moth, Key's Matchstick Grasshopper); and, – tile survey for two reptile species (Pink-tailed Legless Lizard, Striped Legless Lizard). • Surveys should be undertaken in accordance with seasonal surveys requirements (Appendix B.1). A preliminary assessment indicates that November is an optimal time for undertaking these surveys, with 20 out of 28 species able to be surveyed during this period. Additional surveys may be required for a further five species in August. Surveys for two additional species may be required in December to February. Survey guidelines for one species are not available. • It is recommended that any species unable to be surveyed due to timeframe limitations are assumed present for the BDAR, and/or that further surveys are undertaken for any species which cannot be surveyed in accordance with NSW and Commonwealth survey guidelines during response to submissions or post-approval (as a part of the management plan process), and prior to construction.
Key fish habitat assessments	• Key fish habitat assessments will be required and should be undertaken as part of a comprehensive "aquatic ecology assessment". Key fish habitat is currently mapped conservatively and does not account for variation within a waterway that would be available from field assessments. As such, there is potential for estimates of impacts on key fish habitat to be overestimated, and thus aquatic ecology offsets to be overestimated. In-field characterisation, in combination with examination of existing stream order data, will be required to be undertaken (in accordance with DPI policy) by assessing "waterway type" and "waterway class".
Threatened species surveys – aquatic fauna	• Aquatic surveys will need to be undertaken as part of a comprehensive "aquatic ecology assessment" to document the aquatic values within the aquatic study area. Targeted surveys, undertaken in accordance with NSW and Commonwealth guidelines, will be required for up to four threatened aquatic species and potentially for the Platypus, as outlined in Section 4.5. This may include a combination of the following methods, or alternative accepted methods; gill netting, fyke netting, electrofishing, angling, eDNA sample analysis, etc. • It should be noted that consultation with DPI Fisheries should be undertaken as soon as practicable to discuss appropriate sampling techniques and expectations.
GDE assessment	• Reduction in surface water base flow downstream has the potential to impact any surface waterbodies and/or subterranean fauna if there is a degree of ground-surface water interaction. Further assessment to understand GDEs, and quantify these impacts, is likely to be required. Surface and groundwater modelling and a water balance assessment should be undertaken as well as, at a minimum, a desktop assessment of the likelihood of occurrence of, and impact to, aquatic GDEs. The desktop assessment may provide recommendations that further field survey is undertaken.

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Appendix A

Species credit species habitat suitability assessment

A.1 Flora species credit species

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Acacia ausfeldii	Ausfeld's Wattle		V	Yes. Footslopes and low rises on sandstone present in the study area.	-
Acacia curranii	Curly-bark Wattle	V	V	Yes, due to uncertainty. Question is whether rocky areas are within the study area.	No. The nearest record of this species is 200km west of Wyangala, and the study site is outside its predicted distribution.
Acacia meiantha		E	E	-	Yes. Although this species is restricted to three disjunct populations, Wyangala is within its predicted distribution.
Ammobium craspedioides	Yass Daisy	V	V	-	Yes. The species has been recorded in the study area previously and the study area meets the geographic, geological and habitat requirements of the species.
Austrostipa wakoolica	A spear-grass	E	E	Yes, due to uncertainty. Alluvial plains could be present in the study area.	Yes. Although the nearest record is over 70km from the study area, the site fulfils the habitat requirements for the species and is within its predicted distribution.
Bossiaea fragrans		CE	CE	-	Yes. The records for this species are within 20km of Wyangala, and the study area fulfils some of the habitat requirements for the species.
Brachyscome papillosa	Mossgiel Daisy	V	V	-	No. The study area is over 100km away from known populations further west near Coolamon.
Caladenia arenaria	Sand-hill Spider Orchid	E	E	-	Yes. Although the study area is over 100 km from recorded populations near Cootamundra, habitat and geological requirements of the species exist within the study area.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Caladenia concolor	Crimson Spider Orchid	V	E	-	Yes. Although the study area is over 100 km from the closest recorded population at Burrinjuck Nature Reserve, habitat and geological requirements of the species exist within the study area.
Callistemon pungens		V		-	No. The distribution of this species is restricted to northern NSW.
Commersonia procumbens		V	V	No. Species is restricted to Pilliga sandstone, which is not present in the study area.	-
Cullen parvum	Small Scurf-pea		E	-	Yes. Although the study area is over 70 km from records near Young, habitat and geological requirements of the species exist within the study area.
Dichanthium setosum	Bluegrass	V	V	-	Yes. Although the nearest record is over 70km from the study area, the site fulfils some of the habitat requirements for the species and is within its known distribution.
Diuris sp. (Oaklands, D.L. Jones 5380)	Oaklands Diuris		E	-	No. Although some habitat requirements for this species are present within the study area, the nearest record is 200km away from Wyangala.
Diuris tricolor	Pine Donkey Orchid		V Endangered Population Muswellbrook LGA not relevant to Wyangala Dam	-	Yes. Although the study area is over 70 km from records near Grenfell, habitat and geological requirements of the species exist within the study area.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Eleocharis obicis	Spike-Rush	V	V	No. Semi-permanent/ephemeral wet areas are present within the study area, but there are no records within 100km of Wyangala.	-
Eucalyptus alligatrix subsp. *alligatrix*		V	V	-	Yes. Although the species is restricted to an area about 150km from Wyangala, the study area is within its predicted distribution and fulfils some of the species' habitat requirements.
Euphrasia arguta		CE	CE	-	Yes. This species has only recently been rediscovered in northern NSW. Although there are no records near the study area, habitat and geological requirements of the species are present, and it is predicted to occur in the region.
Grevillea divaricata			E	-	No. Known only from one historic record, 70km north of Wyangala.
Grevillea iaspicula		E	CE	No. Limestone rock substrates are not present within the study area.	-
Grevillea ilicifolia subsp. *ilicifolia*	Holly-leaf Grevillea		CE	-	No. Wyangala is not within the predicted range of this species, and there are no previous records within the study area.
Grevillea obtusiflora		E	E	-	No. This species has a restricted range, over 100km away from Wyangala.
Grevillea wilkinsonii	Tumut Grevillea	E	E	-	Yes. Although the current records for this species are restricted to the Tumut area, the study area is within the predicted distribution of this species and fulfils some of its habitat requirements.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	V	V	-	No. This distribution of this species is restricted to northern NSW.
Indigofera efoliata	Leafless Indigo	E	E	-	No. Very rare and possibly extinct, the only records are from Dubbo, over 100km from the study area.
Lepidium aschersonii	Spiny Peppercress	V	V	-	No. Nearest records are over 100km away from Wyangala, and the habitat requirement do not exist within the study area.
Lepidium hyssopifolium	Aromatic Peppercress	E	E	-	Yes. Although there are no recent records of this species in the study area, there is a historic record 30km from Wyangala, and the habitat requirements of the species are present within the study area.
Lepidium monoplocoides	Winged Peppercress	E	E	-	No. The closest record is over 100 km from the study area, and the habitat requirements of the species are not present in the area.
Lepidium peregrinum	Wandering Pepper Cress	E	E	-	No. The only recent records are from northern NSW, and the habitat requirements of the species are not present in the area.
Leucochrysum albicans var. *tricolor*		E		-	Yes. The species has been recorded in the study area previously and the study area meets the geographic, geological and habitat requirements of the species.
Monotaxis macrophylla	Large-leafed Monotaxis		E	-	No. The study area is over 200 km from the nearest record of the species.
Persoonia marginata	Clandulla Geebung	V	V	-	Yes. Although the records for this species are over 70km away from Wyangala, the study area is within its predicted distribution, and fulfils some of its habitat requirements.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Philotheca ericifolia		V		-	Yes. Although the nearest record for this species is 60km away from Wyangala, the study area fulfils its habitat requirements, and is within the species predicted distribution.
Pimelea curviflora var. *curviflora*		V	V	-	No. This species is restricted to more coastal areas around Sydney.
Platyzoma microphyllum	Braid Fern		E	-	No. The study area is over 400km away from the known population in the Yetman district of northern NSW.
Pomaderris pallida	Pale Pomaderris	V	V	-	No. This distribution of this species is to the south of the study area, with the nearest record over 100km away from Wyangala.
Pomaderris queenslandica	Scant Pomaderris		E	-	Yes. Although all the records of this species are to the north of Wyangala, the study area is within its predicted distribution, and fulfils the species habitat requirements.
Prasophyllum petilum	Tarengo Leek Orchid	E	E	-	Yes. The closest record of this species is about 50 km away at Boorowa; however, the study area contains the geological and habitat requirements for this species.
Prasophyllum sp. *Wybong*	Tarengo Leek Orchid	CE		-	Yes. Although there are no records of the species in the study area, the study some fulfils some of the habitat requirements and is within its predicted distribution.
Pterostylis despectans		E	CE	-	No. The study area does not contain the habitat requirements for this species, and all records are over 200km away from Wyangala.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Pultenaea humilis	Dwarf Bush-pea		V	-	Yes. Although all the records of this species are to the south of Wyangala, the study area is within its predicted distribution, and fulfils the species habitat requirements.
Rutidosis leptorrhynchoides	Button Wrinklewort	E	E	-	No. This species is only recorded south from Goulburn.
Senecio garlandii	Woolly Ragwort		V	-	Yes. Although the nearest record is over 100km away from the study area, the study area is within the predicted distribution, and contains the habitat and geological requirements of the species.
Swainsona murrayana	Slender Darling Pea	V	V	-	No. The closest record for the species is over 100 km away from Wyangala, and the study area does not fulfil the habitat requirements for this species.
Swainsona recta	Small Purple-pea	E	E	-	Yes. The species has been previously recorded within 30km of the study area, and the study area meets the habitat requirements of the species.
Swainsona sericea	Silky Swainson-pea		V	-	Yes. The species has been previously recorded within 30km of the study area, and the study area meets the habitat requirements of the species.
Thesium australe	Austral Toadflax	V	V	-	No. The nearest record for this species is over 100km to the east of the study area, and the study area does not meet the habitat requirements of the species.
Tylophora linearis		E	V	-	Yes. Although the nearest record is over 80km away from Wyangala, the study site is within the distribution of this species and fulfils its habitat requirements.

Table A.1 Flora species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Zieria obcordata	Obcordate-leafed Zieria	E	E	Yes. Granite boulders and rocky outcrops may be present within the study area, as there are large areas of granite geology mapped in the area.	-

A.2 Fauna species credit species

Table A.2 Fauna species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Amphibians					
Crinia sloanei	Sloane's Froglet		V	Yes. Study area is within 500m of waterbody	-
Litoria booroolongensis	Booroolong Frog	E	E	-	Yes. The species has been recorded within 30km of the study area previously and the study area meets the habitat requirements of the species.
Litoria castanea	Yellow-spotted Tree frog	E	CE	-	No. There are no recent records from within the study area. Historically it was recorded within 50km. Survey may be required for the species.
Mixophyes balbus	Stuttering Frog	V	E	-	No. The study area does not fulfil the habitat requirements of this species.
Birds					
Anthochaera phrygia	Regent Honeyeater	CE	CE	Yes, due to uncertainty. Mapped important areas to be checked with the NSW Biodiversity and Conservation Division (BCD).	Yes – for foraging. Considered unlikely to be mapped as 'important habitat' as a breeding area for the species, but due to uncertainty has been treated as a yes at this stage.
Burhinus grallarius	Bush Stone-curlew		E	Yes. Fallen/standing dead timber is present within study area.	-

Table A.2 Fauna species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Calidris ferruginea	Curlew Sandpiper	CE	E	Awaiting mapped important habitat areas from BCD	Yes. Although there are no records from within the study area, Wyangala is within the predicted distribution for this species and there are widespread records in the surrounding area and across NSW. If mapped by BCD as 'important habitat' survey is not required.
Callocephalon fimbriatum	Gang-gang Cockatoo		V	Yes. Hollow bearing trees are present in the study area.	-
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies)		V	No. Study area is outside of known range for this species.	-
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	Yes. Hollow bearing trees are present in the study area.	-
Haliaeetus leucogaster	White-bellied Sea-Eagle		V	Yes. Mature trees within 1km of a waterbody are present within the study area.	-
Hamirostra melanosternon	Black-breasted Buzzard		V	Yes. Study area is within 40m of an inland watercourse, with dead eucalypts.	-
Hieraaetus morphnoides	Little Eagle		V	Yes. Nest trees (large old trees) are present within the study area.	-

Table A.2 Fauna species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Lathamus discolor	Swift Parrot	CE	E	Awaiting mapped important habitat areas from BCD	Yes, for foraging. The species has been recorded in the study area previously and the study area meets the foraging habitat requirements of the species. The area may be mapped as 'important habitat' for the species. A request has been submitted to the NSW Biodiversity and Conservation Division (BCD) to seek to confirm whether this applies to the site, as they hold the mapping for this species.
Lophochroa leadbeateri	Major Mitchell's Cockatoo		V	Yes. Trees with hollows greater than 10cm are present within the study area.	-
Lophoictinia isura	Square-tailed Kite		V	Yes. Potential nest trees are present within the study area.	-
Ninox connivens	Barking Owl		V	Yes. Trees with hollows greater than 20cm are present within the study area.	-
Ninox strenua	Powerful Owl		V	Yes. Trees with hollows greater than 20cm are present within study area.	-
Numenius madagascariensis	Eastern Curlew	CE		No. This is a coastal species (confirm with important habitat maps from BCD).	No. The study area does not fulfil the habitat requirements of this species.
Polytelis swainsonii	Superb Parrot	V	V	Yes. Trees with hollows greater than 5cm (*E. blakelyi* in particular) are present in the study area.	-

Table A.2 Fauna species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Tyto novaehollandiae	Masked Owl		V	Yes. Trees with hollows greater than 20cm are present within the study area.	-
Insects					
Synemon plana	Golden Sun Moth	CE	E	Yes. Serrated Tussock (*Nassella trichotoma*) is present within the study area.	-
Keyacris scurra	Key's Matchstick Grasshopper	E	E	-	Yes. At this stage information on the species is limited, and the nearest records are some distance to the south of Wyangala, but there is the possibility that once listed the species may be triggered by the BAM tool (as the tool uses predictions).
Mammals					
Cercartetus nanus	Eastern Pygmy-possum		V	-	Yes. Although there are no records of this species within the study area, Wyangala is within its distribution, and the study area fulfils some of its habitat requirements
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes. Rocky areas present.	-
Miniopterus orianae oceanensis	Eastern Bent-wing Bat		V	Uncertain. Need to survey site for caves, culverts, other potential breeding areas.	Yes. The species has been recorded in the study area previously and the study area meets the habitat requirements of the species.
Myotis macropus	Southern Myotis		V	Yes. Hollow bearing trees within 200m of riparian zone, and waterbodies are present in the study area.	-

Table A.2 Fauna species credit species predicted to occur within the study area, and an assessment of habitat suitability

Scientific name	Common name	Conservation status		Habitat / geographic constraint present	Assessment of habitat suitability
		EPBC Act	BC Act		
Petauroides volans	Greater Glider	V		Yes. Hollow bearing trees are present in the study area.	-
Petaurus norfolcensis	Squirrel Glider		V	-	Yes. Although there are no records of this species from within the study area, there are numerous records within 30km of Wyangala, and the study area fulfils its habitat requirements.
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E	Yes. Rocky areas present.	Yes. Although most of the records for this species are in the ranges to the east of Wyangala, there is one record within 40km of the study area, and the study area fulfils its habitat requirements.
Phascogale tapoatafa	Brush-tailed Phascogale		V	-	Yes. Although there are no records of this species from within the study area, Wyangala is within its predicted distribution and the study area fulfils its habitat requirements.
Phascolarctos cinereus	Koala	V	V	Yes. Habitat constraints need to be identified via survey.	Yes. The species has been recorded in the study area previously and the study area meets the habitat requirements of the species.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	No. Nearest breeding camp is near Cowra, over 25km to the west of Wyangala.	-
Vespadelus troughtoni	Eastern Cave Bat		V	No. The distribution of this species is over 100km to the north east of Wyangala.	-

Reptiles					
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	TBC Survey required to identify rocky areas within the study area.	Yes. The species has been recorded in the study area previously and the study area meets the habitat requirements of the species.
Delma impar	Striped Legless Lizard	V	V	-	Yes. Although there are no records of this species within the study area, Wyangala is within its distribution and the study area fulfils some of its habitat requirements
Hoplocephalus bitorquatus	Pale-headed Snake		V	-	Yes. Although there are no records of this species from within the study area and the known distribution is generally further north, Wyangala is within its predicted distribution and the study area fulfils its habitat requirements

A.3 Migratory species

Table A.3 Migratory species likelihood of occurrence assessment

Scientific name	Common name	Conservation status EPBC Act	Likelihood of occurrence	Rationale for likelihood ranking
Apus pacificus	Fork-tailed Swift	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on or potentially flying over the site as distribution and habitat requirements of the species are present within the study area.
Hirundapus caudacutus	White-throated Needletail	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on or potentially flying over the site as distribution and habitat requirements of the species are present within the study area.
Motacilla flava	Yellow Wagtail	Mi	Low	Existing records for this species are generally in northern Australia or in coastal areas, with none recorded in the Wyangala region
Myiagra cyanoleuca	Satin Flycatcher	Mi	Moderate	Although there are no records of this species from within the study area, the species is widespread and there are numerous records in the region
Rhipidura rufifrons	Rufous Fantail	Mi	Low	The study area is too far west from recorded populations widespread in eastern Australia.
Actitis hypoleucos	Common Sandpiper	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on the site as distribution and habitat requirements of the species are present within the study area.
Calidris acuminata	Sharp-tailed Sandpiper	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on the site as distribution and habitat requirements of the species are present within the study area.
Calidris ferruginea	Curlew Sandpiper	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on the site as distribution and habitat requirements of the species are present within the study area.

Table A.3 Migratory species likelihood of occurrence assessment

Scientific name	Common name	Conservation status EPBC Act	Likelihood of occurrence	Rationale for likelihood ranking
Calidris melanotos	Pectoral Sandpiper	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on the site as distribution and habitat requirements of the species are present within the study area.
Gallinago hardwickii	Latham's Snipe	Mi	Moderate	Although this species has not been previously recorded in the study area, this species cannot be discounted from potentially occurring on the site as distribution and habitat requirements of the species are present within the study area.
Numenius madagascariensis	Eastern Curlew	Mi	Low	The study area is too far from recorded populations widespread in coastal Australia. The study area does not support correct foraging habitat for this species.

A.4 Aquatic species

Table A.4 Aquatic species likelihood of occurrence assessment

Scientific name	Common name	Conservation status		Likelihood of occurrence	Rationale for likelihood ranking
		EPBC Act	FM Act		
Bidyanus bidyanus	Silver Perch	CE	V	Moderate	The PMST indicates that "species or species habitat known to occur within area", which is also supported by DPI Fisheries data.
Galaxias rostratus	Flathead Galaxis	CE	CE	Low	Nearest DPI Fisheries data is located more than 70km away.
Maccullochella peelii	Murray Cod	V		High	The PMST indicates that "species or species habitat known to occur within area", which is also supported by anecdotal sources (likely via restocking programs).
Macquaria australasica	Macquarie Perch	E	E	High	The PMST indicates that "species or species habitat known to occur within area", which is also supported by DPI Fisheries data.
Mogurnda adspersa	Southern Purple-spotted Gudgeon	-	E	Moderate	DPI Fisheries data indicates the nearest location is not within the Lachlan River; however, the potential exists for the species to move from Morongla Creek.
Nannoperca australis	Southern Pygmy Perch	-	E	Moderate	DPI Fisheries data indicates the species may occur within the Lachlan River, upstream of the Wyangala Dam, as well as within Grahams Creek, a tributary.
Tandanus tandanus	Murray-Darling Basin population of Eel-tailed Catfish	-	E	Moderate	DPI Fisheries data indicates the species may occur within the Wyangala Dam upstream of the dam wall within the Abercrombie and Lachlan Rivers.

Appendix B

Survey requirements – threatened species

B.1 Seasonal survey requirements

Table B.1 Seasonal surveys requirements

Scientific name	Common name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Flora													
Acacia ausfeldii	Ausfeld's Wattle								Y	Y	Y		
Acacia meiantha								Y	Y	Y	Y		
Ammobium craspedioides	Yass Daisy									Y	Y	Y	
Austrostipa wakoolica	A spear-grass										Y	Y	Y
Bossiaea fragrans		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Caladenia arenaria	Sand-hill Spider Orchid									Y			
Caladenia concolor	Crimson Spider Orchid									Y			
Cullen parvum	Small Scurf-pea	Y											Y
Dichanthium setosum	Bluegrass	Y	Y	Y	Y	Y						Y	Y
Diuris tricolor	Pine Donkey Orchid									Y	Y		
Eucalyptus alligatrix subsp. alligatrix		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Euphrasia arguta		Y	Y	Y								Y	Y
Grevillea wilkinsonii	Tumut Grevillea										Y		
Lepidium hyssopifolium	Aromatic Peppercress										Y	Y	Y
Leucochrysum albicans var. *tricolor*		Y	Y	Y	Y					Y	Y	Y	Y
Persoonia marginata	Clandulla Geebung	Y	Y	Y									
Philotheca ericifolia										Y	Y	Y	Y
Pomaderris queenslandica	Scant Pomaderris	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Prasophyllum petilum	Tarengo Leek Orchid									Y	Y		

Table B.1 Seasonal surveys requirements

Scientific name	Common name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Prasophyllum sp. Wybong	Tarengo Leek Orchid									Y	Y		
Pultenaea humilis	Dwarf Bush-pea										Y	Y	Y
Senecio garlandii	Woolly Ragwort	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Swainsona recta	Small Purple-pea									Y	Y	Y	
Swainsona sericea	Silky Swainson-pea									Y	Y	Y	
Tylophora linearis		Y	Y	Y	Y	Y					Y	Y	Y
Zieria obcordata	Obcordate-leafed Zieria									Y	Y		
Fauna													
Crinia sloanei	Sloane's Froglet							Y	Y				
Litoria booroolongensis	Booroolong Frog											Y	Y
Burhinus grallarius	Bush Stone-curlew	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Calidris ferruginea	Curlew Sandpiper	n/a – if mapped by BCD as 'important habitat' survey is not required											
Callocephalon fimbriatum	Gang-gang Cockatoo	Y									Y	Y	Y
Calyptorhynchus lathami	Glossy Black-Cockatoo				Y	Y	Y	Y	Y				
Haliaeetus leucogaster	White-bellied Sea-Eagle							Y	Y	Y	Y	Y	Y
Hamirostra melanosternon	Black-breasted Buzzard									Y	Y	Y	
Hieraaetus morphnoides	Little Eagle								Y	Y	Y		
Lathamus discolor	Swift Parrot	n/a – if mapped by BCD as 'important habitat' survey is not required											
Lophochroa leadbeateri	Major Mitchell's Cockatoo									Y	Y	Y	Y
Lophoictinia isura	Square-tailed Kite	Y								Y	Y	Y	Y
Ninox connivens	Barking Owl					Y	Y	Y	Y	Y	Y	Y	Y
Ninox strenua	Powerful Owl					Y	Y	Y	Y				

Table B.1 Seasonal surveys requirements

Scientific name	Common name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Polytelis swainsonii	Superb Parrot									Y	Y	Y	
Tyto novaehollandiae	Masked Owl					Y	Y	Y	Y				
Synemon plana	Golden Sun Moth										Y	Y	Y
Keyacris scurra	Key's Matchstick Grasshopper	Not yet available											
Cercartetus nanus	Eastern Pygmy-possum	Y	Y	Y							Y	Y	Y
Chalinolobus dwyeri	Large-eared Pied Bat	Y										Y	Y
Miniopterus orianae oceanensis	Eastern Bent-wing Bat	Y	Y										Y
Myotis macropus	Southern Myotis	Y	Y	Y							Y	Y	Y
Petauroides volans	Greater Glider	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Petaurus norfolcensis	Squirrel Glider	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Petrogale penicillata	Brush-tailed Rock-wallaby	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Phascogale tapoatafa	Brush-tailed Phascogale	Y	Y	Y	Y	Y	Y						Y
Phascolarctos cinereus	Koala	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Aprasia parapulchella	Pink-tailed Legless Lizard									Y	Y	Y	
Delma impar	Striped Legless Lizard									Y	Y	Y	Y
Hoplocephalus bitorquatus	Pale-headed Snake	Y	Y	Y								Y	Y