CHAPTER 5

Matters of National Environmental Significance

Table of Contents

List of Tables

List of Figures

5 Matters of National Environmental Significance (MNES)

5.1 Introduction

Six Mile Creek Dam, commonly referred to as Lake Macdonald, is located on the Sunshine Coast in Noosa Shire and is one of two principal raw water sources that supply potable drinking water to the residents of Noosa Shire. Ownership of the dam was transferred from Noosa Council to Seqwater on 1 July 2008.

The Project comprises a safety upgrade of Six Mile Creek Dam and includes replacing the existing spillway and embankment to improve the spillway discharge capacity and earthquake stability while maintaining water supply security. Before proceeding with the Project, studies considered a range of options including decommissioning of the dam, retrofit of strengthening works and new build options. The Project area is along Six Mile Creek and borders Tewantin National Park, located to the north.

Terrestrial and aquatic surveys were carried out to inform and support an Impact Assessment Report (IAR) prepared under the bilateral agreement between the Commonwealth and State Governments, and subsequent approvals for the dam upgrade. These surveys included, amongst other things, an assessment of Matters of National Environmental Significance (MNES). The Project area and the study areas are outlined in Figure 5-1.

This chapter:

- Describes the MNES in the Project and study areas
- Outlines the potential impacts of the Project on MNES
- Identifies mitigation measures that will be implemented, where appropriate, as part of a program of environmental management to minimise or avoid impacts on MNES affected by the Project.

5.2 Project Description

The existing Six Mile Creek Dam is an ungated, zoned earth and rock fill dam. The spillway consists of anchored concreted slabs on compacted earth fill, with an uncontrolled ogee crest. The capacity of the dam is 8,018 megalitres (ML) at a full supply level (FSL) of 95.32 m Australian Height Datum (AHD), with an impoundment area of approximately 260 hectares (ha) at FSL.

The Project will comprise the following:

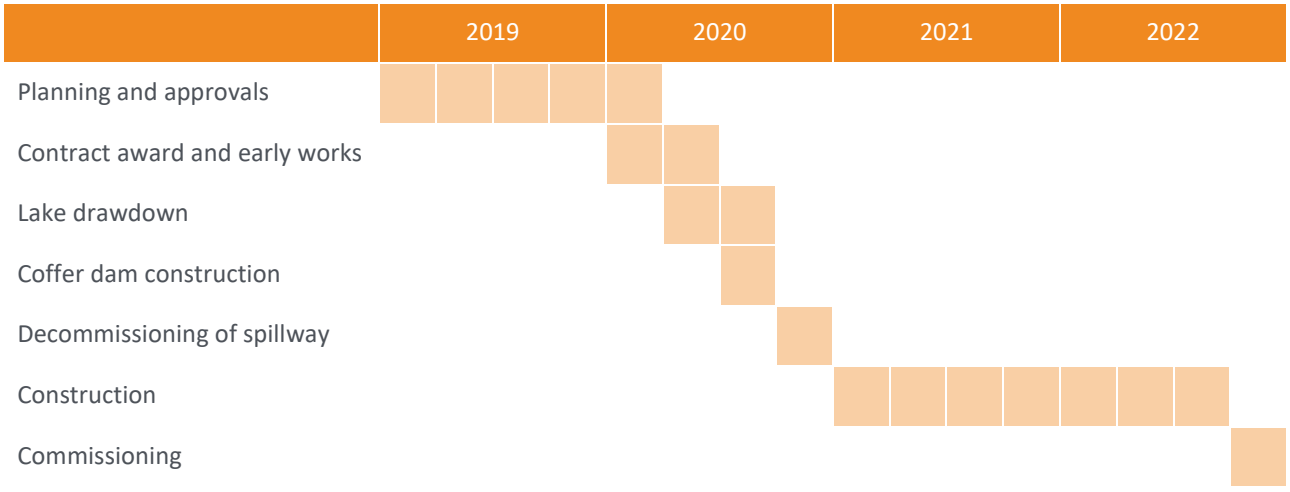
- Lowering of the lake in preparation for demolition and construction of the spillway and embankments.
- Demolition of the existing spillway and embankments
- Installation of a temporary sheet pile coffer dam in the upstream dam embankment and then construction of a working platform at RL 89 m AHD within the area of the existing spillway.
- Construction of a new mass filled concrete, labyrinth spillway and embankments.

The new spillway will be an uncontrolled dual height labyrinth weir, with the capacity, FSL, and inundation area remaining the same as the existing spillway after the Project is completed, as shown in Table 5-1. The Project area layout is shown in Figure 5-2 and is indicative of the proposed construction and ancillary works area necessary to safely undertake the demolition and construction of the dam and embankments. The majority of Project activities are expected to be undertaken in the areas adjacent to Lake Macdonald Drive and around the existing spillway. In order to facilitate construction of the new spillway and embankments, it will be necessary to lower Lake Macdonald before the Project construction begins.

Table 5-1: Key parameters of the existing and upgraded dam

	EXISTING STRUCTURE	UPGRADED STRUCTURE
Spillway type	Uncontrolled fixed ogee crest	Uncontrolled dual height labyrinth
Spillway Description	Concrete slab broad crest weir	Mass concrete dual height, multiple cycle labyrinth weir
Spillway crest elevation (low level)	Initial: RL 95.32 m AHD Full width: RL 95.35 m AHD	Initial: RL 95.32 m AHD Full width: RL 95.40 m AHD
Spillway crest elevation (high level)	Not applicable	RL 97.1 m AHD
Stilling basin floor elevation	RL 83.5 m	RL 84.0-86.0 m
Energy dissipation method	Plunge pool/stilling basin	Plunge pool/stilling basin
Full supply level	8,018 ML	8,018 ML
Dead storage	RL 87.7 m	RL 87.7 m
Historical No Failure Yield	7,118 ML/y	7,118 ML/y
Maximum depth	10.5 m	10.5 m
Area inundated at FSL	260 ha	260 ha

The construction period is currently programmed to occur between August 2020 and December 2022, subject to obtaining approvals, procurement timeframes, and incident weather through the construction period. Based on the current program, it is anticipated that the drawdown of Lake Macdonald will be carried out over a three-month period, beginning in early to mid-2020. As outlined in an indicative Gantt chart below, the lake lowering will nominally occur from May to July 2020, with off-site mobilisation and site preparation works completed during this period. Any changes to the construction period would carry through the three-month drawdown period.



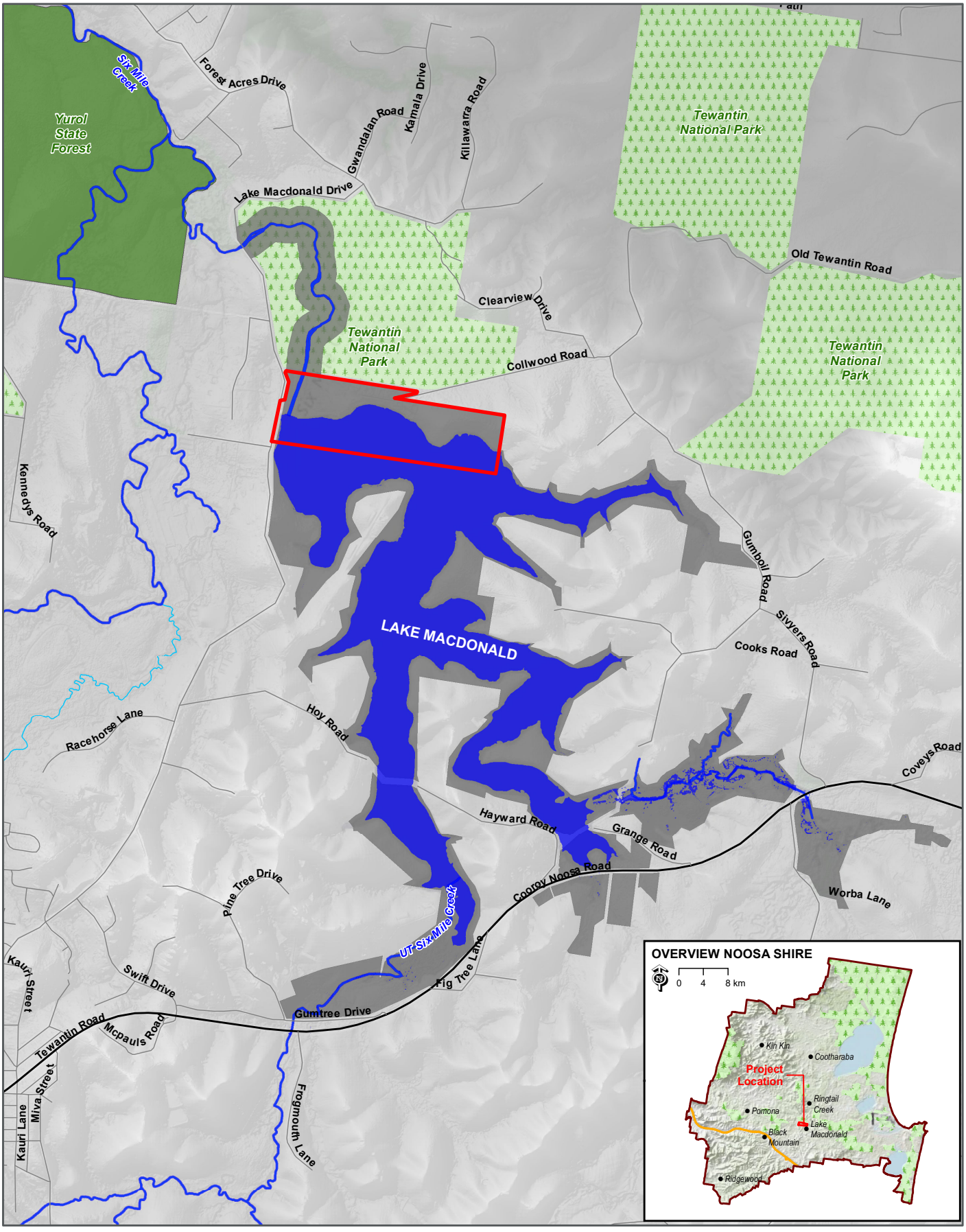
The Noosa region water supply zone is currently supplied from two sources – the Noosa water treatment plant (WTP) as well as Seqwater's Northern Pipeline Interconnector (NPI). The Noosa WTP receives raw water from two sources – Lake Macdonald and the Mary River. For the duration of the Project, Lake Macdonald will not have a reliable yield as a raw water source. Seqwater has planned for supply of the Noosa region water supply zone without Lake Macdonald water, relying on raw water from Mary River to feed the Noosa WTP and/or treated water from the NPI. All current treated water supply points will continue to be supplied by Seqwater, via the existing water reticulation network managed by Unitywater.

Seqwater has undertaken water supply assessments to identify any water supply, water quality and water security risks associated with removing Lake Macdonald as a raw water source for the duration of the Project. This process has provided a sound understanding of the risks and reliability compared with business as usual and was used in the assessment of water supply options. In summary, the Noosa water supply zone will continue to be supplied throughout the Project by using existing alternative water sources and Seqwater will manage operation of the alternative water sources in response to changing conditions, such as raw water quality fluctuation or emerging drought.

No works on the water treatment plant are proposed as part of the Six Mile Creek Dam Safety Upgrade Project, though various related infrastructure projects will occur to facilitate reliable water supply to the Noosa region water supply zone.

FIGURE 5-1: PROJECT AREA

Six Mile Creek Dam Safety Upgrade Project



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LEGEND

- Bruce Highway
- Secondary Road
- Local Roads
- Watercourse
- Six Mile Creek and Upper Tributary
- Lake Macdonald
- Project Area
- Study Area
- Local Governmental Area

Protected Areas

- National Parks
- State Forest

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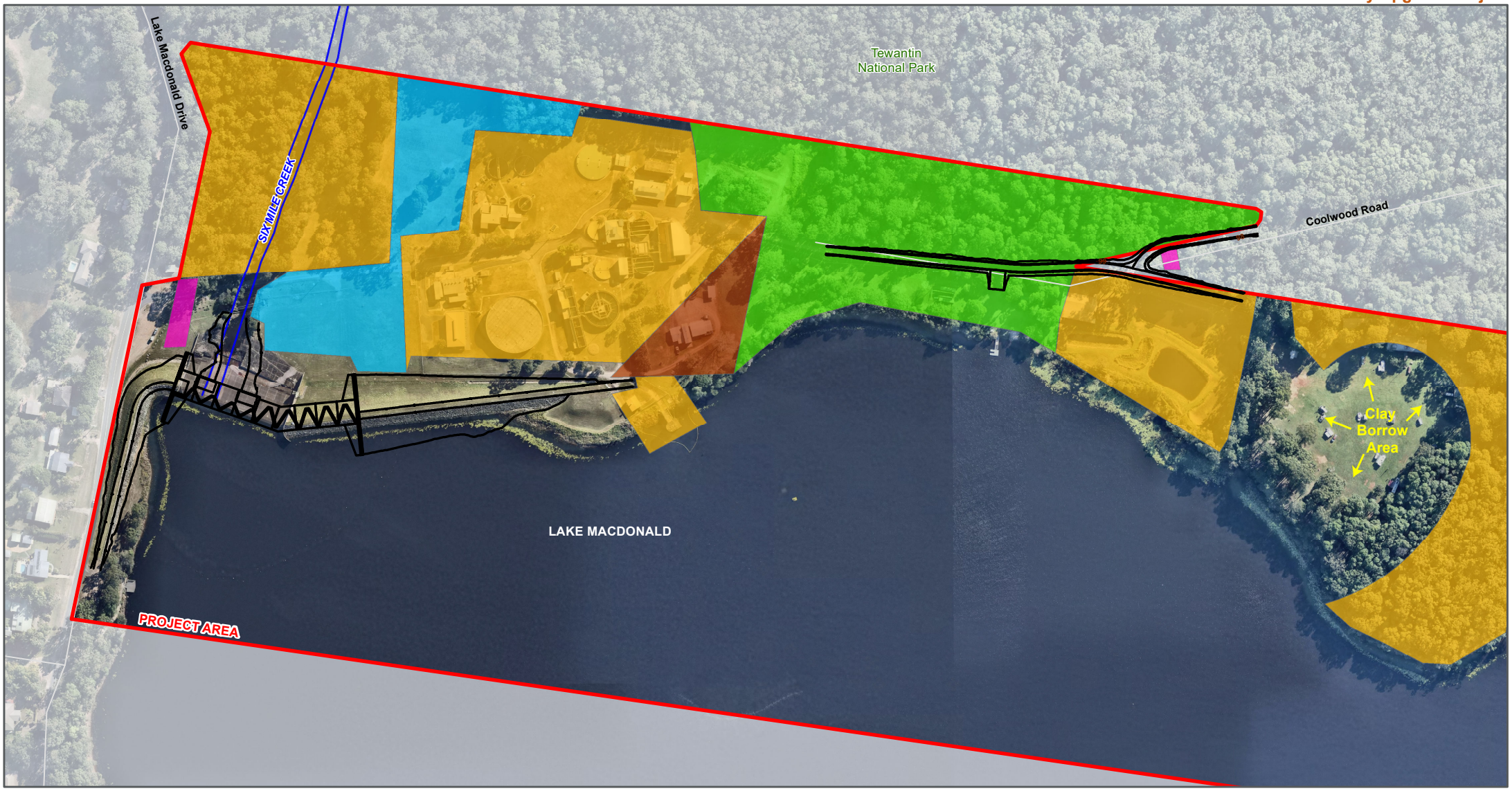
FIGURE 5-2: SIX MILE CREEK DAM SAFETY UPGRADE PROJECT AREA SITE MAP



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seqwater
WATER FOR LIFE

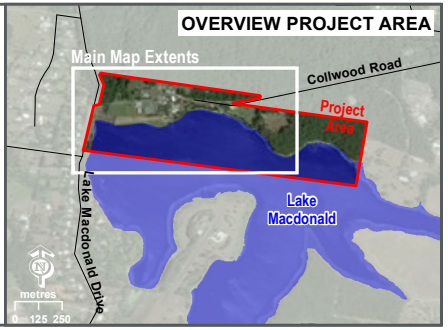
LEGEND

- Local Roads
- Six Mile Creek
- Upgraded Dam Layout (after construction)
- Project Area

Construction Site Layout

- Access Gate
- Area Not Available for Construction Activity
- Concrete Batching Plant
- Contractor Facilities and Parking
- Stockpile / Laydown Area

OVERVIEW PROJECT AREA



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5.3 Relevant Matters of National Environmental Significance

A referral for the Project was submitted to the Minster of the Environment, under the Commonwealth Department of Environment and Energy (DoEE), for consideration in October 2017. The referral outlined the potential impacts to MNES protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project was deemed to be a controlled action on 6 December 2017, reference EPBC 2017/8078, due to the potential impact the Project may have on listed threatened species and communities (sections 18 and 18A of the EPBC Act), notably the following species:

- Australia lungfish (*Neoceratodus forsteri*) – Vulnerable
- Giant barred frog (*Mixophyes iteratus*) – Endangered
- Mary River cod (*Maccullochella mariensis*) – Endangered
- Mary River turtle (*Elusor macrurus*) – Endangered
- White-throated snapping turtle (*Elseya albagula*) – Critically Endangered.

An IAR has been prepared pursuant to the bilateral agreement between the Commonwealth of Australia and the State of Queensland. This enables the IAR to meet the environmental impact assessment requirements under both Commonwealth and Queensland legislation. The IAR is managed by the Office of the Coordinator-General on behalf of the Queensland State Government and Minister for the Environment (Commonwealth).

5.3.1 Listed Threatened Species and Communities with Potential to be Impacted by the Project

EPBC Act listed threatened flora and fauna species that have the potential to occur within 10 km of the Project study area (i.e. species with a moderate or high likelihood of occurrence) are shown in Table 5-2. The potential occurrence of these species in this area is based on database searches and field surveys; a full list of the database search results is provided in Appendix A .

There are three Threatened Ecological Communities (TECs) that may occur within 10 km of the study area:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – Listed as Endangered under the EPBC Act
- Lowland Rainforest of Subtropical Australia – Listed as Critically Endangered under the EPBC Act
- Subtropical and Temperate Coastal Saltmarsh – Listed as vulnerable under the EPBC Act.

The potential impact of the Project on these species and the Lowland Rainforest of Subtropical Australia TEC is discussed in section 5.6.4 and 5.6.6. The Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community was listed after the controlled action decision for the Project, and does not need to be considered for assessment (section 158A of the EPBC Act). As per paragraph 18A(4)(b) of the EPBC Act, the Subtropical and Temperate Coastal Saltmarsh ecological community is not a MNES in the context of this Project because it is listed in the vulnerable category. Therefore, the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland and Subtropical and Temperate Coastal Saltmarsh ecological communities are not considered further.

Table 5-2: EPBC Act listed threatened species identified as potentially occurring (i.e. species with a moderate or high likelihood of occurrence) within the study area

SPECIES (SCIENTIFIC NAME)	COMMON NAME	EPBC ACT STATUS*
Plants		
Arthraxon hispidus	Hairy jointgrass (M)	V
Bosistoa transversa	Yellow satinheart (M)	V
Cryptostylis hunteriana	Leafless tongue orchid (M)	V
Macadamia integrifolia	Macadamia nut	V
Phaius australis	Lesser swamp orchid	E
Prostanthera spathulata	-	V

SPECIES (SCIENTIFIC NAME)	COMMON NAME	EPBC ACT STATUS*
Samadera bidwillii	Quassia	V
Triunia robusta	Glossy spice bush	E
Xanthostemon oppositifolius	Southern penda	V
Birds		
Anthochaera phrygia	Regent Honeyeater	CE
Botaurus poiciloptilus	Australasian Bittern	E
Calidris ferruginea	Curlew sandpiper	CE, M
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	E
Erythrotriorchis radiatus	Red goshawk	V
Lathamus discolor	Swift parrot	CE
Rostratula australis	Australian painted snipe	E
Turnix melanogaster	Black-breasted button-quail	V
Fish		
Maccullochella mariensis	Mary River cod	E
Neoceratodus forsteri	Australian lungfish	V
Frogs		
Mixophyes iteratus	Giant barred frog	E
Mammals		
Chalinolobus dwyeri	Large-eared pied bat	V
Dasyurus maculatus maculatus	Spotted-tail quoll (south-eastern mainland population)	E
Phascolarctos cinereus	Koala	V
Pteropus poliocephalus	Grey-headed flying-fox	V
Reptiles		
Saiphos reticulatus	Three-toed snake-tooth skink	V
Elseya albagula	White-throated snapping turtle	CE
Elusor macrurus	Mary River turtle	E

* The status of the species under the EPBC Act: CE – Critically Endangered, E – Endangered, V – Vulnerable, M – Migratory

5.4 Methodology

5.4.1 Assessment of Impact Significance

DoEE has prepared 'Significant Impact Guidelines' to assist in assessing whether an action is likely to have a significant impact on any MNES (DoEE, 2013). Within this guideline, significant impact criteria have been developed for all nine MNES. These criteria have been used to determine the potential impacts of the Project on all MNES identified as likely to occur (i.e. species with a moderate or high likelihood of occurrence) within the study area and are set out in Table 5-4.

Table 5-3: Significant impact criteria

MATTER OF NATIONAL ENVIRONMENTAL SIGNIFICANCE	SIGNIFICANT IMPACT CRITERIA
Species listed as Vulnerable	An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: • Lead to a long-term decrease in the size of an important population of a species • Reduce the area of occupancy of an important population • Fragment an existing population into two or more populations • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of an important population • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat • Introduce disease that may cause the species to decline • Interfere with the recovery of the species.
Species listed as Critically endangered or endangered	An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will: • Lead to a long-term decrease in the size of a population • Reduce the area of occupancy of the species • Fragment an existing population into two or more populations • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of a population • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat • Introduce disease that may cause the species to decline • Interfere with the recovery of the species.
Ecological communities listed as Critically endangered or endangered	An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will: • Reduce the extent of an ecological community • Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines • Adversely affect habitat critical to the survival of an ecological community

MATTER OF NATIONAL ENVIRONMENTAL SIGNIFICANCE	SIGNIFICANT IMPACT CRITERIA
	• Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns • Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting • Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – Assisting invasive species, that are harmful to the listed ecological community, to become established, or – Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community • Interfere with the recovery of an ecological community.

5.4.2 Terrestrial Ecology

A desktop assessment verified by field surveys was completed to determine the suite of threatened species listed under the EPBC Act known and likely to occur across the study area.

The desktop assessment involved a review of relevant databases, mapping and literature, including but not limited to:

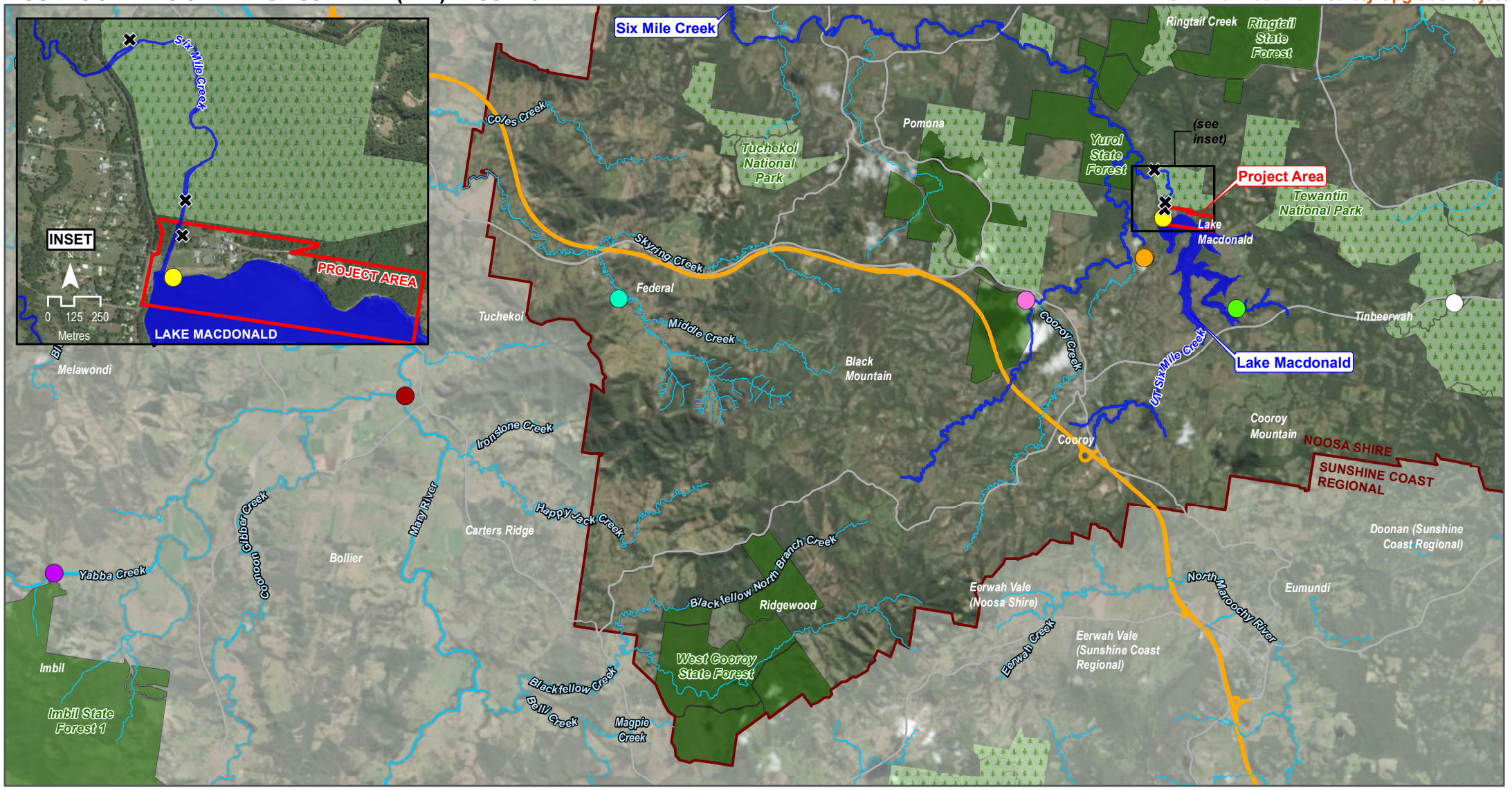
- EPBC Act Protected Matters Search Tool (10 km buffer from the approximate centre of the Project area)
- DES Wildlife Online Database (10 km buffer from the approximate centre of the Project area)
- DES Species Profile Search information on key species
- DES Protected Plants Flora Survey Trigger Map
- Atlas of Living Australia, including HERBRECs data (refer to Figure 5-3)
- DNRME's Regulated Vegetation Management mapping (Version 10.1)
- Published literature and research papers
- Six Mile Creek Dam (Lake Macdonald) Safety Upgrade Project, Initial Advice Statement (Seqwater, 2017)
- Lake Macdonald, Ecology Review (URS, 2014)
- Protected plants flora survey guidelines (DES, 2016)
- Relevant legislation and supplementary guidance.

Terrestrial flora and fauna were also surveyed across the study area in February 2018 in accordance with standard methods (refer to Figure 5-4 and Appendix B). Field surveys specifically targeted potential habitats of threatened species considered likely to be present and were conducted under an animal ethics approval and scientific purposes permit.

An assessment of the likelihood of occurrence of threatened species identified in the databases searches was then undertaken based on field survey results and literature reviews.

FIGURE 5-3: ATLAS OF LIVING AUSTRALIA (ALA) RECORDS

Six Mile Creek Dam Safety Upgrade Project



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seqwater
WATER FOR LIFE

LEGEND

ALA Records (Common Name)
- Australian lungfish
- Mary River cod
- Mary River turtle
- Giant barred frog
- Platypus
- Southern Penda
- Tusked Frog
- White-throated snapping turtle

Survey Records (identified during site visit)
- Giant barred frog
- Bruce Highway
- Secondary Road
- Six Mile Creek and Upper Tributary
- Watercourse
- Lake Macdonald
- Local Governmental Area
- Project Area

Protected Areas
- National Parks
- State Forest

OVERVIEW NOOSA SHIRE

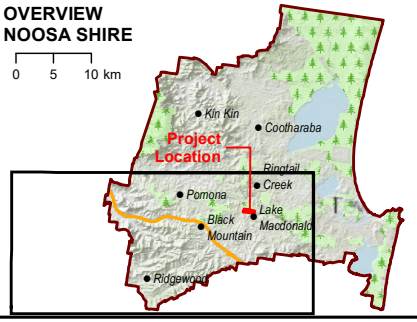

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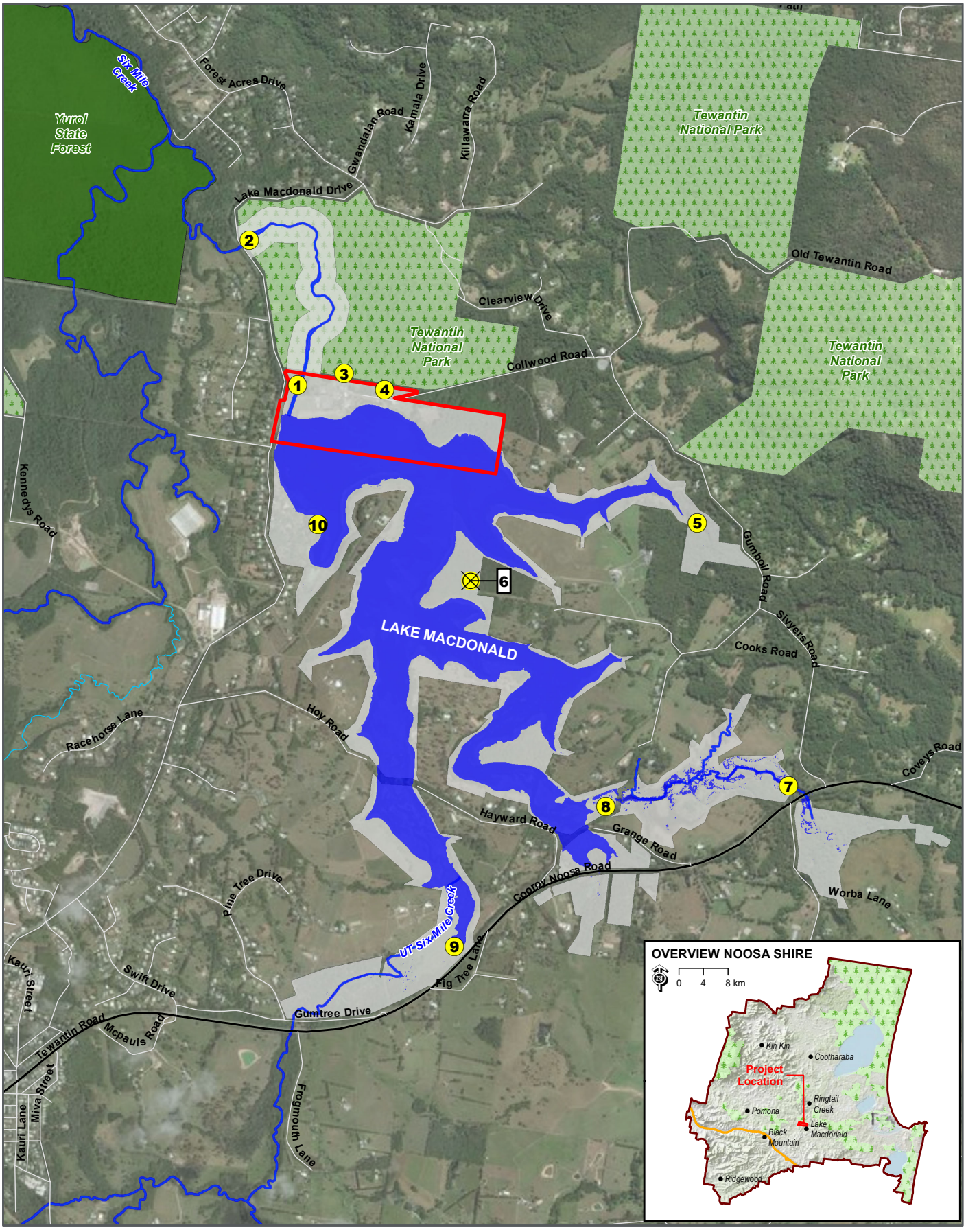
FIGURE 5-4: TERRESTRIAL SURVEY SITES

Six Mile Creek Dam Safety Upgrade Project



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seqwater WATER FOR LIFE

LEGEND

- Terrestrial Survey Sites
- Terrestrial Survey Site (not accessed)
- Bruce Highway
- Secondary Road
- Local Roads
- Watercourse
- Six Mile Creek and Upper Tributary
- Lake Macdonald
- Study Area
- Project Area
- Local Governmental Area

Protected Areas

- National Parks
- State Forest

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5.4.3 Aquatic Ecology

A desktop assessment verified by field surveys was undertaken to determine the threatened aquatic species listed under the EPBC Act that are known and likely to occur in aquatic ecosystems in the study area (refer to Appendix C). The assessment involved:

- A review of relevant databases, mapping and literature, including but not limited to:
  - published literature, such as the Mary Basin Draft Water Resource Plan: Environmental Conditions Report including Mary River, Burrum River and Beelbi Creek Catchments (DNRM, 2004)
  - Matters of State Environmental Significance Search (MSES) Tool
  - Aquatic Conservation Values, as assessed by the Queensland Environmental Protection Agency using the Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM)
  - Department of Agriculture and Fisheries' waterway barrier risk spatial layer
  - Department of Environment and Sciences' Wetland Maps spatial layer
  - Atlas of Living Australia (refer to Figure 5-3)
  - Queensland's floodplain assessment and groundwater-dependent ecosystem spatial layers
- Aquatic ecology field surveys
- Consultation with key experts.

Aquatic ecology surveys were conducted in August and October 2015 and February 2018, and incorporated sampling of fish, macroinvertebrates, aquatic plants, and water quality, as well as an assessment of habitat condition. A total of 13 sites on Six Mile Creek and two sites on Lake Macdonald were sampled, with three sites on the Mary River also surveyed to provide comparative information. The survey methods were consistent with methods for the survey of large freshwater perches and lungfish presented in the *Survey Guidelines for Australia's Threatened Fish* (SEWPAC 2011a) and the *Survey Guidelines for Australia's Threatened Reptiles* (SEWPAC 2011b). Habitat assessment methods were based on the Seqwater Aquatic Habitat Monitoring Program (EPBC Act No 2007/3686) and modified to specifically assess habitat suitability for Mary River cod, Australian lungfish, the Mary River turtle and the white-throated snapping turtle.

Habitat assessments included:

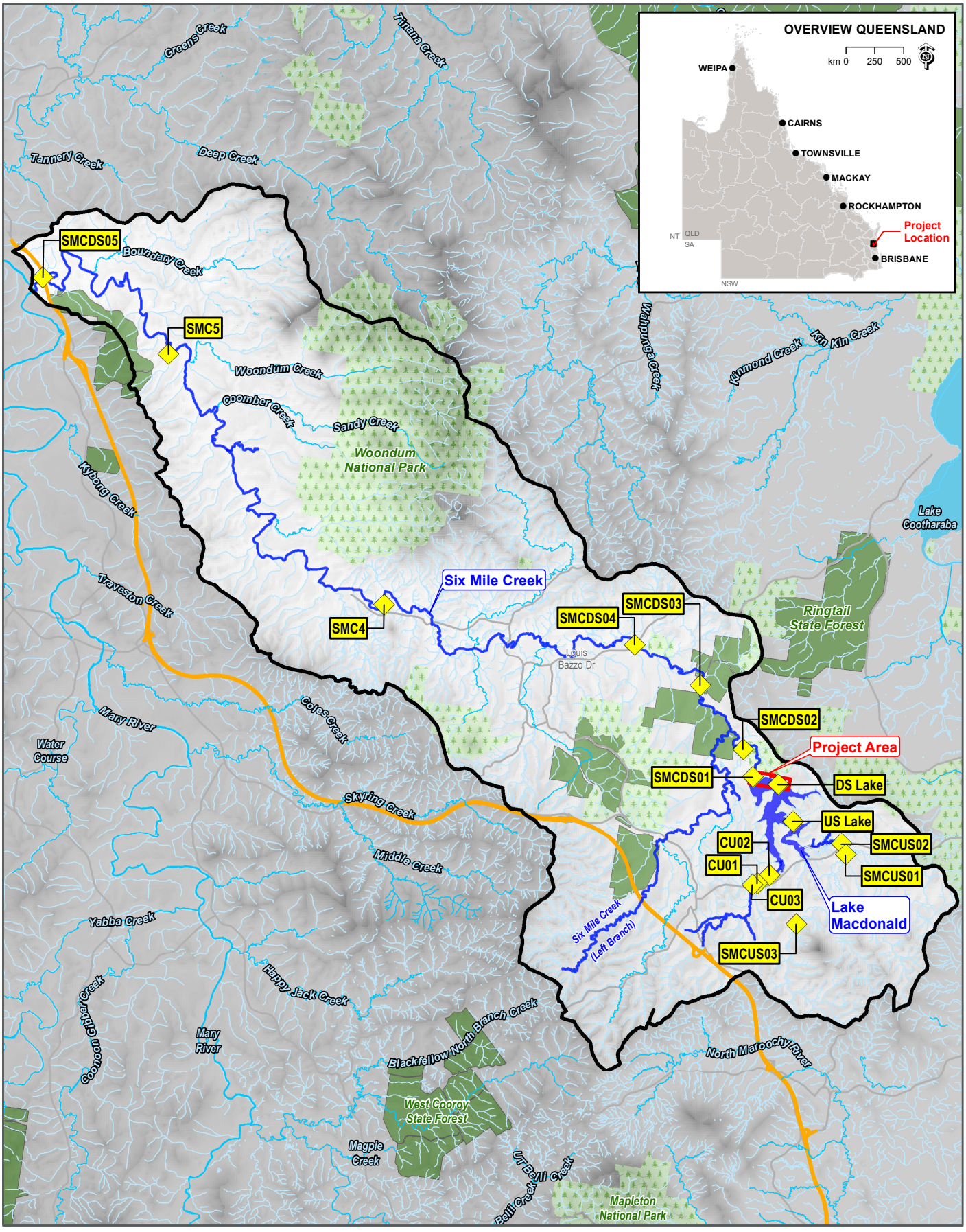
- An evaluation of habitat condition and the type and cover of key habitat features
- Depth and width of streams
- Substrate composition
- Habitat sensitivities to various impacts
- Identification of existing disturbances, including fish passage barriers.

Consultation with key experts was completed in 2015/2016 and comprised a survey distributed by email. The experts consulted were selected due to their recognised experience in fish / turtle distribution and ecology in the Mary River and Six Mile Creek. Responses to the survey were received from:

- Andrew McDougall, Project Leader (Aquatic Ecology), Water Services (South), Queensland Department of Natural Resources, Mines and Energy
- Tom Espinoza, Project Officer (Aquatic Ecology), Water Services (South), Queensland Department of Natural Resources, Mines and Energy
- David T. Roberts, Team Leader Asset Efficiency and Optimisation, Seqwater
- Dr John Harris, Adjunct Associate Professor, Centre of Ecosystem Science, University of New South Wales
- Russel Manning, Manning Fish Hatchery (frc environmental 2016).

FIGURE 5-5: AQUATIC ECOLOGY SURVEY SITES

Six Mile Creek Dam Safety Upgrade Project



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seqwater
WATER FOR LIFE

LEGEND

- Water Quality Sites
- Watercourse
- MSES Drainage Line
- Six Mile Creek
- Lake Macdonald
- Bruce Highway
- Secondary Road
- Project Area
- Aquatic Study Area

Protected Areas

- National Parks
- State Forest

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5.5 Results of the Ecology Studies

5.5.1 Listed Threatened Terrestrial Flora

The EPBC Act protected matters search identified 19 flora species with the potential for the species or species habitat to occur within 10 km of the site (27 August 2018). A likelihood of occurrence assessment was undertaken for all threatened species listed in the search results. Eight species were determined to have a moderate or high likelihood of occurrence within the study area; these species are listed in Table 5-5.

No species listed as threatened under the EPBC Act were identified within the Project area. However, a number of threatened species have been recorded in the surrounding area, including a number of records of southern penda, which is listed as vulnerable under the EPBC Act. The closest of these is a southern penda individual on the eastern side of Six Mile Creek, downstream of the spillway and approximately one kilometre from the Project area. Extensive targeted survey in this area could not relocate this individual, but it is assumed that the record is correct and a limited number of this species is present in that area. The location of the record suggests that the specimen is probably in Tewantin National Park, north of the Project area. Other records for this species are generally to the east of the dam and all appear to be on private property.

The complete flora species list for each survey site is provided in Appendix B .

5.5.2 Listed Threatened Terrestrial Fauna

The EPBC Act protected matters search identified 53 fauna species with the potential for the species or species habitat to occur within 10 km of the site (27 August 2018). A likelihood of occurrence assessment was undertaken for all 53 threatened terrestrial species listed in the search results. Twenty-nine species were determined to have a moderate or high likelihood of occurrence within the study area; these species are listed in Table 5-6.

During the field survey giant barred frogs were heard calling at Site 1 of Six Mile Creek and a single juvenile was observed at Site 2, downstream of the dam. All of Six Mile Creek downstream of Lake Macdonald appears to be suitable habitat for this species, though the field survey results suggest a low population density.

Four EPBC listed bird species were observed across the study area during the field survey. This included forest and wetland bird species. The field survey targeted species within forested areas that may be cleared or subject to construction disturbance, and also shallower areas of the dam that will be impacted by lowering of the water.

No striped blind snakes (*Anilios broomi*) or three-toed snake-tooth skink (*Saiphos reticulatus*) (the target EPBC reptile species) were captured during the field survey and these species are considered unlikely to occur in the study area due to a lack of microhabitat features necessary for these species (e.g. deep leaf litter and rotting logs).

Several microbats were detected on the Anabat during spotlighting surveys along Six Mile Creek and around Lake Macdonald. None of the recorded species are protected under the EPBC Act.

5.5.3 Listed Threatened Aquatic Fauna

Two threatened fish species and two threatened reptile species listed under the EPBC Act have the potential to occur in Six Mile Creek and Lake Macdonald. These species are listed below, and their likelihood of occurrence is discussed in Table 5-6:

- Australian lungfish– vulnerable
- Mary River cod– endangered
- Mary River turtle– endangered
- White-throated snapping turtle– critically endangered.

Field surveys confirmed the presence of Mary River cod and Australian lungfish in Six Mile Creek downstream of Lake Macdonald, and the potential for Mary River turtle and white-throated snapping turtle to occur in the lower reaches of Six Mile Creek. Mary River cod are known to breed in Six Mile Creek downstream of Lake Macdonald.

Within and upstream of Lake Macdonald, Mary River cod are known to occur due to a fish stocking program. Australian lungfish may occur in or upstream of the lake, but are unlikely to be breeding as the habitat is considered unsuitable.

Mary River turtle and white-throated snapping turtle were not caught in or upstream of Lake Macdonald during the field surveys, and are considered unlikely to occur. The Protected Matters search did not predict these species to occur within 10 km of the study area and there are also no locality records of the species in the study area.

Table 5-4: Likelihood of occurrence table for flora species mentioned within the EPBC Protected Matters Search Tool.

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Acacia attenuata	-	V	Flat coastal lowland plains in seasonally waterlogged areas of wet heathland, open forest and woodland, particularly on sandy poorly drained soils or peat swamps which are infertile; tolerant of disturbance, may grow along roads.	**Low**. Minimal suitable habitat.	No
Allocasuarina thalassoscopica	-	E	Restricted to one location within the heathland community of Mt Coolum.	**None**. No suitable habitat. Not within known, restricted species range.	No
Archidendron lovelliae	Bacon wood	V	Occurs mostly on well-drained sandy loam soils, which are often alluvial in origin and contain clay, or deep podosols on stabilised sand dunes; the associated vegetation communities are wet sclerophyll forest or lowland subtropical rainforest.	**Low**. May occur on alluvium in moist forest around or below the existing dam (notophyll vine forest RE 12.3.1 and flooded gum-dominated tall open forest RE 12.3.2), though there are no existing records within 12 km of the site.	No
Arthraxon hispidus	Hairy jointgrass	V	In soaks, seepages and edges of wetlands in forests and pasture. Dies down in winter. Threats include lantana invasion.	**Moderate**. May occur in seepages in pasture around the dam and in wet areas in forest.	No
Baloghia marmorata	Marbled balogia	V	Subtropical rainforest, wet sclerophyll forest dominated by Brush Box with a rainforest understorey on basalt at 150-550 m elevation	**Low**. The study area is below the typical elevation range and it is not on basalt.	No
Bosistoa transversa	Yellow satinheart	V	Grows in wet sclerophyll forest, dry sclerophyll forest and rainforest up to 300m elevation.	**Moderate**. The study area is consistent with the general habitat description and most forested areas are potential habitat.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Cryptocarya foetida	Stinking cryptocarya	V	Occurs in littoral rainforest on old sand dunes and subtropical rainforests over slate and occasionally on basalt to an altitude of 150 m	**Low**. Preferred substrates are not present in the study area.	No
Cryptostylis hunteriana	Leafless tongue orchid	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including heathlands, heathy woodlands, sedgelands, *Xanthorrheoa spp*. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation). Soils are generally moist and sandy, however, also grows on dry or peaty soils. The larger populations typically occur in woodland dominated by scribbly gum (*Eucalyptus sclerophylla*), silvertop ash (*E. sieberi*), red bloodwood (*Corymbia gummifera*) and black she-oak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the large tongue orchid (*C. subulata*) and the tartan tongue orchid (*C. erecta*). Flowers August to February.	**Moderate**. Study area consistent with the very general habitat description. The presence of sedimentary rocks in the study area suggest that sandy soils may be present in some areas.	No
Eucalyptus conglomerata	Swamp stringybark	E	Occurs mostly in the ecotone between wet heath (wallum) and tall open forest communities. The soils are infertile, deep and sandy or peaty in texture and tend to be seasonally water-logged.	**Low**. Soil not sandy or peaty; there are no wet heath or wallum vegetation communities mapped in the study area.	No
Floydia praealta	Ball nut	V	Floristically-rich, tall, closed riverine to subtropical rainforest and coastal scrub. Typically grows on basalt.	**Low**. Riverine rainforest present, but not on preferred basalt substrate.	No
Lepidium peregrinum	Wandering pepper-cress	E	Riparian open forest dominated by *Eucalyptus camaldulensis* and *Casuarina cunninghamiana* with a variably dense shrubby understorey of *Hymenanthera dentata*, *Bursaria spinosa, Acacia fimbriata, A. floribunda, Callistemon viminalis* and *Leptospermum brachyandrum*.	**None**. No suitable habitat.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Macadamia integrifolia	Macadamia nut	V	Rainforest and rainforest edges on ridges, hill slopes, scree slopes and foot slopes, gullies, benches and terrace plains on well-drained, high nutrient soils.	**Moderate**. Vegetation mapped downstream (RE 12.3.1) is potential habitat for this species.	No
Macadamia ternifolia	Bopple nut	V	Lowland warm complex notophyll vine forest and Araucarian notophyll vine forest on high-fertility basic and intermediate volcanic soils and alluvia in higher rainfall areas; soils free-draining.	**Low**. Vegetation mapped downstream (RE 12.3.1) may be suitable habitat for this species, though the soil types are not very suitable.	No
Phaius australis	Lesser swamp orchid	E	Mostly occurs in mixed swamp forest (e.g. *Melaleuca quinqueneria, Lophostemon suaveolens, Eucalyptus robusta*) in association with rainforest elements and palms. May occur along ecotones with other habitat types (e.g. heath, open forest). Flowers September-November.	**Moderate**. Open forests containing *Melaleuca quinquenervia*, *Eucalyptus robusta* and *Lophostemon suaveolens* are mapped in the Project area (RE 12.3.4).	No
Prostanthera spathulata	-	V	Occurs in shrubland on rocky hillslopes and in tall open forest on gently inclined slopes, or flat terrain on the coastal plain (Halford 1998). Associated species include red mahogany (*Eucalyptus resinifera*), *E. racemosa*, pink bloodwood (*Corymbia intermedia*), turpentine (*Syncarpia glomulifera*), *Lophostemon* sp., tall saw-sedge (*Gahnia clarkei*) and black-mouth bush (*Melastoma affine*).	**Moderate**. Suitable floristic associations present below existing dam and adjacent to proposed works.	No
Samadera bidwillii	Quassia	V	Lowland rainforest or on rainforest margins occasionally open forest or woodland. Commonly found near temporary or permanent watercourses up to 510 m elevation. Soils include lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils.	**Moderate**. Potential habitat present in the study area.	No
Sophora fraseri	Brush sophora	V	North from Casino. Grows in moist habitats, often in hilly terrain at altitudes from 60–660 m on shallow soils along rainforest margins in eucalypt forests, vine forest or in large canopy gaps in closed forest communities.	**Low**. Limited suitable habitat present in the study area.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Triunia robusta	Glossy spice bush	E	Notophyll vine forest, or mixed tall open forest developing a rainforest understorey in the absence of fire, usually within 25 m of streams, on south or south-east facing slopes or river terraces on well-drained soil.	**Moderate**. Notophyll vine forest (RE 12.3.1) and tall open forest dominated by flooded gum (RE 12.3.2) present in the study area.	No
Xanthostemon oppositifolius	Southern penda	V	Occurs predominantly in riparian communities on slightly acid clayey sands to sandy clays derived from sedimentary and metasedimentary rocks. Associated vegetation includes notophyll vine forest, simple notophyll mixed tall closed forest with *Araucaria cunninghamii* (hoop pine) emergents or in the rainforest understorey developing within tall open forest.	**Moderate**. Vegetation in the study area (RE 12.3.1 and RE 12.3.2) is suitable habitat for this species.	No

* The status of the species under the EPBC Act: CE – Critically Endangered, E – Endangered, V – Vulnerable, M - Migratory

Table 5-5: Likelihood of occurrence table for fauna species mentioned within the EPBC Protected Matters Search Tool.

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Birds					
Anthochaera phrygia	Regent honeyeater	CE	This species generally inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Regarded as an occasional visitor to Queensland, but there is some evidence that a small breeding population exists near Warwick. Infrequent in coastal area where winter flowering swamp mahogany, forest red gum and spotted gum/ironbark associations are important.	**Moderate**, occasional. Winter flowering swamp mahogany, forest red gum and grey ironbark present in the study area.	No
Botaurus poiciloptilus	Australasian bittern	E	Inhabits temperate freshwater wetlands and occasionally estuarine reed beds, with a preference for permanent waterbodies with tall dense vegetation. The species prefers wetlands with dense vegetation, including sedges, rushes and reeds. Freshwater is generally preferred, although dense saltmarsh vegetation in estuaries and flooded grasslands are also used by the species.	**Moderate**. May occur along the margins of the existing dam.	No
Calidris canutus	Red knot	E, M	Tidal mudflats, sandflats, beaches, saltmarsh, ploughed fields, flooded pasture	**Low**. Prefers inter-tidal habitats.	No
Calidris ferruginea	Curlew sandpiper	CE, M	Intertidal mudflats in sheltered coastal areas, non-tidal swamps, lakes and lagoons near the coast. Occasional occurrence at inland lakes and dams.	**Moderate**. May occasionally use the lake margins.	No
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	E	Rainforest, particularly stands with figs; sometimes isolated trees.	**Moderate**. Depends on the availability of figs in the study area. A variety of fig species were identified throughout the study area, particularly around waterways e.g. sandpaper fig. Larger figs were observed in relatively low abundance.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Dasyornis brachypterus	Eastern bristlebird	E	Tall, dense, grassy ground-cover in open Eucalyptus forests or woodlands at high elevation; often at the ecotone, or interspersed, with mature subtropical rainforest. The ground-layer vegetation in these habitats is usually about 1.0–1.5 m tall and fairly dense, providing about 65–90% coverage. Typical ground cover includes tussock-grasses such as *Sorghum leiocladum*, and other grasses including *Imperata cylindrica, Poa labillardiera, P. sieberiana and Themeda triandra*, with a variety of scattered small shrubs, woody herbs, patches of ferns and vine tangles	**None**. Study area is at low elevation. No suitable habitat.	No
Diomedea antipodensis	Antipodean albatross	V, M	Marine aerial species that is highly mobile. Rests and sleeps on the ocean. Breeds in open, patchy vegetation including tussock grassland or shrubs on ridges.	**None**. No suitable habitat in the study area.	No
Diomedea antipodensis gibsoni	Gibson's albatross	V	Marine aerial species that is highly mobile. Breeds on islands on coastal or inland ridges, slopes or plains.	**None**. No suitable habitat in the study area.	No
Diomedea exulans	Wandering albatross	V, M	Migratory marine species. Island breeding sites located on coastal/inland ridges with open, patchy vegetation and grass tussocks.	**None**. No suitable habitat in the study area.	No
Erythrotriorchis radiatus	Red goshawk	V	Occurs in coastal and sub-coastal areas in woodland and forests, including riverine forests. Favours intermediate density forests to aid hunting of birds. Nest in tall trees, often beside permanent water sources.	**Moderate**. Suitable habitat for this species occurs in the study area. However, it is a highly mobile species with a large territory and the importance of the study area is currently unknown.	No
Geophaps scripta scripta	Squatter pigeon (Southern)	V	Open-forests to sparse, open-woodlands and scrub with a patchy, tussock-grassy understory. Nests in shallow depressions in the ground, requiring free-draining soils.	**None**. No suitable habitat with an open grassy groundcover.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Lathamus discolor	Swift parrot	CE	Breeds exclusively in Tasmania during the summer, migrating to the mainland during winter. Being nectarivorous, winter flowering Eucalypts are important foraging resources on the mainland. Favoured feed trees include winter flowering species such as swamp mahogany (*Eucalyptus robusta*), spotted gum (*Corymbia aculate*), red bloodwood (*C. gummifera*), mugga ironbark (*E. sideroxylon*), and white box (*E. albens*).	**Moderate**, occasional. Winter flowering swamp mahogany, forest red gum and grey ironbark present in the study area.	No
Limosa lapponica baueri	Bar-tailed godwit (baueri)	V	Estuaries and lagoons with large intertidal sandflats or mudflats.	**None**. No suitable habitat in the study area.	No
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	CE	Intertidal sandflats, mudflats, estuaries, inlets, coastal lagoons, near coastal saltmarsh and exposed beaches.	**None**. No suitable habitat in the study area.	No
Macronectes giganteus	Southern giant-petrel	E, M	Migratory marine bird distributed from Antarctic to subtropical waters and nests on offshore and Antarctic islands.	**None**. No suitable habitat in the study area.	No
Macronectes halli	Northern giant petrel	V, M	Circumpolar pelagic distribution with breeding on Australian offshore islands. Nest in secluded, sheltered coastal habitat with dense vegetation.	**None**. No suitable habitat in the study area.	No
Numenius madagascariensis	Eastern curlew	CE, M	Estuaries, tidal mudflats, sand spits, saltmarsh, mangroves.	**None**. No suitable habitat in the study area.	No
Pachyptila turtur subantarctica	Fairy prion (southern)	V	Ocean, breeds on subantarctic islands.	**None**. No suitable habitat in the study area.	No
Poephila cincta cincta	Southern black-throated finch	E	Grassy, open woodlands and forests, typically dominated by *Eucalyptus*, *Corymbia* and *Melaleuca*, and occasionally in tussock grasslands or other habitats (e.g. freshwater wetlands); often near water.	**None**. No suitable grassy forest habitat.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Rostratula australis	Australian painted snipe	E	Inhabits shallow inland wetlands, either freshwater or brackish water bodies. Nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats.	**Moderate**. Likely to forage around the edges of the existing dam when muddy substrate is exposed. Unlikely to breed in the study area as no islands are present.	No
Thalassarche cauta cauta	Shy albatross	V, M	Oceans, breeds on islands.	**None**. No suitable habitat in the study area.	No
Thalassarche cauta steadi	White-capped albatross	V, M	Subantarctic and subtropical oceans, sometimes near shoreline; breeds on islands.	**None**. No suitable habitat in the study area.	No
Thalassarche eremita	Chatham albatross	E, M	Subantarctic and subtropical oceans, sometimes near shoreline; breeds on islands.	**None**. No suitable habitat in the study area.	No
Thalassarche impavida	Campbell albatross	V, M	Subantarctic and subtropical oceans, sometimes near shoreline; breeds on islands.	**None**. No suitable habitat in the study area.	No
Thalassarche melanophris	Black-browed albatross	V, M	Circumpolar distribution and inhabits Antarctic, subantarctic and subtropical marine waters.	**None**. No suitable habitat in the study area.	No
Thalassarche salvini	Salvin's albatross	V, M	Subantarctic and subtropical oceans, sometimes near shoreline; breeds on rocky islets and stacks.	**None**. No suitable habitat in the study area.	No
Turnix melanogaster	Black-breasted button-quail	V	Drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest; also in low, dense acacia thickets and, in littoral area, in vegetation behind sand dunes. Will use Lantana, particularly when it forms a mosaic with preferred habitat types.	**Moderate**. May occur in viney or Lantana infested areas within RE 12.3.1 (notophyll vine forest) and RE 12.3.2 (tall open forest dominated by flooded gum).	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Fish					
Epinephelus daemelii	Black rockcod	V	Adult black rockcod are usually found in caves, gutters and beneath bomboras on rocky reefs. They are territorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries.	**None**. No suitable habitat in the study area.	No
Maccullochella mariensis	Mary River cod	E	Endemic to the Mary River, but introduced elsewhere. Larger river and creeks. Avoids shallow areas.	**High**. Known to occur in the Mary River, Lake Macdonald and downstream waterways.	Yes
Neoceratodus forsteri	Queensland lungfish	V	The species' natural distribution is the Mary, Burnett and Brisbane River systems and (possibly) the Pine River system, but it has been translocated to many other locations. Translocated populations persist in the Coomera, Condamine, Albert and Logan Rivers. Occurs in permanent still or slow-flowing, shallow, vegetated pools with clear or turbid water in which to spawn and feed.	**High**. Known to occur in the study area.	Yes
Frogs					
Litoria olongburensis	Wallum sedge frog	V	Ephemeral, semi-permanent and permanent wetlands and creeks within sedgeland, wet heath, and paperbark swamps with a well-developed understory of sedges and/or *Blechnum indicum* where the groundwater is acidic, usually on coastal sand; perches on emergent sedges and ferns (particularly *Baumea*, *Schoenus* and *Chorizandra* species), occasionally other vegetation; prefers to breed in ephemeral and semi-permanent perched swamps with thick emergent vegetation in spring, summer and autumn, though calling may also occur in winter; generally large breeding aggregations.	**None**. Lack of suitable habitat.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Litoria pearsoniana	Cascade treefrog	V	Dense rainforest and wet sclerophyll forest near fast flowing rocky streams 200-1000 m elevation. Shelters under logs, rocks, rotting leaf litter and moist soil cavities adjacent to the water edge during the day. At night males call from rocks, low vegetation, and debris in or near streams.	**Low**. Potential habitat present below the existing dam, but elevation of the study area is only about 100 m. No fast-flowing rocky streams present.	No
Mixophyes fleayi	Fleay's frog	E	Occurs in streams within and adjacent to rainforest habitat. Key habitat is permanent and semi-permanent streams between 100 to 1000 m altitude. This is particularly within Mt Tamborine, the McPherson, Main and Conondale Ranges, Mistake Mountains and Bunya Mountains.	**Low**. Potential habitat present below the existing dam and elevation is approximately 100 m. However, the study area is not within the known species locations.	No
Mixophyes iteratus	Giant barred frog	E	Occurs in damp rainforest, and both moist and dry eucalypt forest below 1000 m. Inhabits deep leaf litter and breeds in shallow, flowing rocky streams. Adult frogs generally forage within 20 m of streams, but are capable of dispersing hundreds of metres from streams.	**High**. Known to occur in Six Mile Creek downstream of the existing dam. Observed during the field survey.	Yes
Insects					
Argynnis hyperbius inconstans	Australian fritillary	CE	Open, swampy, coastal areas where the larval food plant, *Viola betonicifolia*, occurs; usually in association with *Lomandra longifolia* and grasses, especially bladey grass	**None**. No open, swampy habitat present. Larval food plant not recorded in study area.	No
Phyllodes imperialis smithersi	Pink underwing moth	CE	Undisturbed, subtropical rainforest below 600m. It occurs in association with a rare collapsed form of the vine *Carronia multisepalea*, which provides the food and habitat necessary for breeding. It does not associate with the more common upright form of *C. multisepalea*.	**Low**. May occur within RE 12.3.1 downstream of Six Mile Creek. However, larval food plant not recorded.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Mammals					
Chalinolobus dwyeri	Large-eared pied bat	V	Roosts in disused mine shafts, caves, overhangs and disused Fairy Martin nests for shelter and to raise young. Also potentially roost in tree hollows. Occurs in low to mid-elevation dry open forest and woodlands, preferably with extensive cliffs, caves or gullies. Pied Bat is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat).	**Moderate**. Sandstone cliffs for roosting within several kilometres of the study area. Study area potential foraging habitat.	No
Dasyurus hallucatus	Northern quoll	E	Occupies a diversity of habitats across its range, including rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Generally requires rocky areas or tree hollows for denning.	**None**. The study area is well south of accepted range limit (approximately Rockhampton).	No
Dasyurus maculatus maculatus	Spotted-tail quoll (south-eastern mainland population)	E	Utilises a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	**Moderate**. Suitable rainforest and open forest is mapped as occurring in the Project area and further downstream. Rocky cliffs within several kilometres of the study area, which may provide refuges from introduced predators and help to stabilise a local population.	No
Petauroides volans	Greater glider	V	Eucalypt forests and woodlands, preferring mature forest with numerous large tree hollows. Folivorous, usually selecting habitats with a diversity of Eucalypt species. Sensitive to habitat fragmentation, restricted to gliding locomotion and reluctant to disperse through non-native habitat.	**Low**. May occur within remnant Eucalypt forest in the study area. However, tree hollows appear to be limiting and the species was not found during spotlighting surveys.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Phascolarctos cinereus	Koala	V	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, availability of feed trees (primarily *Eucalyptus tereticornis* and *E. viminalis*) and presence of mature trees very important. Preferred food tree species vary with locality and there are quite distinct regional preferences. They are able to persist in fragmented habitats, and even survive in isolated trees across a predominantly agricultural landscape.	**Moderate**. Preferred feed trees, such as Swamp Mahogany, Forest Red Gum and Tallowwood are present in the study area. Secondary food trees also present. However, surveys failed to locate the species.	No
Potorous tridactylus tridactylus	Long-nosed potoroo (South East mainland)	V	Coastal heaths, dry and wet eucalypt forests, rainforest margins; requires a dense understorey with occasional open areas; soil typically a sandy loam; digs for the underground fruit bodies of fungi	**Low**. Limited suitable habitat available and potential food sources on site.	No
Pteropus poliocephalus	Grey-headed flying-fox	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy. They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.	**High**. Intermittent occurrence pending fruit or nectar availability. A variety of suitable flowering and fruiting trees present in the study area (e.g. swamp mahogany, forest red gum, grey ironbark).	No
Xeromys myoides	Water mouse	V	Mangroves and the associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands. Most feeds within the intertidal zone at low tide. Builds nests as high tide refuges.	**None**. No suitable habitat	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Reptiles					
Delma torquata	Adorned delma	V	Inhabits drier eucalypt woodlands and open forests on alluvium, fine-grained sedimentary rocks and sandstone. Important microhabitat features include rocks, logs, bark and other coarse woody debris, and mats of leaf litter.	**Low**. Potential macrohabitat present (e.g. RE 12.9-10.1/12.9-10.17. The availability of microhabitat features is not known, but lack of preferred rocky habitat. No known records in the locality.	No
Saiphos reticulatus	Three-toed snake-tooth skink	V	Rainforest, occasionally moist eucalypt forest, on loamy or sandy soils; a burrowing skink that requires loose soil, leaf litter and rotting logs, and feeds on earthworms and beetle grubs.	**Moderate**. May occur in notophyll vine forest (RE 12.3.1) and flooded gum-dominated tall open forest (RE 12.3.2) in the study area pending the availability of suitable microhabitat.	No
Furina dunmalli	Dunmall's snake	V	Forests and woodlands on black alluvial cracking clay and clay loams dominated by brigalow (*Acacia harpophylla*), other wattles, native Cypress (*Callitris spp*.) or bull-oak (*Allocasuarina luehmannii*) or various spotted gum (*Corymbia citriodora*), ironbark (*Eucalyptus crebra* and *E. melanophloia*), white cypress pine (*Callitris glaucophylla*) and bulloak open forest and woodland associations on sandstone derived soils.	**None**. No suitable habitat	No
Elseya albagula	White-throated snapping turtle	CE	Found only in the Fitzroy, Burnett and Mary River catchments. Within each catchment populations are fragmented by artificial structures (e.g. dams, weirs) that reduce water quality. Prefers clear, flowing, well-oxygenated waters, which appears to be associated with their physiological adaption to extract oxygen from water via cloacal respiration. Sometimes occurs in non-flowing waters, but typically at much reduced densities. Tends not occur in deeper waters due to reduced oxygen levels.	**Moderate**. Six Mile Creek has not been identified as a Mary River tributary known to contain a significant population. The Protected Matters search did not predict the species to occur within 10 km of the study area, there are no locality records within this search area. This species was not caught during the field surveys, but	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
				Six Mile Creek may be capable of supporting a non-breeding population.	
Elusor macrurus	Mary River turtle	E	Endemic to the Mary River catchment. The species uses cloacal respiration, which restricts it to flowing, well-oxygenated sections of streams. Its habitat consists of riffles (particularly productive parts of a river that are shallow with fast-flowing, aerated water) and shallow stretches alternating with deeper, flowing pools. It generally does not occur in impoundments due to reduced oxygen levels. Adults are usually found in areas with underwater shelter, such as sparse to dense aquatic plant cover, submerged logs and rock crevices. They bask on logs and rocks. Juveniles occur in rocky areas with sand or gravel on the river bed, based on limited data.	**Moderate**. Six Mile Creek has not been identified as a Mary River tributary known to contain a significant population of this species. The Protected Matters search did not predict the species to occur within 10 km of the study area and there are no locality records of the species. Six Mile Creek below the dam is generally unsuitable, however, it is potential habitat for dispersal and migration. This species was not caught during field surveys, but Six Mile Creek may be capable of supporting a non-breeding population.	No
Caretta caretta	Loggerhead turtle	E, M	Oceans, nests on beaches.	**None**. No suitable habitat in the study area.	No
Chelonia mydas	Green turtle	V, M	Oceans, nests on beaches.	**None**. No suitable habitat in the study area.	No
Dermochelys coriacea	Leatherback turtle	E, M	Oceans, nests on beaches.	**None**. No suitable habitat in the study area.	No
Eretmochelys imbricata	Hawksbill turtle	V, M	Oceans and reefs, nests on beaches.	**None**. No suitable habitat in the study area.	No

SPECIES NAME	COMMON NAME	EPBC ACT STATUS	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	RECORDED DURING SURVEYS
Lepidochelys olivacea	Olive ridley turtle	E, M	Oceans, particularly over the continental shelf, nests on sandy beaches.	**None**. No suitable habitat in the study area.	No
Natator depressus	Flatback turtle	V, M	Turbid, shallow inshore waters and over the continental shelf, nests on sandy beaches.	**None**. No suitable habitat in the study area.	No
Pristis zijsron	Green sawfish	V, M	Marine waters, rivers and estuaries with muddy bottoms, usually in shallow waters.	**None**. No suitable habitat in the study area.	No

* The status of the species under the EPBC Act: CE – Critically Endangered, E – Endangered, V – Vulnerable, M - Migratory

5.5.4 Listed Threatened Ecological communities

The EPBC Act Protected Matters Search one relevant TECs that is likely to occur within 10 km of the study area– Lowland rainforest of subtropical Australia, which is critically endangered under the EPBC Act.

The TEC lowland rainforest of subtropical Australia is noted in the listing advice (TSSC, 2013b) as occurring between Maryborough in Queensland to the Clarence River in New South Wales on basalt and alluvial soils. The community generally occurs below 300 m sea level where rainfall is higher. Thus, the study area is within the geographical range of this TEC and is below the maximum elevation at which this community occurs. The listing advice (TSSC, 2013b) notes this TEC as being equivalent to RE 12.3.1. This RE was recorded in the study area, but was not present in the proposed Project construction area and would not, therefore, be directly impacted by the Project. None of the REs in the proposed construction area for the Project are listed as equivalent to the lowland rainforest TEC.

5.6 Description of Matters of National Environmental Significance

This section provides a description of species listed as MNES that have a high or moderate likelihood of occurring within the Project study area and then assesses potential impacts on these species in relation to the significant impact assessment criteria. Each species description includes:

- A discussion of the species current distribution
- Relevant information about the ecology of the species (habitat, feeding and breeding behaviour, etc.)
- Information about any populations of the species or habitat for the species in the area affected by the Project
- A discussion of current threats to the species, especially those in the area to be affected by the Project
- A discussion of relevant controls or planning regimes already in place
- Relevant recovery plans for the species.

Some species have been described as a group, where appropriate (e.g. species with similar habitat requirements), and potential impacts for these have also been assessed as a group.

5.6.1 Listed Threatened Species known from the Study Area

Species that have previously been recorded within the study area or that have a high likelihood of occurring within the study area based on an understanding of the preferred habitats of the species, condition of habitats actually present within the study area, and the results of the field surveys and literature review, have been discussed below.

Southern Penda

Current distribution

The Southern penda covers a range of approximately 250 km and is known from three general localities across southeast Queensland. It has been recorded from Kin Kin-Boreen Point – Cooroy District near Noosa, south of Maryborough at the Teddington Weir, and southwest of Miriam Vale on the Granite Creek and Broken Creek (DoEEa, 2018).

Ecology

Southern penda predominantly grows within various vine forests with the emergence of Hoop Pine or in rainforests where species are restricted to understorey or mid-storey development. The species is generally associated with watercourses on sedimentary rock and derived sandy clays (DoEEa, 2018).

Populations within the study area

The closest record of this species is on the eastern side of Six Mile Creek downstream of the spillway and within one kilometre of the Project area. Extensive targeted investigation in this area could not relocate this individual but it is assumed that the record is correct and that this species is likely present in Tewantin National Park.

Current threats to the species

Current threats to the southern penda include the loss and fragmentation of habitat through land clearing for agriculture and timber harvesting. Weed encroachment, fire and grazing also inhibit species establishment.

Existing controls and planning regimes

There are no formal strategies in place in Queensland or nationally for priority actions to help recover the southern penda. This species is protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*.

At a local level there are no management plans in place to protect or manage existing populations in Maroochy, Noosa or Cooloola Shires.

Mary River Cod

Current Distribution

The Mary River cod has been regarded as being endemic to the Mary River system. Three of the Mary River's tributaries are known to contain abundant populations of Mary River cod, one of which is Six Mile Creek. Throughout these three tributaries, the total area of occupancy is between 5-7.5 km^2 with an estimated population size of less than 600 individuals (Simpson & Jackson, 1996). The populations of Mary River cod in the Mary River main channel are relatively small in comparison to those in these three tributaries.

The Mary River cod are known to have been restocked within certain impoundments in southeast Queensland since 1983, including the Mary River system and Lake Macdonald (DoEEb, 2018).

Ecology

The Mary River cod has a general preference for deep pool habitats that contain large woody debris, making the species sensitive to changes in water levels. Pool habitats within Six Mile Creek are known to be strong-holds for the species. Adult Mary River cod prefer low flowing water in depths of between 1-3 m and generally avoid areas of shallow water below 1 m. The species is known to use woody debris and undercut banks as shelter during high flow periods to block and reduce the flow velocities (Simpson & Jackson, 1996). Following high flows, the species disperses up to 70 km (Simpson & Jackson, 1996). Juvenile Mary River cod prefer shallow water with sufficient cover of rocky substrates and trailing root masses. The species has a relatively small home range, however within the range they tend to move upstream during the summer months and downstream in winter months (DoEEb, 2018).

In spring, when the water temperature is above 20°C, Mary River cod form pairs and spawn. The males of the species exhibit parental care as they select and guard the nest sites as well as caring for the brood until they are ready to disperse (approximately nine days after hatching). Nests are generally presumed to be in hollow logs (Simpson & Jackson, 1996).

It is known that Mary River cod feed on fish and crustaceans and have developed a crepuscular mode of feeding, where they feed at dawn and dusk. Individuals of the species can grow to reach between 23-38 kg (Simpson & Jackson, 1996).

The reported water quality tolerances of Mary River cod are:

- pH = 6.0 – 7.3
- Electrical conductivity (µS/cm) = 100 – 800
- Water temperature (°C) = 15.7 – 29.0, and
- Dissolved oxygen (mg/L) = 3.9 – 9.7 (Hydrobiology, 2008).

Of the above water quality parameters, temperature and dissolved oxygen are paramount, as high temperatures and low dissolved oxygen levels can be lethal to the species (DNRME, 2001).

Populations within the study area

Mary River cod is known to occur in Six Mile Creek downstream of Lake Macdonald. This downstream population is classed as a key breeding population and is therefore a significant source of recruitment. Mary River cod are also stocked in Lake Macdonald in significant numbers.

Current threats to the species

Present and historic pressures on the Mary River cod include:

- Sand and gravel extraction
- Riparian tree clearing
- Snag removal

- Erosion and sedimentation leading to pool infilling
- Overfishing
- Degradation in water quality
- Biological interactions with introduced fish species.

Existing controls and planning regimes

A Research and Recovery Plan was prepared for the Mary River cod by the Mary River Cod Recovery Team (Queensland Department of Primary Industries and Fisheries).

Recommended recovery actions include:

- Establish a program of community involvement and education
- Review and develop regulations and administrative procedures to ensure protection of the Mary River cod and its habitats
- Develop a plan to improve hatchery production of the Mary River cod, and restock throughout the former range
- Undertake research on key aspects of Mary River cod ecology and captive-breeding techniques
- Restore degraded Mary River cod habitats
- Develop and implement long-term monitoring program for the Mary River cod.

Australian Lungfish

Current distribution

Lungfish in Australia are restricted to southeast Queensland (Kemp, 1987), with its natural distribution restricted to the Mary and Burnett Rivers and possibly the Brisbane River (Brooks and Kind, 2002; Kemp, 1987; Johnson, 2001).

Lungfish were translocated from the Mary River at the end of the 19th century to seven locations (O'Connor, 1897), including:

- North Pine River
- A lagoon near the Albert River
- A dam near Cressbrook on the upper Brisbane River
- Enoggera Reservoir
- Condamine River
- Coomera River
- Botanic Gardens in Brisbane.

Currently, lungfish occur in the Burnett River, the Mary River, the North Pine River (including Lake Samsonvale), the Brisbane River (including Lake Wivenhoe), and Enoggera Reservoir (Brooks & Kind, 2002; Johnson, 2001; Kemp 1995, Hydrobiology, 2008). The species has previously been caught at the confluence of the Mary River and Six Mile Creek which is approximately 55 km upstream of Lake Macdonald. It is estimated that the population of the species consists of less than 10,000 individuals (DoEE, 2018c).

Ecology

In rivers with natural flows of water, lungfish are largely sedentary, with adults usually moving only short distances at night, returning each day to a certain habitat feature such as a submerged log, rock or patch of aquatic plants. Individuals are routinely found resting in the same daytime retreat over many months or even years (Brooks & Kind, 2002; Berghuis & Broadfoot, 2004). A radio-tracking study of lungfish in the Mary River carried out by Kind (2002) found only four of the 20 tagged lungfish moved more than 5 km from their original site. Most movement of the species is reported to occur during the summer months. Lungfish in the Mary River were not observed to undertake spawning migrations.

Lungfish spawning occurs annually between August and December, depending on the suitability of environmental conditions (Kemp, 1995). Factors affecting the choice of spawning location are reportedly complex. However, factors constituting favourable lungfish spawning habitat include aquatic plant cover >70%, shallow depths, still and slow-flowing water and the presence of particular aquatic plant species (DoEEc, 2018).

Adult lungfish reportedly favour submerged logs, dense banks of aquatic vegetation, or underwater caves formed by bed scouring under submerged logs. While lungfish can be found in both pools and riffles, their preferred habitats are

pools of 3-10 m depth. In habitats such as these, they can often live in large groups (Kemp, 1986). All lungfish under 500 mm in length collected by Brooks and Kind (2002) were caught in the sort of dense aquatic plant growth favoured for spawning, suggesting that juveniles prefer the same habitat and are probably slow to disperse after hatching. Johnson (2001) regards this reliance on aquatic plants by juvenile lungfish as a risk to their survival, as these habitats can be removed by scouring during floods, or can become exposed during periods of low flow.

The water quality tolerances of Australian lungfish are:

- pH = 7.0 – 9.1
- Electrical conductivity (µS/cm) = 421 – 1165
- Water temperature (°C) = 10 – 30, and
- Dissolved oxygen (mg/L) = 6.9 – 15.6 (Hydrobiology 2008).

Populations within the study area

The species is known to occur in Six Mile Creek, in particular within the downstream tributaries of Six Mile Creek, although the abundance of lungfish in this area is low. The population downstream of Lake Macdonald can be classed as a breeding population, but with limited recruitment. Due to limited available information, it is unknown if a current population of Australian lungfish exist within Lake Macdonald. However, if this species is present in the lake, the abundance is considered likely to be low.

Current threats to the species

Lungfish are regarded as long-lived, and slow to reach sexual maturity; the species has a population structure based on sporadic periods of successful recruitment. These factors make lungfish potentially vulnerable to anthropogenic change. Present and historic pressures on lungfish populations include:

- Habitat change associated with catchment development including sand and gravel extraction, water quality issues, erosion and sedimentation, riparian zone management and barriers of all sorts
- Water resource development (i.e. impoundments)
- Mortality associated with dissolved oxygen crashes
- Mortality associated with movement over spillways
- Low genetic variability, particularly amongst stock based on translocated individuals
- Invasive fish species that prey on eggs and young and compete with adults for breeding habitat (i.e. tilapia - *Oreochromis mossambica*).

Existing controls and planning regimes

The lungfish has been protected since 1914 under the *Queensland Fish and Oyster Act 1914* and, subsequently, the *Fisheries Act 1994*. It was placed on the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) list in 1977 due to its ancient lineage and very restricted distribution in Queensland (Kemp, 1995).

There is a draft National Recovery Plan for the Australian Lungfish. The draft recovery actions can be summarised as follows:

- Reduce the impacts of, and remove any redundant, artificial barriers
- Manage waterways to optimise breeding and recruitment opportunities
- Limit habitat degradation and maintain or enhance water quality
- Reduce the impacts of introduced pest and weed species
- Manage the impacts of water-based recreational activities
- Address key knowledge gaps to improve Australian lungfish management
- Facilitate high levels of community participation and support in the implementation of Australian lungfish management strategies

Giant Barred Frog

Current distribution

Giant barred frogs are distributed along the coast, from Eumundi in southeast Queensland to Warrimoo in the Blue Mountains.

In the southeast Queensland region, the giant barred frog is currently known to occur along the Mary River and one of its major tributaries, Six Mile Creek (DoEEd, 2018).

Ecology

This species can occur in upland and lowland rainforest and wet sclerophyll forest and occasionally adjacent farmland (Hines et al., 2004). Moist riparian habitats are often favoured for deep leaf litter that provide shelter and foraging. Populations have been recorded in disturbed areas with riparian vegetation, such as cattle farms and previously logged areas (Hines et. Al, 2004). Individuals have also been found within eucalypt plantations and streams within partially to completely cleared lands (Hines et. Al, 2004). Spatial movements of giant barred frogs have been monitored, describing their average area of utilisation of 622 m^2 for females and 403 m^2 for males (Streatfield, 1999). Individuals have been recorded to move a maximum of 268 m downstream and 50 m away from the stream.

The giant barred frog is a generalist feeder, with large insects, snails, spiders and frogs included in their diet. Observations have also revealed that tadpoles of the giant barred frog feed on a range of organic matter such as algae and fallen fruit (Future Plus Environmental, 2014).

Giant barred frogs breed within late spring and summer (September to May), heavily influenced by weather events (Future Plus Environmental, 2014). This species is a stream breeding species, where eggs are deposited and fertilised in the water, and the female will kick the eggs onto a suitable bank where they are able to stick. Hatchlings will then drop or wriggle into the water. Tadpoles reach maturity at around 11 cm. The full life cycle from egg to completion of metamorphosis can take up 14 months.

Populations within the study area

There is a Queensland essential habitat record for the giant barred frog from approximately 150 m downstream of Lake Macdonald on Six Mile Creek. Based on the field survey conducted in February 2018 this species is present along Six Mile Creek, but in a low density population.

Current threats to the species

As the giant barred frog mainly occurs within the lower reaches of streams, the habitat has often been affected by major disturbances such as clearing, timber harvesting and urban development in the headwaters. Impacts associated with chytrid fungus, upstream clearing, changes in water flow regimes, degradation of water quality, feral animals, domestic stock, weed invasion and disturbance to riparian vegetation are currently unknown (DoEEd, 2018). Individuals of the giant barred frog have sometimes been killed in the mistaken belief that they are the introduced cane toad (*Rhinella marina*).

Existing controls and planning regimes

This species is subject to a range of recovery actions and is included in the National Recovery Plan for Stream Frogs of southeast Queensland 2001-2005 (Hines 2002). Recovery actions, outlined in earlier recovery plans, have been implemented since 1998. The major actions can be summarised as:

- Conduct regular, long-term population monitoring and assessments of likely habitat
- Conduct research to further develop husbandry and translocation techniques, investigate the genetic structure of populations, and investigate the role of disease
- Develop protocols addressing frog handling and contingency planning
- Develop prescriptions for effective habitat protection and management
- Develop and distribute a range of materials to increase public education and information.

Mary River Turtle

Current Distribution

The Mary River turtle is endemic to the Mary River in southeast Queensland. Populations are known to occur within the major tributaries and the main channel of the Mary River. Individuals have well defined home ranges and show strong site fidelity (Cann & Legler, 1994; Limpus, 2008; Micheli-Campbell et al., 2013).

Ecology

Like other turtles with cloacal respiration, the Mary River turtle occurs in flowing, well-oxygenated sections of streams, with preferred habitat being shallow and fast-flowing streams. Its habitat consists of riffles (particularly productive parts of a river that are shallow with fast-flowing, aerated water) and shallow stretches alternating with

deeper, flowing pools. The species is also known to reside in backwaters during flooding and also move upstream during high flow periods (Flakus & Connell, 2008).

There are no specific water quality tolerances for the Mary River turtle, however they are known to prefer flowing water with high concentrations of dissolved oxygen (Thomson et al., 2006). It is reasonable to assume that their preferences for other water quality parameters would be similar to that of the Mary River cod, as both species are endemic to the Mary River.

Recent reports suggest that cloacal ventilating species can live and breed in some impoundments (Hamman et al., 2004 and Limpus 2007). Limited data on juveniles suggest that they occur in rocky areas with sand or gravel on the river bed, in a variety of water depths. Adults are usually found in areas with underwater shelter, such as sparse to dense aquatic plant cover, submerged logs and rock crevices. They bask on logs and rocks (Flakus, 2002; S. Flakus, pers. comm., 2003). Some turtles have also been captured at sites with little aquatic vegetation or submerged logs.

The Mary River turtle can live for between 30 and 80 years and do not breed until between 15 and 25 years of age (Limpus, 2008). Preferred nesting habitats include sandy river banks that are sparsely vegetated and in close proximity to riffles and pools. Breeding occurs once a year with a clutch size of approximately 13 eggs (Flakus et al, 2008). A period of 50 consecutive days after nesting of non-inundation is crucial for the success of hatching and for this reason, nests are typically located up to 30 m inland from the watercourse and 5 m above water level. Nesting occurs between late October and December, generally after the first significant summer rain event (Cann & Legler, 1994; Flakus & Connell, 2008; Limpus, 2008). The incubation period is between 50-56 days depending on the temperature of the sand (Cann & Legler 1994).

Adult Mary River turtles are mainly herbivorous, and aquatic plants (macrophytes) make up 79% of the diet by weight. Juvenile Mary River turtles eat mainly aquatic insect larvae (53%), as well as freshwater sponges (21%) and aquatic plants (25%) (Flakus, 2002).

During the non-breeding season, the length of the home range used by Mary River turtles was 200 m to 650 m, and the average distance moved per day was 192 m (Flakus, 2002). There was no difference in the range or distance moved each day by male and female turtles during the non-breeding season. During the breeding season (October to December), female Mary River turtles moved to areas of the river that are adjacent to sand banks for nesting. Females had longer ranges in the breeding season than the non-breeding season, because they moved to and from nesting areas (Flakus, 2002).

Populations within the study area

The Mary River turtle has been recorded within Six Mile Creek on a periodic basis with it being unlikely to breed in the area. As Six Mile Creek is not listed as one of the Mary River tributaries to contain significant populations of the species, it has been concluded that the species are likely to primarily use the creek for dispersal and migration. Lake Macdonald provides limited suitable foraging habitat for the species, however is not suitable for breeding. No individuals were identified within and around Lake Macdonald in field surveys.

Current threats to the species

The Mary River turtle is susceptible to threatening processes due to its restricted distribution and low population size. The key pressure on the Mary River turtle is the illegal taking of eggs and predation of nests by foxes, goannas and pigs, as well as trampling of nests by stock, people and floods. Other pressures arise from a decline in water quality in the streams it inhabits as well as clearing and heavy grazing on parts of the Mary River catchment. On these reaches of the river, the turtle is vulnerable to the effects of increased runoff, siltation and pollution.

Removal of riparian trees prevents recruitment of logs into the instream environment. Emergent logs and log jams may be important elements of the Mary River turtle's microhabitat.

Existing controls and planning regimes

There are no formal strategies in place in Queensland or nationally to help protect the Mary River turtle. This species is protected from inappropriate development (and subsequent loss) by the EPBC Act.

Proposed recovery actions for the Mary River turtle include (DES, 2017):

- Control feral animals, mainly foxes, in areas of known nesting
- Protect nesting sites from access of stock to prevent trampling
- Undertake further surveys to more accurately determine the distribution, habitat requirements and conservation requirement for this species

- Monitor the impact of grazing on water quality and adjust grazing management to reduce adverse impacts
- Strictly adhere to watercourse protection zone guidelines, as outlined in the Code of Practice – Native Forest Timber Production
- Control public access at known nesting sites on State forests and timber reserves.

White-throated Snapping Turtle

Current Distribution

The white-throated snapping turtle is known to occur within the Burnett, Fitzroy, Raglan and Mary River drainages in South-east Queensland (DoEE, 2017).

Ecology

The white-throated snapping turtle is the largest known species of snapping turtle, with a carapace measuring up to 420 mm. This species is a habitat specialist that prefers permanent flowing, clear and well oxygenated water that contains shelter such as woody debris and undercut banks (Limpus et al. 2008). Specimens recorded within the Fitzroy, Burnett and Mary River catchments were associated almost exclusively with permanent flowing stream areas that have sand-gravel substrates and submerged rock crevices and undercut banks.

The white-throated snapping turtle has an herbivorous diet primarily consisting of aquatic plants, fruits and leaves that overhang from riparian vegetation. When plant food sources are limited they are also known to eat periphyton, insects and freshwater bivalves.

This species is characterised by a long life span and slow growth to maturity. Breeding first occurs between 15 to 20 years of age (Limpus et al., 2008). Breeding takes place once a year, typically during autumn and winter, with females breeding in each successive year unless the turtle has been injured or debilitated, or habitat has been altered. Nests are created by the female on sandy banks, however, nests have been observed on loose gravel and soils also. Generally, nests are laid in areas with a low canopy cover and dense grass cover. The nests are laid over 15 m from the water's edge and eggs laid in deep chambers on banks with a 26.5° slope (Hamann et al., 2007). The same areas of banks will be repeatedly used over multiple years by this species (Limpus et al., 2007). The survival of eggs and young juveniles is low due to the species presenting no parental care (Hamann et al., 2007).

Populations within the study area

The white-throated snapping turtle has been identified as potentially occurring within Six Mile Creek on a periodic basis. As Six Mile Creek is not listed as one of the Mary River tributaries to contain significant populations of the species, it has been concluded that the species is likely to use the creek for dispersal and migration. Field surveys determined there is limited suitable habitat within the downstream areas of Six Mile Creek for this species and therefore the downstream population is considered to be rare.

Current threats to the species

The white-throated snapping turtle is known to have poor breeding success which is largely due to egg predation by feral and native species such as foxes and goannas. High levels of predation may also correlate with the lack of parental care that the species displays (Hamann et al., 2007). Water impoundments has also had a large effect on the species due to the reduction in the amount and quality of habitat available for the species (DoEEe, 2018).

Existing controls and planning regimes

There is a draft National Recovery Plan for the white-throated snapping turtle and the recovery strategies can be summarised as the following (DoEE, 2017):

- Substantially improve the recruitment of hatchlings into the population;
- Reduce the incidence of adult mortality and injury;
- Maintain and/or improve stream flow and habitat quality throughout the species' distribution;
- Maintain and/or improve the connectivity within populations throughout each catchment; and
- Increase public awareness and participation in conservation of the species and its habitat

5.6.2 Listed Threatened Species that May Occur in the Study Area

Species that have a moderate likelihood of occurrence to occur within the study area based on an understanding of the preferred habitats of the species, condition of habitats actually present within the study area, and the results of the field surveys and literature review, have been discussed below.

Koala and the grey headed flying fox have been discussed separately due to appropriate foraging habitat present and also a history of anecdotal information on the intermittent occurrence of the species within the study area.

Plants

There are several species of flora that have not been recorded from the study area, but have the potential to occur, as identified in Table 5-5. As these species share similar or overlapping habitat requirements, they have been discussed collectively.

Current distribution

Distributions of the relevant species are as follows:

- Glossy spice bush - distribution ranges from Beachmere to the northern reaches of Rainbow Beach.
- Hairy jointgrass - occurs north from Gibraltar Range in New South Wales to Toolara State Forest in Queensland.
- Leafless tongue orchid - extends from Orbost in East Gippsland in Victoria to coastal NSW and up to the Tin Can Bay area of Queensland.
- Lesser swamp orchid - occurs from southern Queensland to northern New South Wales.
- Macadamia nut - is restricted in southeast Queensland from Mt Bauple (near Gympie) to Nicols Scrub near the New South Wales-Queensland border. It is frequently cultivated for its fruit and is commonly found in backyards.
- *Prostanthera spathulata* is known in four locations in the Mount Tinbeerwah area near Tewantin, Queensland.
- Quassia - occurs in several locations between Mackay and the north of Gympie.
- Yellow satinheart - occurs from Maryborough in Queensland to the Nightcap Range north of Lismore in northeast New South Wales.

Ecology

Habitat preferences for these species are as follows:

- Glossy spice bush - occurs predominantly in riparian communities.
- Hairy jointgrass - occurs in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.
- Leafless tongue orchid - prefers a wide range of communities including, heathlands, heathy woodlands, dry sclerophyll forest, wetlands, grasslands and grassy woodlands.
- Lesser swamp orchid - mostly occurs in mixed swamp forest in association with rainforest elements.
- Macadamia nut - primarily occurs in dry and subtropical rainforest, but persists in a variety of situations, including amongst Acacia and mixed species regrowth.
- *Prostanthera spathulata* - occurs in shrubland on rocky hillslopes and in tall open forest.
- Quassia - prefers lowland rainforest or on rainforest margins, occasionally open forest or woodland.
- Yellow satinheart - occurs in lowland subtropical rainforest.

Populations within the study area

These species are not confirmed to occur within the study area and were not observed during the field survey, but have the potential to occur based on the following previous records:

- Hairy jointgrass – recorded within Noosa Headlands, approximately 14 km east of the study area.
- Leafless tongue orchid – recorded approximately 17 km southeast of the study area in Coolum.
- Lesser swamp orchid – recorded approximately 20 km southwest of the study area.
- *Prostanthera spathulata* – multiple records within approximately 10 km east of the study area.
- Quassia – one record within Eenie Creek, approximately 18 km southeast of the study area.
- Yellow satinheart – recorded approximately 8 km south of the study area, towards Eumundi.

There have been no records of glossy spice bush or macadamia nut within 2 km of the study area. These species are found within RE 12.3.1, for which a small area of suitable habitat is present in the study area upstream of the dam, but

outside of the Project construction area. Consequently, these species have potential to occur in the study area, but are unlikely to occur within the Project area.

Current threats to the species

The flora species listed above are threatened by loss and fragmentation of habitat for agriculture and development, inappropriate fire regimes, weed invasion and over-grazing by cattle.

Existing controls and planning regimes

Priority actions have been identified to help recover some of these rainforest flora including hairy-joint grass, three-leaved bosistoa in New South Wales, but there are no formal strategies in place in Queensland or at the national level. All species mentioned above are protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*. At the local level, there are no management plans in place to protect or manage existing populations in Maroochy, Noosa or Cooloola Shires.

Birds

There are several species of birds that have not been recorded from the study area, but that have the potential to occur, as identified in Table 5-6. As these species share similar or overlapping habitat requirements, they have been discussed collectively.

Current distribution

- Australasian bittern – has a range between the upper reaches of Rockhampton, along the coast to Port Pirie near Adelaide.
- Australian painted snipe – occurs in the wetlands of all states of Australia, primarily eastern Australia.
- Black-breasted button-quail – restricted to coastal and near coastal regions of south eastern Queensland and north eastern NSW.
- Coxen's fig-parrot – core distribution extends from Gympie in south-eastern Queensland to the Richmond River in northern New South Wales.
- Curlew sandpiper – Queensland populations are found from the Gulf of Carpentaria with widespread records along the coast to the south of Cairns.
- Red goshawk – sparsely dispersed across 15% of coastal and sub-coastal Australia, from western Kimberley to north eastern NSW.
- Regent honeyeater – is known to occur between south-east Queensland and central Victoria.
- Swift parrot – is distributed between northern Hervey Bay in Queensland to Bordertown in South Australia along the coast.

Ecology

Habitat preferences of the relevant species are as follows:

- Australasian bittern – occurs within freshwater wetlands and occasionally estuarine reed beds.
- Australian painted snipe – inhabits shallow inland wetlands.
- Black-breasted button-quail – prefers dry, low closed forests, particularly semi – evergreen vine thicket.
- Coxen's fig-parrot – prefers rainforest habitat.
- Curlew sandpiper – prefers intertidal mudflats in sheltered coastal areas.
- Red goshawk – occurs within woodlands and forests including riverine forests.
- Regent honeyeater – inhabits temperate woodlands and open forests.
- Swift parrot – occurs within flowering eucalypt forests for foraging.

Populations within the study area

These species have no confirmed records within the study area, but have potential to occur based on the following previous records:

- Curlew sandpiper – recorded approximately 10 km from the study area, in Eumundi.
- Regent honeyeater – recorded within 5 km of the study area.

There are no records of Australasian bittern, Coxen's fig-parrot, red goshawk, swift parrot, Australian painted snipe or the black-breasted button-quail in the vicinity of the study area. However, these species are often found along the outreaches of waterbodies, such as Lake Macdonald.

Current threats to the species

All of the species above are affected by habitat clearing and fragmentation, removing breeding and foraging habitat.

Existing controls and planning regimes

Recovery plans are available for the following species:

- Black-breasted button-quail – National recovery plan for the black-breasted button-quail *Turnix melanogaster*. In effect under the EPBC Act from 13-Nov-2009.
- Coxen's fig-parrot – Coxen's Fig-Parrot *Cyclopsitta diophthalma coxeni* Recovery Plan 2001-2005. Coxen's Fig-Parrot Recovery Team (2001). In effect under the EPBC Act from 13-Oct-2003 as *Cyclopsitta diophthalma coxeni*.
- Recovery Plan is required for the Australian painted-snipe, stopping the decline and supporting the recovery of this species is complex and involves a highly adaptive management process and the requirement for a high level of: planning to abate the threats; cross-jurisdictional co-ordination; co-ordination between managers; support by key stakeholders; and prioritisation of actions (Approved Conservation Advice for *Rostratula australis*, 2013).
- Red goshawk – National recovery plan for the red goshawk *(Erythrotriorchis radiates*). In effect under the EPBC Act from 24-Jul-2012 as *Erythrotriorchis radiatus*.
- Regent honeyeater – National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*). In effect under the EPBC Act from 04-May-2016 as *Anthochaera phrygia*.
- Swift Parrot –National Recovery Plan for the Swift Parrot (*Lathamus discolor*). Saunders, D.L. & C.L. Tzaros (2011). In effect under the EPBC Act from 10-Feb-2012.

All species mentioned above are protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*. At the local level, there are no management plans in place to protect or manage existing populations in Maroochy, Noosa or Cooloola Shires.

Koala

Current distribution

Koalas are found from northern Queensland to the Eyre Peninsula west of Adelaide in South Australia. Koalas have been moved to different locations and reintroduced into different states, and consequently occur outside of their natural habitat in areas such as islands off Victoria, South Australia and Queensland. Their distribution is also affected by altitude, temperature and, at the western and northern ends of their range, leaf moisture.

Ecology

The koala inhabits a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by eucalypt species.

Female koalas generally produce a single offspring each year, however on some occasions twins are produced. Koala births occur between October and May, where the young remains in the mother's pouch for up to eight months before leaving the pouch and remaining dependant until approximately 12 months old. Female koalas have been known to have a lifespan of up to 15 years and males 12 years (TSSC, 2012).

Koalas tend to be a territorial species, although the home ranges of individuals' overlap, males will fight for territory. Home ranges are estimated to be 20 hectares for males and 10 hectares for females, and the maximum dispersal for adult koalas is approximately 10 km (Martin & Handasyde, 1999).

Populations within the study area

There were no koalas observed within the study area during the field survey. However, the species has been recorded within 10 km of the study area, to the east within Tewantin National Park.

Current threats to the species

Habitat loss and fragmentation are currently the largest threats to koala populations. Also, with an increase in infrastructure development in Queensland, koalas are becoming more susceptible to the effects of drought, climate

change and disease. Dog attacks, vehicle strikes and disease are also contributing threats to the species (Cogger et al., 2003).

Existing controls and planning regimes

The current recovery plan in place for the koala is the 'National Koala Conservation and Management Strategy'. Following the expiration of this plan, another recovery plan will be developed. The conservation and management actions in the strategy include:

- The identification of koala habitat and the protection of habitat
- Implement strategies which minimise the impacts of dogs on koala populations
- Extend community involvement in koala conservation and engagement with government.

Grey-headed Flying Fox

Current Distribution

The grey-headed flying fox is endemic to Australia, occurring from Rockhampton, Queensland to Melbourne in Victoria. However, only a small portion of this range is used at one time, depending on where food is available. As a result, patterns of occurrence and relative abundance within their distribution region vary between seasons and years. The species is widespread throughout their range in summer, whilst in autumn it occupies coastal lowlands and is not common inland. Brisbane, Newcastle, Sydney and Melbourne have been identified as areas that are occupied continuously.

Ecology

The grey-headed flying-fox is a canopy-feeding frugivore and nectarivore, utilising vegetation communities such as rainforests, open forests, and closed and open woodlands. This species primarily feed on blossoms from eucalypts and occasionally rainforest fruits.

The grey-headed flying-fox roosts in various sized exposed branches. Roost sites are generally located near water, such as lakes and rivers (Ratcliffe, 1931). The vegetation of roosting sites includes rainforest patches, melaleucas, mangroves, riparian vegetation and also highly modified vegetation in urban and suburban areas (Nelson, 1965).

The breeding season of the grey-headed flying fox occurs in early autumn, where larger camps separate after mating and reform in spring/early summer as food resources become more abundant (Hall & Richards, 2000). Females give birth in October after six months of gestation. During food shortages or times of environmental stress, females will abort or abandon their young, often leading to mass abortions and premature birthing events in the wild (Hall et al., 1991).

Populations within the study area

There were no grey-headed flying-fox recorded within the study area during the field survey. However, the species has been recorded 5 km east of the study area.

Current threats to the species

The acceleration of clearing native vegetation for agriculture and forestry operations has been widespread over the range of the grey-headed flying-fox. As a result, foraging and roosting habitat has been disturbed or destroyed (State of the Environment Advisory Council, 1996). Habitat loss has also resulted in a decrease in the variety of flowering and fruiting tree species, primarily those with a high nectar output (Birt, 2000).

The grey-headed flying-fox is known to destroy commercial fruit grown in Queensland and NSW. It is estimated that 100,000 individuals have been shot illegally annually. A large proportion of individuals shot in orchards are pregnant and lactating females, leaving juveniles in maternity camps to die of starvation (Parry-Jones, 1992).

Other known threats to the grey-headed flying-fox are pollutants, electrocution and pathogens. Individuals are prone to electrocution on powerlines, particularly in urban areas, resulting in a high number of lactating females killed (Duncan et al., 1999).

Existing controls and planning regimes

There are no formal strategies in place in Queensland or at the National level for priority actions to help recover the grey-headed flying-fox. This species is protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*.

Recovery actions identified by DES (2017b) are listed below:

- Identify and map important foraging and roosting habitats
- Prevent the destruction and degradation of important forested habitat, through: identifying guidelines to protect habitat; appropriate zoning; identifying development alternatives and incentives to retain habitat and educating communities.
- Encourage community partnerships and initiatives that protect important habitats, and where possible re-vegetate with foraging trees for grey-headed flying-foxes
- Work with orchardists to improve the image of grey-headed flying-foxes, and to identify and implement non-destructive methods to protect fruit crops, such as: appropriate netting (not monofilament netting) that is not hung loose over trees (which can entangle bats and birds)
- Reduce negative public attitudes and conflict with humans
- Develop accurate methods for monitoring population size.

Other Mammals

The large-eared pied bat and the spotted-tail quoll have not been recorded from the study area, but are considered to have the potential to occur, as identified in Table 5-6. As these species share similar or overlapping habitat requirements, they have been discussed collectively.

Current distribution

- Large-eared pied bat – The Large-eared pied bat inhabits a range of coastal and inland habitats and is most commonly recorded from dry eucalypt forests and woodlands. It may also be found in rainforest and wet sclerophyll margins. It has been recorded from scattered localities as far south as Nowra in coastal New South Wales and on the Blackdown Tableland, west of Rockhampton. The only known recent records in Queensland are from the Border Ranges, the Main Range, Gambubal State Forest, Wivenhoe Dam, and Moogerah Dam.
- Spotted-tail quoll – There are two subspecies of the spotted-tailed Quoll: *Dasyurus maculatus gracilis* occurs in a small isolated population in north Queensland, while *Dasyurus maculatus maculatus* occurs along the remainder of the east coast (NPWS in prep.) from southeast Queensland to Tasmania.

Ecology

- Large-eared pied bat – In southeast Queensland this species has primarily been recorded from higher altitude moist tall open forest adjacent to rainforest. Little is known about the roosting requirements and foraging habits of this species but natural roosts may depend heavily on sandstone outcrops. It has been found roosting in disused caves, overhangs and disused Fairy Martin nests (Schulz, 1998). It also possibly roosts in tree hollows.
- Spotted-tail quoll – The spotted-tailed quoll utilises a variety of habitats including sclerophyll forest and woodlands, coastal heathlands and rainforests (Dickman, 1996; Edgar & Belcher, 1995). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. It is a highly mobile species and there are numerous records of overnight movements of several kilometres (Edgar & Belcher, 1995). Within its home range, this species has 'latrines' where it defecates, which are suggested to define territories (Edgar & Belcher, 1995).

Populations within the study area

There are no confirmed records of the large-eared pied bat from the study area, but this species may occur in riparian forests. There are no caves in the study area.

The spotted-tailed quoll has not been recorded from the study area, but may occasionally visit habitats in the area, particularly riparian areas, and may potentially occur in the study area.

Current threats to the species

- Large-eared pied bat – Destruction or interference of subterranean roosts is a confirmed threat, for example from flooding, mining operations or recreational caving activities. Other possible threats include clearing and isolation of foraging habitat near cliffs, caves and old mine workings for agriculture and development, impact of forestry operations and predation by feral animals.
- Spotted-tail quoll – Current pressures on the species include: loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar & Belcher, 1995; Dickman & Read, 1992.), loss of large hollow logs and other potential den sites, competition for food and

predation by foxes and cats (Edgar & Belcher, 1995; Dickman & Read, 1992), spread of epidemics, such as a parasitic protozoan, by cats to the Quolls (Edgar & Belcher, 1995; Dickman & Read, 1992). Historically (and currently) this species was extensively persecuted by humans following perceived predation on stock and poultry (Edgar & Belcher, 1995; Dickman & Read, 1992).

Existing controls and planning regimes

There are no formal strategies in place in Queensland for the large-eared pied bat and the spotted-tail quoll, however these species are protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*.

Three-toed Snake-tooth Skink

Current distribution

The Three-toed snake-tooth skink occurs in the sub-coastal ranges and lowlands between Cooloola in southeast Queensland and Grafton in north-eastern New South Wales (Greer & Cogger, 1985). Known localities in Queensland include Emuvale, Tambourine Mountain, Beechmont, Lamington National Park, Maleny, Cooloola State Forest, and Cunningham's Gap.

Ecology

This species is generally considered to be an inhabitant of closed forest (Czechura, 1974) and possibly open layered Eucalypt forest (McDonald, 1977). It is generally recorded in moist layered forest on loamy basaltic soils, but also found in closed forest overlying silica sand dunes at Cooloola. There are two published records of individuals in logged forest which had tall softwood regrowth (Cogger et al., 1993). One specimen was recorded in a three-hectare isolated stand of rainforest regrowth near Maleny (Czechura, 1974).

Within forests, this species is found in well-mulched, loose, friable rainforest soil in leaf litter, often immediately adjacent to fallen tree trunks (Ehmann, 1987; Cogger et al., 1993).

Populations within the study area affected by the proposed action

This species is not known from the study area, but may be found in vine forest communities such as those that occur in the study area.

Current threats to the species

Current threats to the species include a combination of factors, such as overgrazing by stock, clearance of habitat for agriculture and grazing, crop production, tropical fruit production, native forest logging and fragmentation of habitat, especially in lowland areas.

Existing controls and planning regimes

There is no formal Recovery Plan in place in Queensland or at the national level. The species is protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*.

Latham's Snipe

Current distribution

Latham's snipe visits Australia throughout the non-breeding season, using northern Australia as a migratory passage. The species has been recorded along the east coast of Australia from Cape York Peninsula to south-eastern South Australia. Their distribution range also extends over the tablelands in south-east Queensland and to the west of the Great Dividing Range in New South Wales.

Ecology

Latham's snipe prefers permanent and ephemeral wetlands, up to 2,000 m above sea level, typically inhabiting open, freshwater wetlands with low-lying and dense vegetation. However, they can also occur in modified artificial habitats within close proximity to human activity. This species is omnivorous, feeding on seeds, other plant material, invertebrates and occasionally molluscs.

Populations within the study area

These species have no confirmed records within the study area, but have potential to occur based on the previous records within 20 km of the study area. This species is often found along the outreaches of waterbodies, such as Lake Macdonald.

Current threats to the species

Latham's snipe is affected by habitat clearing and fragmentation, minimising breeding and foraging habitat. Historically the species has been subject to legal hunting, resulting in a loss of approximately 10,000 individuals per year.

Existing controls and planning regimes

There is currently no recovery plan available for Latham's snipe. However, the species is protected from inappropriate development (and subsequent loss) by the EPBC Act and indirectly through the *Vegetation Management Act 1999*. At the local level, there are no management plans in place to protect or manage existing populations in Maroochy, Noosa or Cooloola Shires.

5.6.3 Impacts on Listed Threatened Species Known from the Study Area

The potential impacts of the Project on threatened species listed under the EPBC Act that have previously been recorded within the study area or that have a high likelihood of occurring within the study area based on an understanding of the preferred habitats of the species, condition of habitats actually present within the study area, and the results of the field surveys and literature review, have been assessed against the significant impact criteria in the tables below.

Southern Penda

Based on the assessment provided in Table 5-8, the Project will not have an impact on southern penda. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-6: Southern penda

WILL THE PROPOSED WORKS…	SOUTHERN PENDA (VULNERABLE)
1. Lead to a long-term decrease in the size of an important population of a species?	The southern penda is associated with RE 12.3.1, gallery rainforest (notophyll vine forest), which is located within the study area, but is not in the Project area. RE 12.3.2, riverine wetland or fringing riverine wetland, is also listed as suitable habitat for the southern penda. A small amount of RE 12.3.2 will be removed during construction of the Project, however targeted searches for the southern penda did not locate any individuals within the Project or study area. There is a very low likelihood that there will be a long term decrease in the size of an important population.
2. Reduce the area of occupancy of an important population?	No individuals were found within the study area and preferential habitat will not be disturbed. Therefore, the area of occupancy for an important population of the southern penda will not be reduced.
3. Fragment an existing important population into two or more populations?	No individuals were found within the study or Project area and therefore it is unlikely that the Project will fragment an existing population into two or more populations.
4. Adversely affect habitat critical to the survival of a species?	The southern penda is associated with RE 12.3.1, which is located within the study area, but is not in the Project area. Approximately 11,000 m^2 of RE 12.3.2, which is also associated with the southern penda, will be removed during construction of the Project, however targeted searches for the southern penda did not locate any individuals within the Project or study area.

WILL THE PROPOSED WORKS…	SOUTHERN PENDA (VULNERABLE)
	As disturbance will be minimal and contained within the Project area, it is unlikely that the Project will adversely affect habitat critical to the survival of southern penda.
5. Disrupt the breeding cycle of an important population?	No southern penda individuals were found in the study area or Project area and therefore the Project is unlikely to disrupt the breeding cycle of an important population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Preferential habitat RE 12.3.1 will not be disturbed. Approximately 11,000 m^2 of preferential habitat RE 12.3.2 will be removed, however no individuals were found within the study or Project areas. Therefore, the Project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Preferential habitat RE 12.3.1 will not be disturbed or cleared, however preferential habitat RE 12.3.2 will be removed. Mitigation measures such as regular vehicle wash downs and pest management will be implemented throughout the duration of the Project. Monitoring of pest species establishment will also occur once construction has ceased. Therefore, it is unlikely that the Project will result in invasive species that are harmful to the southern penda establishing within its habitat.
8. Introduce disease that may cause the species to decline?	The Project will not result in the introduction of a disease that is likely to cause a decline in the population of the species as no individuals were recorded in the study or Project areas. There are also no diseases identified in the species listing advice (DoEE, 2008) that are key threats to this species or require priority management actions.
9. Interfere substantially with the recovery of the species?	There are currently no rehabilitation activities that occur within the study area that are likely to be impacted by the Project. As the Project is not likely to remove critical habitat for this species, it is not expected to interfere with its recovery.
Mitigation measures	The following mitigation measures are recommended: • Construction works areas utilise previously cleared and disturbed land to the greatest extent possible, thereby minimising the removal of remnant vegetation. • Areas of vegetation to be retained be clearly flagged or signed to prevent construction access. • Weed management measures be implemented throughout construction and operation of the Six Mile Creek dam. Further information on the proposed management and mitigation measures is provided in Appendix B, Appendix E and Chapter 8. Performance criteria, and monitoring and reporting provisions, for Terrestrial Flora are provided in section B.4.6 of Appendix B – Environmental Management Plan.

Giant Barred Frog

Based on the assessment provided in Table 5-9, the Project is unlikely to have a significant impact on the giant barred frog. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-7: Giant barred frog

WILL THE PROPOSED WORKS…	GIANT BARRED FROG (ENDANGERED)
1. Lead to a long-term decrease in the size of a population?	The field survey results concluded that a low density population of giant barred frog is likely to occur along the downstream section of Six Mile Creek. Monitoring by future-plus Environmental on behalf of Transport and Main Roads (2013) supports the survey findings after also determining low density populations of the species within upstream Six Mile Creek. Populations have persisted in this location despite disturbance from clearing, indicating some capacity to cope with habitat disturbance. Increased water flow and sediment transport through Six Mile Creek during the lake drawdown may create a localised and temporary impact on the population downstream of the dam. However, as the drawdown process will be gradual over a period of three months, which will allow the frogs to relocate if needed, and releases will not exceed bankfull height (i.e. within the existing flood regime), it is unlikely that the Project will lead to a long term decrease in the size of a population.
2. Reduce the area of occupancy of the species?	A temporary and localised reduction in the area of occupancy of the giant barred frog will be likely during the lake drawdown process, where water levels in Six Mile Creek may increase. This is due to the increase in downstream water flows during the drawdown process possibly inundating currently dry habitat used for foraging. However, releases are planned not to exceed the bankfull height of the waterway. It is expected that giant barred frogs will temporarily move higher up the bank to account for the changing water levels. Giant barred frogs are known to move up to 50 m from the water's edge and would have experienced flood events in Six Mile Creek previously (Streatfield, 1999).
3. Fragment an existing population into two or more populations?	An increase in water flow of Six Mile Creek downstream of the dam may result in a temporary and localised loss of habitat for this species due to higher water levels. However, as this impact is temporary, it is not expected to lead to a permanent fragmentation of populations.
4. Adversely affect habitat critical to the survival of a species?	The giant barred frog prefers slow moving streams and sandy banks. An increase in water flow and velocity through Six Mile Creek will inundate and temporarily alter the key microhabitat attributes for this species during the lake lowering process. However, this increase in water flow will be temporary (approximately three months) and intermittent, due to a controlled drawdown of the lake, and is unlikely to adversely affect habitat critical to the survival of this species.
5. Disrupt the breeding cycle of a population?	The lake drawdown process is proposed to occur outside of the giant barred frog's breeding season. It is therefore unlikely that the Project will disrupt the breeding cycle of the local population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of	It is likely that the lake drawdown process will temporarily modify, isolate or decrease the availability and quality of aquatic habitat used by the giant barred frog. However, this is unlikely to lead to a long term, permanent decline in the population as the water level of the lake and therefore the current flow regime in Six Mile Creek will be restored to pre-existing conditions after the Project is

WILL THE PROPOSED WORKS…	GIANT BARRED FROG (ENDANGERED)
habitat to the extent that the species is likely to decline?	complete. In addition, environmental flows will be maintained during the Project. Mitigation measures will be put in place to reduce the extent of impact throughout construction.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Several invasive flora and fauna species are known to or are likely to occur in Lake Macdonald and Six Mile Creek. Significant invasive species include Cabomba, mosquito fish and cane toad. With the water levels being reduced, a large volume of water will be released downstream into Six Mile Creek. During the release of water, it is highly likely that tadpoles, fish and aquatic weeds (e.g. Cabomba) will be released downstream, thereby having the potential to increase existing populations of mosquito fish, cane toad tadpoles and aquatic weeds in Six Mile Creek. These species currently exist within Six Mile Creek (downstream) in low abundance and are likely to travel downstream from the dam during periods of high flow. Therefore, the Project is not expected to result in the establishment of any new invasive species within potential habitat for giant barred frog. Mitigation measures will be implemented during the Project to manage invasive species.
8. Introduce disease that may cause the species to decline?	Chytrid fungus is a known threat to giant barred frogs. However, the Project will not result in changes that are likely to introduce or further spread this disease. If it is currently present in the vicinity of Lake Macdonald, tadpoles with the fungus would be transported downstream during flood events, which would not change during the lake lowering or construction phases of the Project. The Project is therefore unlikely to introduce any diseases that may cause the population to decline.
9. Interfere with the recovery of the species?	Due to only a localised and temporary decrease in habitat, it is unlikely that the Project will interfere with the objectives mentioned in the National recovery plan for Stream Frogs of South-east Queensland 2001-2005 (Hines, 2002). Following construction, the dam environment will be restored.
Mitigation measures	The following mitigation measures are recommended for the giant barred frog: • Reduce bank degradation, riparian vegetation loss and habitat loss by facilitating a drawdown program that mimics the natural flow regime of Six Mile Creek • Plan a drawdown program outside of breeding season (September to November) • Where possible, construction should be avoided on creek and dam banks with dense overhanging riparian vegetation to retain suitable breeding places. • Undertake a gradual drawdown of Lake Macdonald and control the release of water during drawdown and construction to minimise sudden changes in flow in Six Mile Creek. • Implement erosion control in Six Mile Creek downstream of the dam if required. • Within the site induction, site personnel should be educated on how to recognise the physical attributes of threatened fauna species protected under the EPBC Act that may occur in the Project area and their burrows to STOP, MANAGE and NOTIFY when encountered. • No bank disturbance is to be undertaken until a suitably qualified person has checked the banks for threatened fauna and fauna burrows within the Project area.

WILL THE PROPOSED WORKS…	GIANT BARRED FROG (ENDANGERED)
	• Construction should be restricted to the Project area. • Location of stockpiles should not be placed in natural drainage areas. • Designated stockpile areas should be accurately communicated to all site personnel. • Avoid disturbance of key habitat for the giant barred frog (i.e. vegetated riparian strips) by constraining Project area to that identified in Figure 5-2. • All temporarily disturbed land will be rehabilitated to achieve stable and sustainable soil cover and minimise sediment run off. • The construction site should be re-profiled to original or stable contours, re-establishing surface drainage lines and other features. To prevent slumping and erosion. • Temporary erosion control measures should be left in place until bare soil has stabilised. Stabilise exposed soils by using materials such as mulch, biodegradable matting, geotextile fabrics, and/or soil stabilisation products. • Water quality monitoring should be conducted by qualified personnel or, where automated instrumentation is used, installed, calibrated and maintained by qualified personnel. • Implement an Environmental Management Plan that addresses biosecurity. • Any plant and equipment brought onto site should comply with Biosecurity Queensland's Vehicle and Machinery Inspection Procedure. • Install cane toad traps in areas of pooling within Lake Macdonald after the drawdown of the dam has occurred to minimise increased prevalence of cane toad due to the change in lake environment. • Monitor the extent of introduced plant and fauna species weekly. • Use only the minimum amount of lighting needed for safety and, where possible, utilise lighting that does not attract insects and avoid the use of naked bulbs and use narrow spectrum bulbs. • All bright lights should be positioned as close to the ground as practical and shielded to minimise light spill towards any surrounding habitat patches. • Where possible, use motion sensor lights to only illuminate areas in use. Further information on the proposed management and mitigation measures is provided in Appendix B, Appendix E and Chapter 8. Performance criteria, and monitoring and reporting provisions, for Terrestrial Fauna are provided in section B.4.7 of Appendix B – Environmental Management Plan.

Mary River Cod

Based on the assessment provided in Table 5-10, the Project is unlikely to have a significant impact on the Mary River cod. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-8: Mary River cod

WILL THE PROPOSED WORKS…	MARY RIVER COD (ENDANGERED)
1. Lead to a long-term decrease in the size of a population?	Mary River cod is known from Six Mile Creek downstream of Lake Macdonald, and the lake has previously been stocked with this species. There will be a temporary reduction in the population of Mary River cod in Lake Macdonald due

WILL THE PROPOSED WORKS…	MARY RIVER COD (ENDANGERED)
	to the lowering of lake for the Project construction. The mitigations applied will protect water quality, habitat and flows that support this species, as well as ensure any individuals of Mary River cod are not injured or stranded in Lake Macdonald. Stocking densities at the relocation sites will be carefully managed and monitored. There will be no long-term decrease in the size of a population of Mary River cod associated with the Project. There will be no direct disturbance of Mary River cod in Six Mile Creek downstream of the dam and environmental flows from Lake Macdonald will be maintained during the Project, with daily water quality monitoring undertaken. Therefore, there will be no long-term decrease in the size of the population of Mary River cod in Six Mile Creek downstream of the dam due to the Project.
2. Reduce the area of occupancy of the species?	As the Project is replacing an existing spillway, in the long-term there will be no change from the current condition and the area of occupancy is expected to be maintained. There will be a temporary reduction in the area of occupancy in Lake Macdonald while the lake is lowered for the Project construction. A fauna salvage and relocation program that includes Mary River cod will be implemented to minimise the impacts of reduced habitat condition associated with lower water levels in the lake, thereby reducing the area of occupancy. Lake Macdonald has previously been stocked with Mary River cod and it is expected that significant numbers of this species will be relocated during the salvage operation. After the Project is complete, Lake Macdonald will be re-stocked with Mary River cod, within the scope of ongoing fish stocking programs, and it is expected that the area of occupancy will be re-established.
3. Fragment an existing population into two or more populations?	Mary River cod is known to be present in Six Mile Creek downstream of Lake Macdonald and has been stocked to Lake Macdonald. Replacement of the spillway and embankments will not change the current level of connectivity (i.e. no connectivity) between upstream and downstream populations of Mary River cod. No further fragmentation of populations will occur as a result of the Project as, with the exception of the replacement of the spillway and embankments, all works will be temporary.
4. Adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of Mary River cod occurs in Six Mile Creek downstream of Lake Macdonald. While Mary River cod has been stocked to Lake Macdonald, it is considered that the lake is not habitat critical to the survival of this species. Impacts to downstream habitat and water quality in Six Mile Creek will be mitigated using numerous measures described in the mitigation measures section of this table. It is unlikely that there will be an impact to habitat critical to the survival of Mary River cod.
5. Disrupt the breeding cycle of a population?	Mary River cod are known to breed in Six Mile Creek downstream of Lake Macdonald, but the population in Lake Macdonald is considered to be non-breeding. Impacts to downstream habitat and water quality in Six Mile Creek will be mitigated using numerous measures described in the mitigation measures section of this table, which will also function to minimise potential impacts to Mary River cod breeding in Six Mile Creek. The drawdown phase will occur outside the breeding season of Mary River cod; thus, this phase of the Project will have no influence on Mary River cod breeding in Six Mile Creek. The release of water to Six Mile Creek during the lake drawdown will be controlled and not exceed bankfull height (i.e. will be within the range of

WILL THE PROPOSED WORKS…	MARY RIVER COD (ENDANGERED)
	naturally occurring flood events). Thus, there will be no adverse effects to breeding cycles of populations of Mary River cod associated with the Project.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Mary River cod are known to breed in Six Mile Creek downstream of Lake Macdonald, but the population in Lake Macdonald is considered to be non-breeding. Impacts to downstream habitat and water quality in Six Mile Creek will be mitigated using numerous measures described in the mitigation measures section of this table, which will also function to minimise potential impacts to Mary River cod breeding in Six Mile Creek. Temporary reduction of habitat availability for stocked Mary River cod in Lake Macdonald during the drawdown and construction phases will be mitigated by salvage, relocation and restocking program, with long-term habitat quality for Mary River cod in Lake Macdonald enhanced during the construction phase. Therefore, the Project will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Mary River cod is likely to decline.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters of the study area (e.g. Cabomba, Hygrophila, tilapia) will be carefully managed using an Environmental Management Plan that addresses biosecurity. Fish passage will not be provided for the dam upgrade, which will eliminate the risk of tilapia moving upstream of the dam barrier. During the Project construction there is a risk that tilapia may move upstream if high flows result in the drowning out of the coffer dam. Proposed mitigation measures for this risk include managing outflows to reduce the potential for drown out and undertaking post drown out drawdown and salvage in Lake Macdonald to target tilapia that may have moved upstream. Therefore, it is unlikely that the Project will result in an invasive species becoming established.
8. Introduce disease that may cause the species to decline?	Aquatic fauna may become injured in pumping equipment during the drawdown phase, which could make them susceptible to pathogens and disease, or be fatally injured, trapped and subsequently drown. To prevent injury and in turn disease, mitigation measures during the drawdown phase will be implemented. Therefore, the Project is unlikely to result in the introduction of a disease that is likely to cause a decline in the population of the species.
9. Interfere with the recovery of the species?	Key recovery recommendations for Mary River cod include: community education and regulatory and administrative initiatives; limiting waterway barrier construction while ensuring that fishways are incorporated into the design of new barriers (and existing barriers where possible), prohibition of stocking of non-indigenous fish in the Mary River systems (especially other species of *Maccullochella*), environmental flow management, and hatchery and stocking programs. The Project will include a commitment to continue support of the Mary Cod hatchery at Lake Macdonald by provision of leased land and utilities. Environmental flow releases to Six Mile Creek will continue with the upgraded dam, in line with current requirements, and so the downstream population should experience no change compared with the current situation. A fishway has been determined to be non-viable at the upgraded Six Mile Creek dam, which would have increased connectivity in Six Mile Creek. Nevertheless, a fishway will be provided at Gympie Weir, which has been identified as a high priority barrier for retrofitting a fishway (Stockwell et al. 2008). A fishway at Gympie Weir improves waterway connectivity between Six Mile Creek and the

WILL THE PROPOSED WORKS…	MARY RIVER COD (ENDANGERED)
	Mary River and will lead to healthier fisheries that are likely to both directly and indirectly benefit recovery of the species. The Project therefore is consistent with the recovery actions for Mary River cod.
Mitigation measures	The following mitigation strategies are recommended for the Mary River cod: • Aquatic habitat within Lake Macdonald will be augmented (i.e. physical habitat structures added; aquatic weeds controlled) during the construction phase to increase the long-term aquatic habitat values of Lake Macdonald from current condition. • Drawdown will use equipment that minimises lake bed disturbance and downstream transfer of unconsolidated bed sediments. • Seeding of the exposed Lake Macdonald bed following initial drawdown with non-invasive grasses to stabilise exposed sediments. • If practical, use physical barriers (e.g. staggered baffles) at key upstream locations to slow flow and reduce erosion in the upper reaches of the lake. • Implementation of an Erosion and Sediment Control Plan (ESCP) in accordance with applicable industry standards, including Healthy Land and Water's Erosion and Sediment Control toolkit. • Avoid drawdown during the Mary River cod breeding season (spring/summer). • Maximum pumping / discharge rate of 10 m^3/s will not exceed the bank full width of Six Mile Creek downstream of the lake. • Releases will be over a ten-week period to avoid a major pulse flow over a shorter duration. • Channelise flows past the construction zone to maintain the natural inflow / outflow regime during the construction period • Using screens of suitable design to prevent aquatic fauna from being entrained and injured or trapped by pumping equipment • Provide supplemental flows to Six Mile Creek if necessary for environmental flow requirements using water piped from the Mary River to the water treatment plant (existing raw water supply). • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and their burrows to STOP, MANAGE and NOTIFY when encountered • Construction should be restricted to the Project footprint. • Implement an Environmental Management Plan that addresses biosecurity. Further information on the proposed management and mitigation measures is provided in: • Appendix B (Environmental Management Plan) • Appendix C (Lake Macdonald Water Lowering – Adaptive Management Plan) • Appendix E (Species Management Plan) • Appendix G (Aquatic Ecology Technical Report). Performance criteria, and monitoring and reporting provisions, for Aquatic Ecology are provided in section B.4.5 of Appendix B.

Australian Lungfish

Based on the assessment provided in Table 5-11, the Project is unlikely to have a significant impact on the Australian lungfish. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-9: Australian lungfish

WILL THE PROPOSED WORKS…	AUSTRALIAN LUNGFISH (VULNERABLE)
1. Lead to a long-term decrease in the size of an important population of a species?	Australian lungfish are known to occur in low numbers in Six Mile Creek, with breeding by the species in Six Mile Creek likely to be infrequent and not critical to the species' long-term survival. Few Australian lungfish are expected to occur in Lake Macdonald, and the species does not breed in Lake Macdonald. Thus, there is not an important population of Australian lungfish in Six Mile Creek or Lake Macdonald. However, the mitigations applied will protect water quality, habitat and flows that support this species, as well as ensure any individuals of this species are not injured or stranded should any be present in Lake Macdonald. There will be no long-term decrease in the size of an important population of Australian lungfish associated with the Project.
2. Reduce the area of occupancy of an important population?	The area of Lake Macdonald will be temporarily reduced during the drawdown and construction phases of the Project, with a fauna salvage and relocation operation implemented during these phases of the Project. It is expected that very few Australian lungfish occur in Lake Macdonald, and thus the temporary reduction in lake area will not be a significant impact on the species. However, any lungfish in Lake Macdonald will be salvaged during the drawdown and construction phases and returned to Lake Macdonald during the refill and operate phase, ensuring that the area of occupancy of this species after completion of construction is the same as current area of occupancy.
3. Fragment an existing important population into two or more populations?	Australian lungfish are known to occur in low numbers in Six Mile Creek, and may also occur in low numbers in Lake Macdonald. Replacement of the spillway will not change the current level of connectivity (i.e. no connectivity) between upstream and downstream populations of Australian lungfish.
4. Adversely affect habitat critical to the survival of a species?	There is no habitat critical to the survival of Australian lungfish in Six Mile Creek or Lake Macdonald. Impacts to downstream habitat and water quality in Six Mile Creek will be mitigated using numerous measures described in the mitigation measures section of this table. There will be no impact to habitat critical to the survival of Australian lungfish.
5. Disrupt the breeding cycle of an important population?	Australian lungfish are known to occur in low numbers in Six Mile Creek, with breeding by the species in Six Mile Creek likely to be infrequent. Impacts to downstream habitat and water quality in Six Mile Creek will be mitigated using numerous measures described in the mitigation measures section of this table, which will also function to minimise potential impacts to Australian lungfish breeding in Six Mile Creek. The drawdown phase will occur outside the breeding season of Australian lungfish; thus, this phase of the Project will have no influence on any Australian lungfish breeding in Six Mile Creek.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Australian lungfish are known to occur in low numbers in Six Mile Creek, and may also occur in low numbers in Lake Macdonald. While neither Six Mile Creek or Lake Macdonald is habitat that is critical to the survival of Australian lungfish, the mitigations applied will protect water quality, habitat and flows that support

WILL THE PROPOSED WORKS…	AUSTRALIAN LUNGFISH (VULNERABLE)
	this species. There will be no adverse effects to the quality of habitat for Australian lungfish associated with the Project.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters of the study area (e.g. Cabomba, Hygrophila, tilapia) will be carefully managed using a Biosecurity Management Plan. The Biosecurity Management Plan will also ensure that new biosecurity matters will not become established in the study area.
8. Introduce disease that may cause the species to decline?	Aquatic fauna may become injured in pumping equipment during the drawdown phase, which could make them susceptible to pathogens and disease, or be fatally injured, trapped and subsequently drown. To prevent injury and in turn disease, mitigation measures during the drawdown phase will be implemented. Therefore, the Project is unlikely to result in the introduction of a disease that is likely to cause a decline in the population of the species.
9. Interfere substantially with the recovery of the species?	There is a draft National Recovery Plan for the Australian Lungfish. The draft recovery actions can be summarised as follows: • Reduce the impacts of, and remove any redundant, artificial barriers • Manage waterways to optimise breeding and recruitment opportunities • Limit habitat degradation and maintain or enhance water quality • Reduce the impacts of introduced pest and weed species • Manage the impacts of water-based recreational activities • Address key knowledge gaps to improve Australian lungfish management • Facilitate high levels of community participation and support in the implementation of Australian lungfish management strategies The mitigations mentioned within the mitigation measures section of this table are consistent with the draft recovery plan objectives; thus, the Project will not interfere with the recovery of the species.
Mitigation measures	The following mitigation measures have been recommended for the Australian lungfish: • Aquatic habitat within Lake Macdonald will be augmented (i.e. physical habitat structures added; aquatic weeds controlled) during the construction phase to increase the long-term aquatic habitat values of Lake Macdonald from current condition. • Drawdown will use equipment that minimises disturbance and downstream transfer of unconsolidated bed sediments • Seeding of the exposed Lake Macdonald bed following initial drawdown with non-invasive grasses to stabilise exposed sediments • If practical, use physical barriers (e.g. staggered baffles) at key upstream locations to slow flow and reduce erosion in the upper reaches of the lake • Implementation of an Erosion and Sediment Control Plan (ESCP) in accordance with applicable industry standards, including Healthy Land and Water's Erosion and Sediment Control toolkit. • Avoid drawdown during the Australian lungfish breeding season (spring/summer). Maximum pumping / discharge rate of 10 m^3/s will not exceed the bank full width of Six Mile Creek downstream of the lake • Releases will be over a twelve-week period to avoid a major pulse flow over a shorter duration • Channelise flows past the construction zone to maintain the natural inflow / outflow regime during the construction period

WILL THE PROPOSED WORKS…	AUSTRALIAN LUNGFISH (VULNERABLE)
	• Using screens of suitable design to prevent aquatic fauna from being entrained and injured or trapped by pumping equipment • Provide supplemental flows to Six Mile Creek if necessary for environmental flow requirements using water piped from the Mary River to the water treatment plant (existing raw water supply). • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and their burrows to STOP, MANAGE and NOTIFY when encountered • Construction should be restricted to the Project footprint. • Implement an Environmental Management Plan that addresses biosecurity. Further information on the proposed management and mitigation measures is provided in: • Appendix B (Environmental Management Plan) • Appendix C (Lake Macdonald Water Lowering – Adaptive Management Plan) • Appendix E (Species Management Plan) • Appendix G (Aquatic Ecology Technical Report). Performance criteria, and monitoring and reporting provisions, for Aquatic Ecology are provided in section B.4.5 of Appendix B.

Mary River Turtle

Based on the assessment provided in Table 5-12, the Project will not have a significant impact on the Mary River turtle. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-10: Mary River Turtle

WILL THE PROPOSED WORKS…	MARY RIVER TURTLE (ENDANGERED)
1. Lead to a long-term decrease in the size of a population?	Mary River turtle is not expected to occur in Six Mile Creek; thus it is unlikely that any population of this species will be in or near the Project area. However, the mitigations applied will protect water quality, habitat and flows that support these species, as well as ensure any individuals of this species are not injured or stranded should any be present in Lake Macdonald. There will be no long-term decrease in the size of a population of Mary River turtle associated with the Project.
2. Reduce the area of occupancy of the species?	The area of occupancy of Mary River turtle is unlikely to be influenced by the Project, because these species are not expected to occur in Six Mile Creek. The area of Lake Macdonald will be temporarily reduced during the drawdown and construction phases of the Project, with a fauna salvage and relocation operation implemented during these phases of the Project. Should any Mary River turtle be caught and relocated during the salvage operation, they will be returned to Lake Macdonald during the refill and operate phase, ensuring that the area of occupancy of these species after completion of construction is the same as current area of occupancy.
3. Fragment an existing population into two or more populations?	Mary River turtle is not known from Six Mile Creek; thus it is unlikely that any population of this species will be in or near the Project area. It is unlikely that the Project will result in fragmentation of populations of this species.

WILL THE PROPOSED WORKS…	MARY RIVER TURTLE (ENDANGERED)
4. Adversely affect habitat critical to the survival of a species?	The mitigations applied will protect water quality, habitat and flows that support this species. There will be no adverse effects to habitat critical to the survival of Mary River turtle associated with the Project.
5. Disrupt the breeding cycle of a population?	There will be no adverse effects to breeding cycles of populations of Mary River turtle associated with the Project as this species is not known from Six Mile Creek.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Mary River turtle is not known from Six Mile Creek; thus it is unlikely that any population of this species will be in or near the Project area. However, the mitigations applied will protect water quality, habitat and flows that support this species. There will be no adverse effects to the quality of habitat for Mary River turtle associated with the Project.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters of the study area (e.g. Cabomba, Hygrophila, tilapia) will be carefully managed using a Biosecurity Management Plan. The Biosecurity Management Plan will also ensure that new biosecurity matters will not become established in the study area.
8. Introduce disease that may cause the species to decline?	Aquatic fauna may become injured in pumping equipment during the drawdown phase, which could make them susceptible to pathogens and disease, or be fatally injured, trapped and subsequently drown. To prevent injury and in turn disease, mitigation measures during the drawdown phase will be implemented. Therefore, the Project is unlikely to result in the introduction of a disease that is likely to cause a decline in the population of the species.
9. Interfere with the recovery of the species?	There is no recovery plan currently available for Mary River turtle, although the conservation advice statement for the species indicates threats to Mary River turtle are: predation and trampling of nests and hatchlings and lack of recruitment; unfavourable water releases from dams, clearing for agriculture, and impacts to habitat from pollution and invasive weeds. Although recovery actions have not currently been developed for Mary River turtle, the Project will not contribute any of the key threats known for the species. Furthermore, as populations and nesting sites for Mary River turtle are not known from Six Mile Creek, the Project will not interfere with the recovery of this species.
Mitigation measures	The following mitigation measures have been recommended for the Mary River turtle: • Aquatic habitat within Lake Macdonald will be augmented (i.e. physical habitat structures added; aquatic weeds controlled) during the construction phase to increase the long-term aquatic habitat values of Lake Macdonald from current condition. • Drawdown will use equipment that minimises disturbance and downstream transfer of unconsolidated bed sediments. • Seeding of the exposed Lake Macdonald bed following initial drawdown with non-invasive grasses to stabilise exposed sediments. • If practical, use physical barriers (e.g. staggered baffles) at key upstream locations to slow flow and reduce erosion in the upper reaches of the lake. • Implementation of an Erosion and Sediment Control Plan (ESCP) in accordance with applicable industry standards, including Healthy Land and Water's Erosion and Sediment Control toolkit. • Avoid drawdown during the Mary River turtle breeding season (spring/summer), where possible.

WILL THE PROPOSED WORKS…	MARY RIVER TURTLE (ENDANGERED)
	• Maximum pumping / discharge rate of 10 m^3/s will not exceed the bank full width of Six Mile Creek downstream of the lake. • Releases will be over a twelve-week period to avoid a major pulse flow over a shorter duration. • Channelise flows past the construction zone to maintain the natural inflow / outflow regime during the construction period. • Provide supplemental flows to Six Mile Creek if necessary for environmental flow requirements using water piped from the Mary River to the water treatment plant (existing raw water supply). • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and their burrows to STOP, MANAGE and NOTIFY when encountered. • Construction should be restricted to the Project footprint. • Implement an Environmental Management Plan that addresses biosecurity. • Avoid any unplanned disturbance of any sandy banks for the Project until a suitably qualified person has confirmed turtle nests are not present. • Implement slow speed limits of 10 km per hour within the Project area to allow for animals to move out of the way and for drivers to have the ability to safely stop if an animal is identified within the vehicle path. • Using screens of suitable design to prevent aquatic fauna from being entrained and injured or trapped by pumping equipment. • Installing temporary fencing, similar to coarse sediment barriers, between Lake Macdonald and roads to prevent turtles dispersing over roads, coupled with daily surveillance and salvage of turtles along the fencing during the drawdown phase, and weekly during the construction phase. Further information on the proposed management and mitigation measures is provided in: • Appendix B (Environmental Management Plan) • Appendix C (Lake Macdonald Water Lowering – Adaptive Management Plan) • Appendix E (Species Management Plan) • Appendix G (Aquatic Ecology Technical Report). Performance criteria, and monitoring and reporting provisions, for Aquatic Ecology are provided in section B.4.5 of Appendix B.

White-throated Snapping Turtle

Based on the assessment provided in Table 5-13, the Project is will not have a significant impact on the white-throated snapping turtle. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-11: White-throated snapping turtle

WILL THE PROPOSED WORKS…	WHITE-THROATED SNAPPING TURTLE (CRITICALLY ENDANGERED)
1. Lead to a long-term decrease in the size of a population?	White-throated snapping turtle is not expected to occur in Six Mile Creek; thus it is unlikely that any population of these species will be in or near the Project area. However, the mitigations applied will protect water quality, habitat and flows that support these species, as well as ensure any individuals of these species are not injured or stranded should any be present in Lake Macdonald.

WILL THE PROPOSED WORKS…	WHITE-THROATED SNAPPING TURTLE (CRITICALLY ENDANGERED)
	There will be no long-term decrease in the size of a population of the white-throated snapping turtle associated with the Project.
2. Reduce the area of occupancy of the species?	The area of occupancy of the white-throated snapping turtle is unlikely to be influenced by the Project, because this species is not expected to occur in Six Mile Creek. The area of Lake Macdonald will be temporarily reduced during the drawdown and construction phases of the Project, with a fauna salvage and relocation operation implemented during these phases of the Project. Should any white-throated snapping turtle be caught and relocated during the salvage operation, they will be returned to Lake Macdonald during the refill and operate phase, ensuring that the area of occupancy of this species after completion of construction is the same as current area of occupancy.
3. Fragment an existing population into two or more populations?	The Project is replacing an existing spillway; thus, the long-term impact will be no change from current condition. The white-throated snapping turtle is not known from Six Mile Creek; thus it is unlikely that any population of this species will be in or near the Project Area. It is unlikely that the Project will result in fragmentation of populations of this species.
4. Adversely affect habitat critical to the survival of a species?	The mitigations applied will protect water quality, habitat and flows that support this species. There will be no adverse effects to habitat critical to the survival of the white-throated snapping turtle associated with the Project.
5. Disrupt the breeding cycle of a population?	The white-throated snapping turtle is not expected to occur in Six Mile Creek; and breeding habitat for this species in not known from Six Mile Creek or Lake Macdonald. The Project will not adversely impact breeding by the white-throated snapping turtle.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The white-throated snapping turtle is not expected to occur in Six Mile Creek; and suitable habitat for this species in not known from Six Mile Creek or Lake Macdonald. The Project will not modify, destroy, remove, isolate or decrease the availability or quality of habitat of this species.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters of the study area (e.g. Cabomba, Hygrophila, tilapia) will be carefully managed using a Biosecurity Management Plan. The Biosecurity Management Plan will also ensure that new biosecurity matters will not become established in the study area.
8. Introduce disease that may cause the species to decline?	Aquatic fauna may become injured in pumping equipment during the drawdown phase, which could make them susceptible to pathogens and disease, or be fatally injured, trapped and subsequently drown. To prevent injury and in turn disease, mitigation measures during the drawdown phase will be implemented. Therefore, the Project is unlikely to result in the introduction of a disease that is likely to cause a decline in the population of the species.
9. Interfere with the recovery of the species?	Key recovery actions for white-throated snapping turtle include: controlling predators and cattle access to nesting sites to prevent trampling and predation of nests and hatchlings to improve recruitment; managing water releases to avoid inundation of nesting banks during the incubation period while providing adequate environmental flows of good quality water to provide base flows, refugial habitat and geomorphological process to sustain nesting banks; and ensuring that dam and spillway designs minimise injury and mortality of turtles over spillways. As populations and nesting sites for white-throated snapping turtle are not known from Six Mile Creek, the Project will not interfere with

WILL THE PROPOSED WORKS…	WHITE-THROATED SNAPPING TURTLE (CRITICALLY ENDANGERED)
	recovery actions relating to recruitment, waterway barriers and environmental flows. The final design of the labyrinth spillway will have low fall heights, sufficiently deep plunge pools and adopt the recommendations of Berghuis (2017); thus, the design of the new dam will be consistent with the recovery plan for white-throated snapping turtle.
Mitigation measures	The following mitigation measures are recommended for the white-throated snapping turtle: • Aquatic habitat within Lake Macdonald will be augmented (i.e. physical habitat structures added; aquatic weeds controlled) during the construction phase to increase the long-term aquatic habitat values of Lake Macdonald from current condition. • Drawdown will use equipment that minimises disturbance and downstream transfer of unconsolidated bed sediments. • Seeding of the exposed Lake Macdonald bed following initial drawdown with non-invasive grasses to stabilise exposed sediments. • If practical, use physical barriers (e.g. staggered baffles) at key upstream locations to slow flow and reduce erosion in the upper reaches of the lake. • Implementation of an Erosion and Sediment Control Plan (ESCP) in accordance with applicable industry standards, including Healthy Land and Water's Erosion and Sediment Control toolkit. • Avoid drawdown during the white-throated snapping turtle breeding season (autumn/winter), where possible. • Maximum pumping / discharge rate of 10 m^3/s will not exceed the bank full width of Six Mile Creek downstream of the lake. • Releases will be over a twelve-week period to avoid a major pulse flow over a shorter duration. • Channelise flows past the construction zone to maintain the natural inflow / outflow regime during the construction period. • Provide supplemental flows to Six Mile Creek if necessary for environmental flow requirements using water piped from the Mary River to the water treatment plant (existing raw water supply). • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and their burrows to STOP, MANAGE and NOTIFY when encountered. • Construction should be restricted to the Project footprint. • Implement an Environmental Management Plan that addresses biosecurity. • Avoid any unplanned disturbance of any sandy banks for the Project until a suitably qualified person has confirmed turtle nests are not present. • Implement slow speed limits of 10 km per hour within the Project area to allow for animals to move out of the way and for drivers to have the ability to safely stop if an animal is identified within the vehicle path. • Using screens of suitable design to prevent aquatic fauna from being entrained and injured or trapped by pumping equipment. • Installing temporary fencing, similar to coarse sediment barriers, between Lake Macdonald and roads to prevent turtles dispersing over roads, coupled with daily surveillance and salvage of turtles along the fencing during the drawdown phase, and weekly during the construction phase.

WILL THE PROPOSED WORKS…	WHITE-THROATED SNAPPING TURTLE (CRITICALLY ENDANGERED)
	Further information on the proposed management and mitigation measures is provided in: • Appendix B (Environmental Management Plan) • Appendix C (Lake Macdonald Water Lowering – Adaptive Management Plan) • Appendix E (Species Management Plan) • Appendix G (Aquatic Ecology Technical Report). Performance criteria, and monitoring and reporting provisions, for Aquatic Ecology are provided in section B.4.5 of Appendix B.

5.6.4 Impacts on Listed Threatened Species that May Occur in the Study Area

With the exception of the koala and grey headed flying fox, potential impacts to species that may occur (i.e. moderate likelihood of occurrence) have been assessed against the significant impact criteria in Table 5-18 to Table 5-21, respectively.

Koala and the grey headed flying fox have been discussed separately due to the presence of appropriate foraging habitat and also a history of anecdotal information on the intermittent occurrence of the species within the study area.

Koala

Based on the assessment provided in Table 5-15, the Project will not have an impact on the koala. Mitigation measures that will be implemented for the Project are also identified in this table.

Table 5-12: Koala

WILL THE PROPOSED WORKS…	KOALA (VULNERABLE)
1. Lead to a long-term decrease in the size of an important population of a species?	Despite targeted searches, the field survey did not identify any evidence of the koala within the study area. Vegetation communities identified provide suitable foraging habitat for the species, including within the proposed Project construction footprint. The remnant vegetation communities identified are eucalypt dominated, comprising secondary trees for koala. There is potential for the koala to occur in low densities in the Project area, but this is unlikely to constitute an important population of this species. The mitigation measures identified within the EMP will minimise the risk of any koalas being injured during the Project. Consequently, there will be no long-term decrease in an important koala population due to the Project.
2. Reduce the area of occupancy of an important population?	Vegetation communities containing secondary koala trees will be directly impacted by the Project. However, no evidence of koalas or scats was detected within the study area or Project area during field survey. If a koala population is present within the area, it is likely to be at a low density and not an important population. The proposed clearing for the Project occupies a very small percentage of the total mapped area of remnant vegetation communities across Tewantin National Park. Following clearing of vegetation for the Project, a substantial area of similar vegetation will remain immediately adjacent to the Project area. Therefore, the Project is not expected to reduce the area of occupancy of an important population.

WILL THE PROPOSED WORKS…	KOALA (VULNERABLE)
3. Fragment an existing important population into two or more populations?	Vegetation that provides suitable habitat for koala will be directly impacted for construction. However, no koalas were identified within the Project or study area during field surveys. If a koala population is present within the area, it is likely to be at a low density. Clearing will be undertaken in areas connected to previously disturbed areas, extending the existing area of disturbance, but not creating any additional patches or fragmenting any habitat areas. Therefore, the Project is unlikely to fragment an existing important population.
4. Adversely affect habitat critical to the survival of a species?	Clearing of RE vegetation within the Project area is likely to comprise 1.45 hectares, with previously cleared and disturbed land utilised to the greatest extent possible. A koala habitat assessment has been completed in accordance with the EPBC Act referral guidelines for the vulnerable koala. The koala habitat assessment tool concluded that the Project area contains koala habitat with a value of 5. Projects that score 5 or more contain habitat critical to the survival of the koala (refer to Table 5-16). While the koala habitat assessment tool indicates that the Project area includes habitat critical to koala survival, the area to be cleared borders an already highly modified environment and no evidence of koalas was found during the field survey. As such, it is considered that the Project is unlikely to adversely affect habitat critical to the survival of koalas.
5. Disrupt the breeding cycle of an important population?	Vegetation of importance will be directly impacted for construction. However, no koala individuals were identified within the study area or Project area during field surveys. If a koala population is present, it is likely to be at a low density, and not an important population. Clearing will be undertaken over a relatively short duration, and construction activities will be managed to control dust, light and noise impacts, thereby reducing the impacts to adjacent fauna and habitats. Given the lack of koala observations during the field survey and scale of vegetation clearing for the Project, it is considered possible to mitigate any potential impacts to the breeding cycle of any local koalas. It is therefore unlikely that the Project will disrupt the breeding cycle of an important population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Clearing within the Project area is likely to only total 1.45 hectares, with previously cleared and disturbed land utilised as much as possible. The proposed clearing area occupies a very small percentage of the total mapped area of remnant vegetation communities in the vicinity of the Project, including Tewantin National Park. Following clearing of vegetation for the Project, a substantial area of similar vegetation will remain immediately adjacent to the Project area. Therefore, it is unlikely that vegetation clearing will lead to a species decline.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters in the study area, such as lantana, will be carefully managed through implementation of an Environmental Management Plan that addresses biosecurity. The plan will also ensure that new biosecurity matters will not become established in the study area.
8. Introduce disease that may cause the species to decline?	Recent studies by Polkinghorne (2012) suggest that in south east Queensland, approximately 50% of koalas are infected with chlamydia, which is a known threat to the koala population. The Project only involves clearing around the edges of a highly modified environment and is not introducing new corridors for

WILL THE PROPOSED WORKS…	KOALA (VULNERABLE)
	koala movement. Therefore, it is unlikely that the Project will introduce disease that may cause the species to decline.
9. Interfere substantially with the recovery of the species?	The mitigation measures contained within the Environmental Management Plan and Species Management Plan will protect koala habitat where possible and prevent injury of the species. The Project will not interfere with the recovery of the koala.
Mitigation measures	The following mitigation measures are recommended for the koala: • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and to STOP, MANAGE and NOTIFY when encountered. • Construction should be restricted to the Project area. • Implement Environmental Management Plan. • A pre-clearing survey must be conducted by a suitably qualified person to identify possible species protected under the EPBC Act. If koalas are present they should be allowed to move on of their own accord before clearing. • A fauna spotter-catcher must be present during all clearing activities. • Implement speed limits of 10 km per hour in the Project area during construction to allow animals to move out of the way and drivers to have the ability to safely stop if an animal is identified within the vehicle path. • Where possible, it is recommended that koala trees be selected based on koala habitat suitability and retained throughout the construction process. For example, selecting trees to clear that are not non-juvenile koala habitat trees. Further information on the proposed management and mitigation measures is provided in Appendix B, Appendix E and Chapter 8. Performance criteria, and monitoring and reporting provisions, for Terrestrial Fauna are provided in section B.4.7 of Appendix B – Environmental Management Plan.

Table 5-13: Koala Habitat Assessment Tool

ATTRIBUTE	SCORE	COASTAL
Koala occurrence	0 (low)	There is no evidence of one or more koalas within 2 km of the edge of the impact area within the last 5 years according to the Atlas of Living Australia and Species Profile Search.
Vegetation composition	+2 (high)	Has forest or woodland with 2 or more known koala food tree species. Mature *Eucalyptus grandis and Lophostemon confertus* have been identified within the direct clearing footprint.
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape of equal to or more than 500 ha. The Project Area shares a border with Tewantin National Park which covers approximately 1,300 ha.
Key existing threats	+1 (medium)	Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present. Koala occurrence within the Project area scored a 0, and due to the semi suburban locality of the area, it is likely that the existing koala population has some degree of dog or vehicle threat present.
Recovery value	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives. Clearing within the Project Area is likely to be limited to approximately 1.45 ha. Due to the lack of koala occurrence within the Project Area and the large surrounding habitat of similar ecological value, it is unlikely that the Project will impact interim recovery objectives.

Grey-headed Flying Fox

Based on the assessment provided in Table 5-17, the Project is unlikely to have an impact on the grey-headed flying fox. Mitigation measures are also identified in this table.

Table 5-14: Grey-headed flying-fox

WILL THE PROPOSED WORKS…	GREY-HEADED FLYING-FOX (VULNERABLE)
1. Lead to a long-term decrease in the size of an important population of a species?	The field survey did not identify any evidence of the grey-headed flying-fox within the study area or Project area, despite four nights of spotlighting surveys. The nearest identified flying fox camp is within Noosaville, approximately 12 km from the study area. Vegetation communities present provide suitable foraging habitat for the species, including within the proposed Project clearing footprint. The vegetation communities identified are eucalypt dominated, containing winter-flowering species that are an important food source for flying-foxes. There is therefore potential for this species to occur intermittently, though they are highly mobile and often travel 50 km in a single night in search of food (Cohen, 2018). The mitigation measures proposed will ensure any grey-headed flying-fox individuals are not injured. If a grey-headed flying-fox population is present within the area, it is likely to only occur intermittently.

WILL THE PROPOSED WORKS…	GREY-HEADED FLYING-FOX (VULNERABLE)
	There will be no long-term decrease in the size of an important population of the grey-headed flying-fox associated with the Project as the areas of vegetation to be cleared has not been identified as a flying fox roosting site.
2. Reduce the area of occupancy of an important population?	Vegetation of importance to the grey-headed flying fox will be directly impacted for construction of the Project. However, no grey-headed flying-fox individuals were identified within the Project area during field surveys. If a grey-headed flying-fox population is present within the area, it is likely to only occur intermittently. Therefore, the Project will not reduce the area of occupancy of an important population.
3. Fragment an existing important population into two or more populations?	Vegetation of importance to the grey-headed flying fox will be directly impacted for construction. However, no grey-headed flying-fox individuals were identified within the study or Project areas during field surveys. If a grey-headed flying-fox population is present, it is likely to only occur intermittently. Therefore, the Project will not fragment an existing important population.
4. Adversely affect habitat critical to the survival of a species?	Clearing within the Project area is likely to only total 1.45 hectares, with previously cleared and disturbed land utilised as much as possible. It is therefore unlikely that the Project will adversely affect habitat critical to the survival of a species.
5. Disrupt the breeding cycle of an important population?	No grey-headed flying-fox roosting sites were identified within the Project Area. Therefore, it is unlikely that the Project will disrupt the breeding cycle of an important population.
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Clearing within the Project area is likely to only total 1.45 hectares, with previously cleared and disturbed land utilised as much as possible. It is therefore unlikely that vegetation clearing will lead to a species decline.
7. Result in invasive species that are harmful to a species becoming established in the species' habitat?	Known biosecurity matters in the Project area (e.g. lantana) will be carefully managed using an Environmental Management Plan that addresses biosecurity. The plan will also ensure that new biosecurity matters will not become established in the Project area.
8. Introduce disease that may cause the species to decline?	The effects of pathogens such as the Australian bat Lyssavirus, on the grey-headed flying-fox are unknown. However, the incidence of the disease within this species populations are suggested to be low (University of Sydney, 2002). As grey-headed flying-foxes are highly mobile, it is unlikely that the Project will introduce new disease or pathogens to the species which they have not already been exposed to.
9. Interfere substantially with the recovery of the species?	The proposed mitigation measures will protect habitat where possible and prevent injury of the species. The Project will not interfere with the recovery of the grey-headed flying-fox.
Mitigation measures	The following mitigation measures have been recommended for the grey-headed flying-fox: • Within the site induction, site personnel should be educated on how to recognise the physical attributes of species protected under the EPBC Act and to STOP, MANAGE and NOTIFY when encountered.

WILL THE PROPOSED WORKS…	GREY-HEADED FLYING-FOX (VULNERABLE)
	• Construction should be restricted to the Project footprint. • Implement the Environmental Management Plan including mitigation measures to address dust, noise and light disturbance. • A pre-clearing survey is to be conducted by a suitably qualified person to identify the presence of species protected under the EPBC Act. • Ensure a fauna spotter-catcher is present during all clearing activities. • Limit night works, conducting works during daytime hours (6:30am to 6:30pm Monday to Saturday) where possible. Further information on the proposed management and mitigation measures is provided in Appendix B, Appendix E and Chapter 8. Performance criteria, and monitoring and reporting provisions, for Terrestrial Fauna are provided in section B.4.7 of Appendix B – Environmental Management Plan.

Table 5-15: Impact assessment of threatened flora that may occur in the study area

SPECIES (VULNERABLE)	IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY OF AN IMPORTANT POPULATION	IMPACTS OF FRAGMENTATION OF AN IMPORTANT POPULATION	IMPACTS ON THE ECOLOGY AND HABITAT OF AN IMPORTANT POPULATION	INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE	MITIGATION STRATEGIES*	LIKELIHOOD OF SPECIES DECLINE
• Hairy jointgrass • Yellow satinheart • Leafless tongue orchid • Macadamia nut • *Prostanthera spathulata* • *Quassia*	No populations of these plants are known from the Project area.	No populations of these plants are known from the Project area. Clearing within the Project area is likely to only total 1.45 hectares, with previously cleared and disturbed land utilised as much as possible. Therefore, it is unlikely that the Project will fragment an important population.	No populations of these plants are known from the Project area. Clearing within the Project area is likely to only total 1.45 hectares, with previously cleared and disturbed land utilised as much as possible. Therefore, it is unlikely that the Project will impact the ecology and habitat of an important population.	Known biosecurity matters of the Project area (e.g. lantana) will be carefully managed using an Environmental Management Plan that addresses biosecurity. The plan will also ensure that new biosecurity matters will not become established in the Project area.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised.	Decline of these species as a result of the Project is considered very unlikely as no individuals were identified within the Project or study area.
SPECIES (ENDANGERED)	**IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY**	**IMPACTS OF FRAGMENTATION OF A POPULATION**	**IMPACTS ON THE ECOLOGY AND HABITAT OF A POPULATION**	**INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE**	**MITIGATION STRATEGIES**	**LIKELIHOOD OF SPECIES DECLINE**
• Lesser swamp orchid • Glossy spice bush	No populations of these plants are known from the Project Area.	No populations of these plants are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will fragment a population.	No populations of these plants are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact the ecology and habitat of a population.	Known biosecurity matters of the Project Area (e.g. lantana) will be carefully managed using a Biosecurity Management Plan. The Biosecurity Management Plan will also ensure that new biosecurity matters will not become established in the Project Area.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised.	Decline of these species as a result of the Project is considered very unlikely as no individuals were identified within the Project or study area.

Table 5-16: Impact assessment of threatened birds that may occur in the study area

SPECIES (VULNERABLE)	IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY OF AN IMPORTANT POPULATION	IMPACTS OF FRAGMENTATION OF AN IMPORTANT POPULATION	IMPACTS ON THE ECOLOGY AND HABITAT OF AN IMPORTANT POPULATION	INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE	MITIGATION STRATEGIES	LIKELIHOOD OF SPECIES DECLINE
• Red goshawk	No populations of this species are known from the Project Area.	No populations of this species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of a population are expected as no individuals were identified within the study area.	It is likely that feral cats and foxes are already present within the study area, which may pose a threat to this species. The Project will not introduce any feral animals to the study area. An Environmental Management Plan that addresses biosecurity will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised.	Decline of this species as a result of the Project is considered very unlikely as clearing of vegetation will be minimal and localised and the red goshawk is a highly mobile species.
• Latham's snipe	No populations of this species are known from the Project Area.	No populations of this species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of this population are expected as no individuals were recorded within the study area.	It is likely that feral cats and foxes are already present within the Project Area which may pose a threat to this species. The Project will not introduce any feral animals to the study area. A Biosecurity Management Plan will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised. A fauna spotter/catcher will be present during any clearing events.	Decline of this species as a result of the Project is considered very unlikely as no individuals were identified within the Project area and clearing of vegetation will be minimal and localised.

SPECIES (CRITICALLY ENDANGERED/ ENDANGERED)	IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY	IMPACTS OF FRAGMENTATION OF A POPULATION	IMPACTS ON THE ECOLOGY AND HABITAT OF A POPULATION	INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE	MITIGATION STRATEGIES	LIKELIHOOD OF SPECIES DECLINE
• Regent honeyeater • Australasian bittern • Curlew sandpiper • Coxen's fig-parrot • Swift parrot • Australian painted snipe	No populations of these species are known from the Project Area.	No populations of these species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of a population are expected as no individuals were identified within the study area.	It is likely that feral cats and foxes are already present within the study area which may pose a threat to these species. The Project will not introduce any feral animals to the study area. A Biosecurity Management Plan will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised.	Decline of these species as a result of the Project is considered very unlikely as clearing of vegetation will be minimal and localised and the these are highly mobile species.

* Refer to Appendix B, Appendix E and Chapter 8 for further information on management and mitigation measures, performance criteria (section B.4.6), and monitoring and reporting provisions.

Table 5-17: Table Impact assessment of threatened mammals that may occur in the study area

SPECIES (VULNERABLE)	IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY OF AN IMPORTANT POPULATION	IMPACTS OF FRAGMENTATION OF AN IMPORTANT POPULATION	IMPACTS ON THE ECOLOGY AND HABITAT OF AN IMPORTANT POPULATION	INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE	MITIGATION STRATEGIES*	LIKELIHOOD OF SPECIES DECLINE
• Large-eared pied bat	No populations of this species are known from the Project Area. The Project will remove patches of eucalyptus forests which may provide foraging habitat for this species on a seasonal basis.	No populations of this species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of this population are expected as no individuals were identified within the study area.	It is highly likely that feral cats and foxes are already present within the Project Area which may pose a threat to this species. The Project will not introduce any feral animals to the study area. A Biosecurity Management Plan will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised. A fauna spotter/catcher will be present during any clearing events.	Decline of this species as a result of the Project is considered very unlikely as clearing of vegetation will be minimal and localised. The closest roosting site has been identified 12 km away.
SPECIES (CRITICALLY ENDANGERED/ ENDANGERED)	**IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY**	**IMPACTS OF FRAGMENTATION**	**IMPACTS ON THE ECOLOGY AND HABITAT OF A POPULATION**	**INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE**	**MITIGATION STRATEGIES**	**LIKELIHOOD OF SPECIES DECLINE**
• Spotted-tail quoll	No populations of this species are known from the Project Area, however, the spotted- tail quoll may occasionally visit habitats within the Project Area.	No populations of this species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of this population are expected as no individuals were identified within the study area.	It is highly likely that feral cats and foxes are already present within the Project Area which may pose a threat to this species. The Project will not introduce any feral animals to the study area. A Biosecurity Management Plan will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised. A fauna spotter/catcher will be present during any clearing events.	Decline of this species as a result of the Project is considered very unlikely as clearing will occur surrounding a highly modified environment. No individuals were sighted during the survey period.

Table 5-18: Impact assessment of threatened reptiles that may occur in the study area

SPECIES (VULNERABLE)	IMPACTS ON POPULATION SIZE AND AREA OF OCCUPANCY OF AN IMPORTANT POPULATION	IMPACTS OF FRAGMENTATION OF AN IMPORTANT POPULATION	IMPACTS ON THE ECOLOGY AND HABITAT OF AN IMPORTANT POPULATION	INTRODUCTION OF INVASIVE SPECIES AND/OR DISEASE	MITIGATION STRATEGIES	LIKELIHOOD OF SPECIES DECLINE
• Three-toed Snake-tooth Skink	No populations of this species are known from the Project Area.	No populations of this species are known from the Project Area. Clearing within the Project Area is likely to only total 1.45 hectares, utilising previously cleared and disturbed land as much as possible. Therefore, it is unlikely that the Project will impact an important population.	No impacts on the ecology of this population are expected as no individuals were recorded within the study area.	It is likely that feral cats and foxes are already present within the Project Area which may pose a threat to this species. The Project will not introduce any feral animals to the study area. A Biosecurity Management Plan will be implemented.	Construction works areas will utilise previously cleared and disturbed land as much as possible. Any clearing of previously undisturbed areas will be minimised. A fauna spotter/catcher will be present during any clearing events.	Decline of this species as a result of the Project is considered very unlikely as no individuals were identified within the Project area and clearing of vegetation will be minimal and localised.

* Refer to Appendix B, Appendix E and Chapter 8 for further information on management and mitigation measures, performance criteria (section B.4.7), and monitoring and reporting provisions.

5.7 Cumulative Impacts

The Project is located in the upper reaches of Six Mile Creek, at Lake Macdonald. The Lake Macdonald catchment is approximately 49 km^2 and generally consists of rolling hills, with a high proportion of rural residential land-use and dominant surrounding land uses include rural land, low-density rural residential areas, and open space conservation.

Under the Noosa Plan, development in the area surrounding the Project is largely limited to rural activities, with land zoned for open space conservation, rural use and rural settlement. Aside from the Project, there are no other water infrastructure projects occurring in the upper Six Mile Creek catchment. Therefore, cumulative impacts associated with development and infrastructure projects in addition to the Six Mile Creek Dam Safety Upgrade Project are considered unlikely.

Surveys have shown that fish species in Six Mile Creek that undertake diadromous migration (i.e. from freshwater to salt water and vice versa) often have a relatively low abundance, and a number of diadromous species that would be expected to occur have not been caught. This suggests the possibility of existing cumulative impacts to fish passage between the estuary and Six Mile Creek by barriers in the lower Mary River (e.g. Gympie Weir) (see Walker 2008). Six Mile Creek Dam does not currently provide upstream fish passage, and due to biosecurity concerns upstream fish passage will not be included on the upgraded dam. However, it is proposed to provide fish passage at Gympie Weir on the Mary River as an off-site mitigation downstream of the Project. This will lead to a reduction in the existing cumulative impacts to fish passage in the Mary River Basin.

5.8 Summary

The Project was determined to be a controlled action on 6 December 2017 due to the potential impact on listed threatened species and communities (Sections 18 and 18A of the EPBC Act).

Based on the assessment of Project impacts on listed threatened species and communities against the relevant significant impact criteria, the Project overall is unlikely to have a significant impact due to the temporary and localised nature of the works. Specifically, the below conclusions were drawn.

Listed Threatened Terrestrial Species

There are two threatened terrestrial species that may be affected by the Project – Southern penda and the giant barred frog.

Approximately 1.45 ha of vegetation will be cleared during the Project, however clearing will not occur along Six Mile Creek downstream of Lake Macdonald. Clearing will therefore not occur within the habitat of the giant barred frog, or impact the southern penda. Increased water flow and sediment transport through Six Mile Creek during the lake drawdown may create a localised and temporary impact on the giant barred frog population downstream of the dam. However, as the drawdown process will be gradual (over approximately three months) and releases will not exceed bankfull height, this will allow the frogs to relocate if needed (refer to Chapter 8, Appendix C, and Appendix E for further information). Any impact on the giant barred frog is therefore likely to be temporary and localised in nature.

In addition to the threatened species noted above, koala and the grey headed flying fox are discussed due to presence of appropriate foraging habitat and also a history of anecdotal information on the intermittent occurrence of the species within the study area.

The vegetation to be cleared has been identified as suitable koala habitat, but while the koala habitat assessment tool indicates that this is habitat critical to koala survival, the area to be cleared borders an already highly modified environment and there was no evidence of koalas during the field survey. As such, it is considered that the Project is unlikely to adversely affect habitat critical to the survival of koalas (refer to Chapter 8 and Appendix E).

Vegetation of importance to the grey-headed flying fox will also be directly impacted by the Project. However, no grey-headed flying-fox individuals were identified in the Project area during field survey and the nearest identified flying fox camp is within Noosaville, approximately 12 km from Lake Macdonald. If a grey-headed flying-fox population is present within the area, it is likely to only occur intermittently, and is unlikely to be directly impacted by the Project.

Aquatic Species

Mary River cod and Australian lungfish are known from Six Mile Creek downstream of Lake Macdonald, and it is possible that Mary River turtle and white-throated snapping turtle may sometimes occur in the lower reaches of Six Mile Creek, though this is not confirmed. Mary River cod are known to breed in Six Mile Creek downstream of Lake

Macdonald. Within Lake Macdonald, Mary River cod and Australian lungfish may occur but are unlikely to be breeding, and Mary River turtle or white-throated snapping turtle are likely to be rare or absent.

Potential direct and indirect impacts of the Project are likely to affect both Lake Macdonald and Six Mile Creek downstream. Most Project activities were assessed as having a low risk of impact on aquatic fauna when appropriate mitigations are applied as:

- Most potential impacts will be temporary (i.e. for the duration of the drawdown and construction periods; approximately two years)
- There will be no ongoing impacts to the aquatic environmental values of Lake Macdonald or Six Mile Creek (i.e. the Project is replacing an existing dam wall and there will be no change to the current operational status once the Project is complete).

However, the temporary loss of approximately 97.2% of aquatic habitat (by water volume) in Lake Macdonald during the Project represents a moderate risk to aquatic fauna that requires additional mitigation in the form of a comprehensive aquatic fauna salvage operation. This is an unavoidable risk given the safety requirements of the Project. Consequently, the proposed fauna salvage operation is described in detail in Appendix C, the Lake Macdonald Lowering – Adaptive Management Plan, and performance criteria for aquatic ecology are defined in section B.4.5 of Appendix B, the Environmental Management Plan along with monitoring and reporting provisions.

Assessment of these aquatic MNES species against the Significant Impact Criteria indicates that, while there may be temporary impacts, following the implementation of appropriate mitigation measures such as those described in Appendices B and G, and a comprehensive fauna salvage operation as described in Appendix C, a significant impact from the Project on these species is unlikely.