

Culvert upgrade on Scudamores Road, Goondiwindi, Queensland

Waterway Barrier Works Fish Passage Assessment Report

May 2023



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Cover Photo: Wondalli Creek culvert crossing (Credit: Christina Kindermann)

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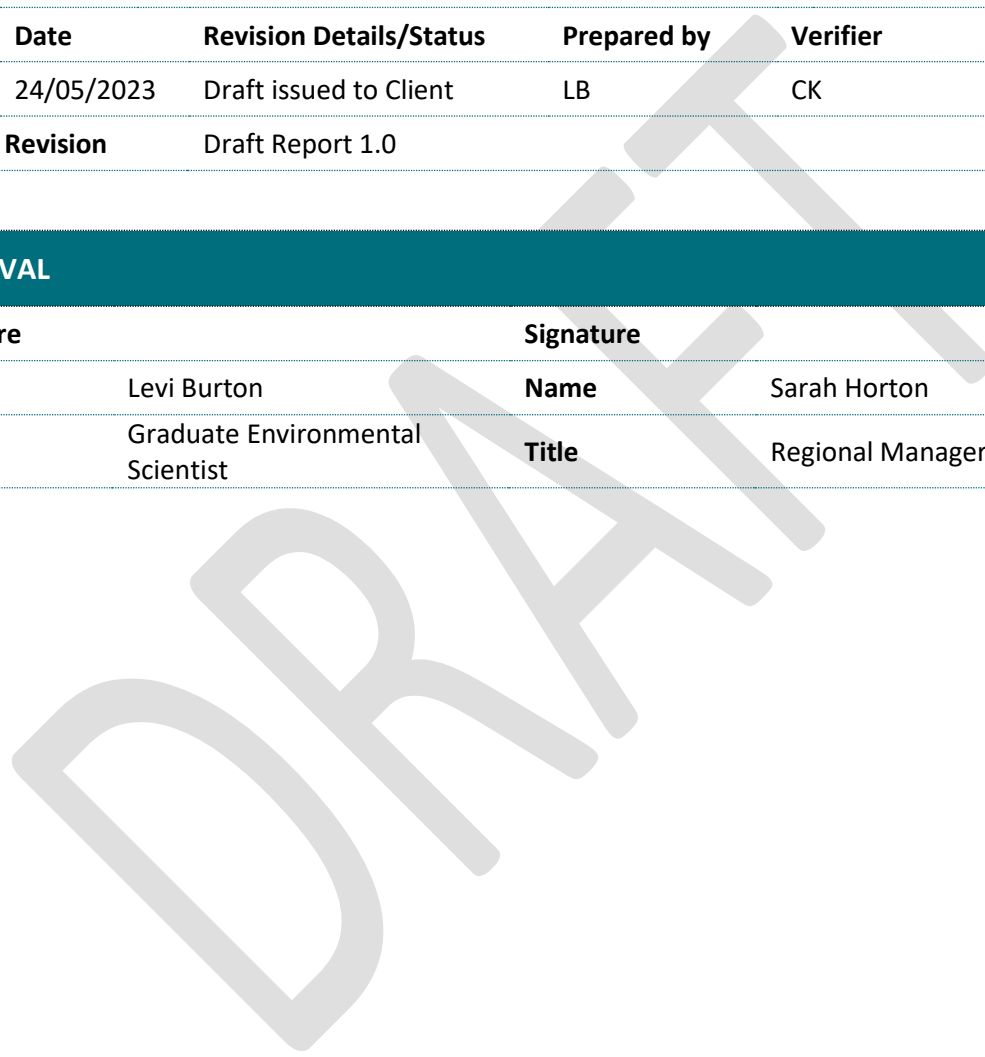
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1 Introduction

1.1 Purpose of report

Metis Energy engaged Redleaf Environmental to prepare a fish passage assessment report for the proposed upgrade of a culvert on Scudamores Road, Goondiwindi centroid: -28.4915991°, 150.3665912° (Figure 1), Queensland as part of the development of Gunsynd Solar Farm. The site is located within the Local Government Area (LGA) Goondiwindi Regional (Council).

Development within mapped waterways may impact upon fish passage. Therefore, if works are considered to constitute waterway barrier works, the works will need to be conducted in accordance with the Department of Agriculture and Fisheries' (DAF) accepted development requirements or under a development approval (DA).

Culvert replacement works (including extensions) within amber waterways are accepted development given requirements are met and therefore do not require a DA under the *Planning Act 2016* (Planning Act) for operational work for Constructing or raising waterway barrier works in fish habitats.

The works consist of widening the existing culvert from 4m to 8m within a floodway in line with road upgrades and widening as part of the Gunsynd Solar Farm development.

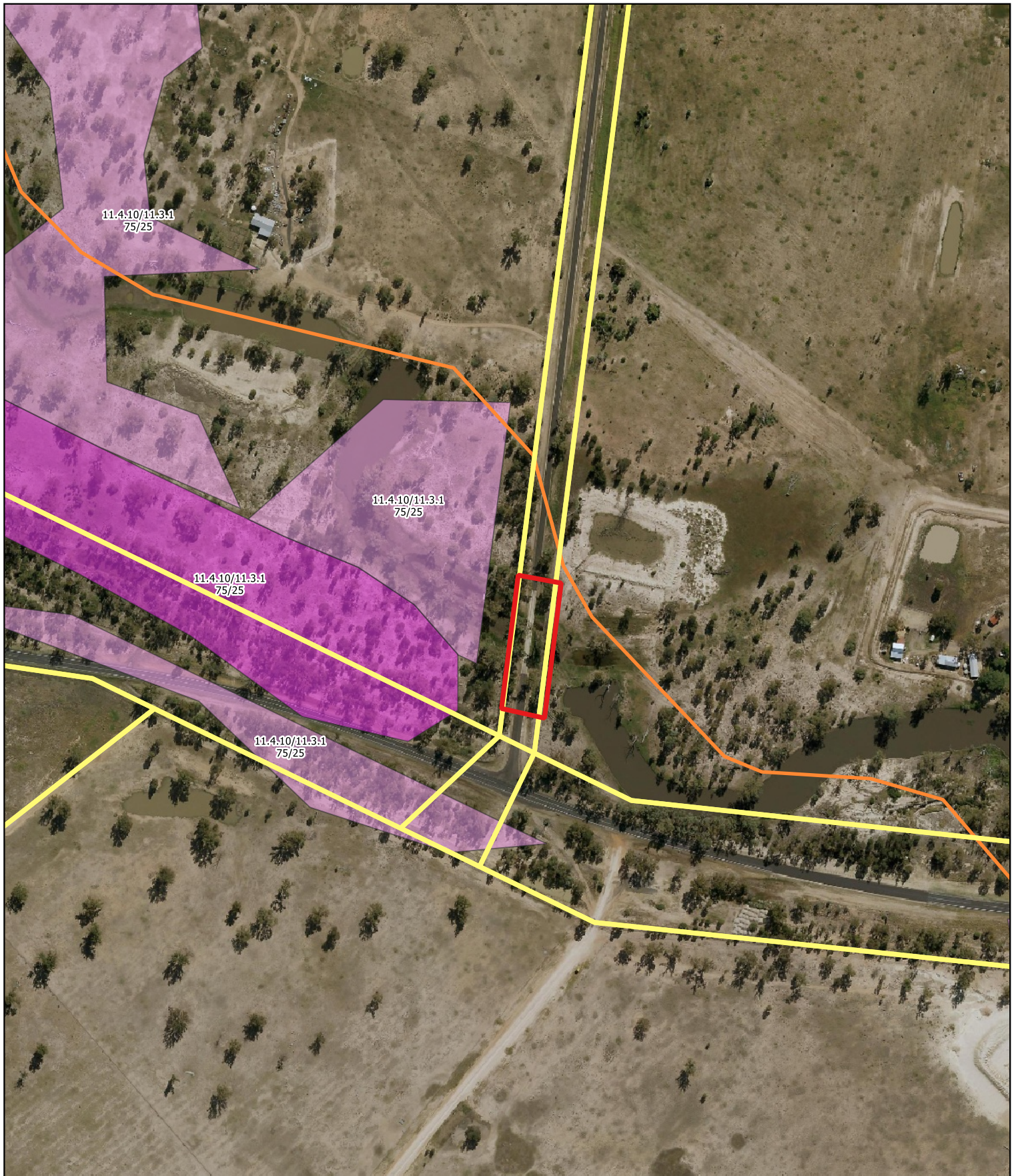
This report addresses the requirements for assessable development under the *Fisheries Act 1994* and the State Development Assessment Provisions State code 18: Constructing or raising waterway barrier works in fish habitats. It also provides supporting information for other approvals and permits.

Specifically, this report addresses:

PO5 Waterway barrier works are designed, constructed, operated and maintained to provide lateral and longitudinal fish passage for all members of the fish community, regardless of size, species, life-stage or swimming ability, and accommodating future and seasonal increases in fish biomass.

1.2 Location Details

Metis Energy is widening the existing culvert on Scudamores Road as part of the requirements for Gunsynd Solar Farm. The proposed culvert upgrade is located on Scudamores Road, approximately 100m north from the Cunningham Highway intersection. Scudamores Road has a width near 4 m and is primarily used for access to local properties with a low traffic flow mainly consisting of light vehicles and few trucks. The proposed culvert upgrade will be 8m wide.



Legend

- Culvert Location
- QLD DCDB
- DAFF Waterway Mapping Moderate
- Vegetation management regional ecosystem map Category A or B area containing endangered
- Category C or R area containing endangered
- Category X area

CRS: GDA 1994 MGA Zone 56
Projection: Transverse Mercator



Scale (A4)



Figure 1 Project Site

Gunsynd Solar Farm Environmental Assessment
Prepared for Metis Energy

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2 Methodology

2.1 Desktop Assessment

A desktop assessment was undertaken to review the potential native fish species present at the study area and to assess the available aquatic habitat using Queensland Globe imagery.

2.2 Field Assessment

A site inspection was undertaken by Redleaf's aquatic ecologists on the 8th of May 2023 to provide a rapid habitat assessment of the proposed culvert location. Wondalli Creek had a slow flow at the time of the inspection.

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3 Aquatic Fauna

From habitat and distribution data 40 species are considered to potentially inhabit the creek near the work site with 8 of those species likely to occur (Table 1). Pusey et al. (2004) provides a comprehensive record of fish species, their life cycle characteristics, and their movement behaviour for catchments in north-eastern Australia. This book sources published material and previously unpublished documents and provides reference material in a standard format. It also provides regional and catchment scale information on the distribution of fish species within these catchments.

Table 1 Fish species potentially inhabiting the waterway at the study site

Presence	Family	Species	Common Name	Size ¹	Habitat ²
Likely	Cyprinidae	<i>Carassius auratus*</i>	Goldfish	M	All
Likely	Atherinidae	<i>Craterocephalus fulvus</i>	Unspecked Hardyhead	S	Fast
Likely	Atherinidae	<i>Craterocephalus stercusmuscarum</i>	Fly-specked hardyhead	S	Fast
Likely	Cyprinidae	<i>Cyprinus carpio*</i>	European carp	L	All
Likely	Poeciliidae	<i>Gambusia holbrooki*</i>	mosquitofish	S	Slow
Likely	Terapontidae	<i>Leiopotherapon unicolor</i>	Spangled perch	M	All
Likely	Percichthyidae	<i>Macquaria ambigua</i>	Golden Perch	L	All
Likely	Clupeidae	<i>Nematalosa erebi</i>	Bony Bream	L	All

1. Size as adult, S = small (<10 cm), M = medium (10-20 cm), L = large (>20 cm). 2. Slow = relatively still and slow waters, Fast = relatively swift moving waters.

4 Existing Environment

4.1 Waterway

The project site occurs on Wondalli Creek, approximately 8km northeast of Goondiwindi township centre, QLD (Figure 1). Wondalli Creek flows east from Brigalow Creek, beginning 5 km west from the existing culvert.

The Queensland Herbarium Regional Ecosystem (RE) vegetation mapping indicates the site contains non-remnant Category X within the road reserve (Figure 1).

The riparian vegetation adjacent to the culvert is characterised as being moderately vegetated primarily with native tree species dominated by Eucalypts. Smaller shrubs and bushes were sparsely scattered along the banks as well ground cover comprising of both native and exotic grasses at the culvert crossing as well as both up and down stream (see section 4.3 Site Photos).

Wondalli Creek is a stream order two (2) Moderate Risk (amber) waterway on the DAF Queensland waterways for waterway barrier works mapping. The study area is at 218 m elevation with Wondalli Creek flowing through relatively flat to hilly land. The surrounding catchment upstream and immediately adjacent is dominated by cleared farmland. This has been the case for many decades until at least 1953 when aerial photos were checked. The Wondalli Creek is a well-defined channel with trees and shrubs scattered along the edges. The river was running at the time of survey.

Its stream bed comprised of sandy soil as the dominant substrate observed within the watercourse. The top of bank width (riparian) at the site is approximately 47m wide upstream and 63m wide downstream, approximately 50 from the crossing. Wondalli Creek has a typical stream morphology of a flat bottom and shallow banks. Low flow width is 1-2 m downstream and upstream within the smaller single box culvert and 5-6 m upstream and downstream at the larger 3 box culvert. There were minimal instream microhabitats at the site including large woody debris (Table 2).

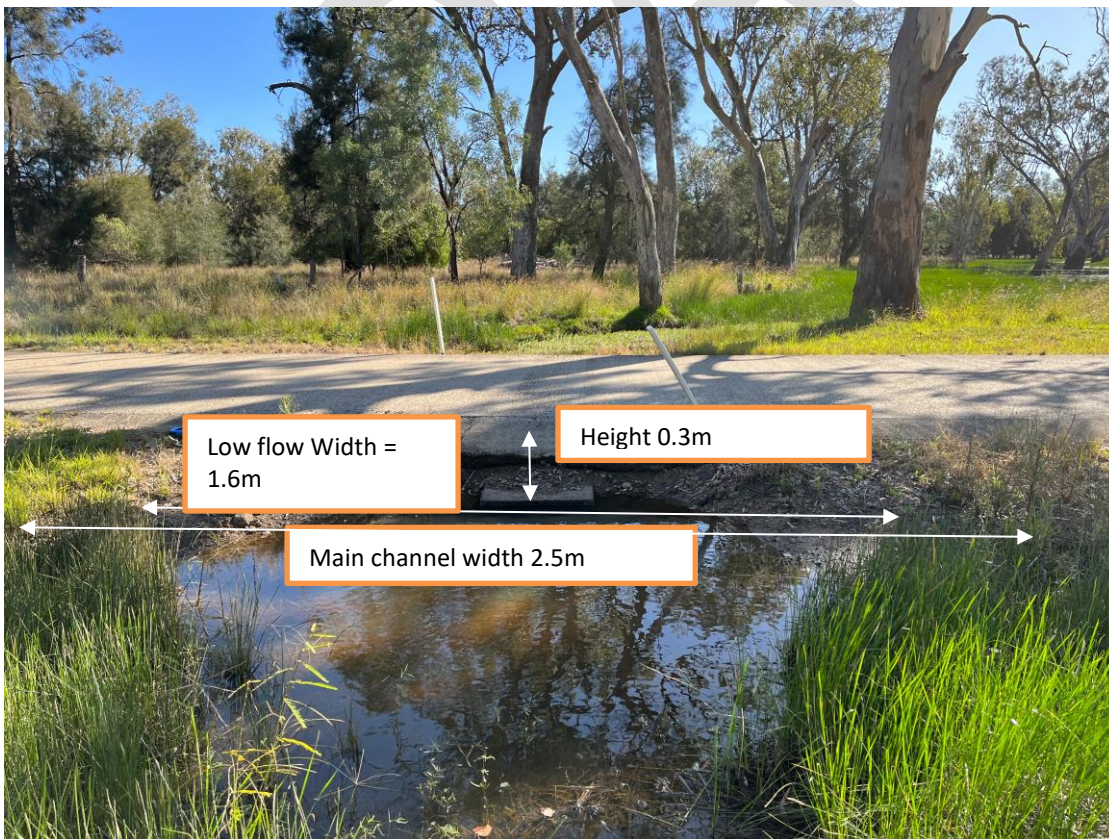
4.2 Upstream and Downstream Aquatic Habitats

The creek flows east on cracking clay across mostly cleared farmland. Wondalli Creek has several road crossings east of the culvert whereas no natural or artificial waterway barriers were observed to the west.

Table 2 Instream waterway measurements



Smaller culvert on upstream (western) side of bridge



Smaller culvert on downstream (eastern) side of bridge



Larger culvert on upstream (western) side of bridge



Larger culvert on downstream (eastern) side of bridge



Creek measurements upstream and downstream from crossing

4.3 Site Photos



Landscape in eastern direction from culvert



Landscape in western direction from culvert



Culvert crossing looking south toward Cunningham Highway



Culvert crossing looking north



Existing culvert



Small pipe just south of the culvert on the floodway

5 Catchment Hydrology

Hydrology designs have not been supplied for the culvert crossing. Recommendations and will be given once these are obtained from the client.

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6 Proposed Works

6.1 Culverts

Construction of a new or replacement of an existing culvert crossing on a moderate impact (amber) waterway is accepted development given conditions are met pertaining to section 1.2 of Table 1 in “Requirements for new work” of “Accepted development requirements for operational work that is constructing or raising waterway barrier works” on DAF the website (summarised below). Further advice and recommendations will be given once relevant designs and hydrology reports have been observed.

Work type	Requirements for accepted development
<p>1.2 Construction of new or replacement of existing culvert crossing on a moderate impact (amber) waterway</p>	<p>Duration</p> <p>Works must commence and finish within a maximum time of 360 calendar days.</p> <p>Instream temporary waterway barriers (which may include sediment control measures) must meet the requirements of section 7 of these accepted development requirements.</p> <p>Culvert crossing dimensions and design</p> <p>The culvert crossing must meet the following (Appendix 1, Figure 11):</p> <ul style="list-style-type: none"> – Have a minimum (combined) culvert aperture width of 2.4m and be placed within the low flow channel; or – Have a combined culvert aperture width that spans 100% of the main channel width. – All new or replacement culvert cells must be installed at or below bed level. – The obvert (internal roof) of the culvert cell(s) must be a minimum of 300 mm above the commence to flow water level (or bed level, for ephemeral waterways). – Where the cell is installed at less than 300 mm below bed level, the culvert floor must be roughened throughout to approximately simulate natural bed conditions, unless installed on bedrock where the natural bed surface is maintained. Where the cell is installed 300 mm or more below bed level, no roughening is required on the culvert floor. – The culvert must be installed at no steeper gradient than the waterway bed gradient. – New culvert cells must be aligned parallel (within 10°) to the direction of water flow to minimise turbulence. <p>All culvert crossings are to be regularly inspected and kept clear of blockages in order to retain fish passage.</p> <p>For the life of the culvert crossing, relative levels of the culvert invert, apron and scour protection and the stream bed must be kept so that there are no drops in elevation at their respective joins.</p>

6.2 Road Works – Exempt Clearing Works

The works area/road reserve is mapped as Category X (exempt), in which no further action under the Vegetation Management Act is required. Additional approvals may be required if works extend into neighbouring properties.

6.3 Riverine Protection Permit

Riverine protection permit exemption requirements (exemption requirements) outline when it is permitted to excavate, place fill or destroy vegetation in a watercourse, lake or spring without the need for a riverine protection permit under the Water Act 2000 (the Act). Exemption requirements area as follows.

Vegetation clearing must be:

- carried out under an accepted development vegetation clearing code (other than if the vegetation is in a category A area) or
- of an area that is less than 0.5ha of a least concern regional ecosystem in a category B area or
- of an area that is less than 0.5ha in a category C, R or X area.

Removal of some large trees situated along the floodway may be required. The clearing of these trees is classed as exempt clearing.

7 Impact Assessment to Fish Passage

A culvert uses a pipe or box shaped cell to allow water to pass underneath a roadway. Flow conditions can be significantly modified both within and immediately adjacent to these crossings resulting in reduced opportunities for fish passage over a wide range of flow conditions. At worst culverts can cause a complete blockage to fish passage for all flow conditions. The most common fish passage problems (from Fairfull and Witheridge 2003) associated with both pipe and box culverts from include:

- excessive flow velocities within the culvert.
- inadequate flow depth within the culvert.
- excessive water turbulence.
- debris blockage of the culvert.
- excessive culvert length and a lack of aquatic habitat and "rest" areas within the culvert.
- inadequate lighting within the culvert.
- excessive variation in water level across the culvert outlet (waterfall effect).

Impact assessments will be provided once designs and hydrology are provided by the client.

8 Environmental Offsets

This development may be a prescribed activity under the *Environmental Offsets Act 2014* (Schedule 1 part 7). The Queensland Environmental Offsets Policy Significant Residual Impact Guideline (2014) is used to determine if a project (prescribed activity) will result in a significant residual impact and therefore require environmental offsets.

8.1 Fish Passage

An action is likely to have a significant impact on a waterway providing for fish passage if there is a real possibility that it will:

- result in the mortality or injury of fish; or
- result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes' energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish; or
- reduce the extent, frequency or duration of fish passage previously found at a site; or
- substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish; or
- result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows; or
- lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues for movement in local fish species.

This project on Wondalli Creek will have **no significant residual impact** and not adversely impact any of the above criteria for fish passage **pending final designs of the culvert upgrade**.

9 References

Fairfull, S. and Witheridge, G. (2003) Why do fish need to cross the road? Fish passage requirements for waterway crossings. NSW Fisheries, Cronulla, 16pp.

Appendix A. Fish of the Murray-Darling Basin

There are 40 species recorded from the Murray-Darling Basin (Atlas of Living Australia). From habitat and distribution data 8 species are considered to potentially inhabit the stream near the study site. These are listed below along with summary information on their known movement requirements, habitat preferences, distribution, and potential occurrence at the project site. The Pusey et al. (2004) publication was referenced which provides a comprehensive record of fish species, their life cycle characteristics, and their movement behaviour for catchments in north-eastern Australia. This book sources published material and previously unpublished documents and provides reference material in a standard format. It also provides regional and catchment scale information on the distribution of fish species within these catchments.

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Ambassidae	<i>Ambassis agassizii</i>	Agassiz's glassfish	Upstream movement can occur anytime of the year, over a wide range of flow conditions.	Variety of habitats, including still or slow-flowing parts of systems.	Widespread throughout	S	All	Unlikely
Anguillidae	<i>Anguilla australis</i>	southern shortfin eel	Catadromous movement pattern. They migrate over large distances from freshwater habitats to spawn in the ocean.	Prefer still water but is found in a wide range of lentic and lotic habitats.	Widespread throughout	L	All	Unlikely
Anguillidae	<i>Anguilla reinhardtii</i>	River eel	Catadromous movement pattern. They migrate over large distances from freshwater habitats to spawn in the ocean.	Prefer flowing waters but is found in a wide range of lentic and lotic habitats including coastal streams, lakes, swamps and lagoons and floodplain streams.	Widespread throughout	L	All	Unlikely
Apogonidae	<i>Glossamia aprion</i>	Mouth almighty		Occurs in rivers, creeks and lagoons. Prefers still or slowly flowing fresh waters	Widespread in northern Australia from the Fitzroy River in the West Kimberley region of Western Australia to the Burnett River in Queensland.	M	Low	Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Ariidae	<i>Neoarius graeffei</i>	Smaller salmon catfish	Marine populations of <i>A. graeffei</i> appear to undertake extensive anadromous migrations associated with breeding	Inhabit freshwater rivers and lagoons, as well as brackish estuaries and coastal marine waters.	Mainly found in the Brisbane River and Lockyer Creek as far inland as Gatton.	L		Unlikely
Atherinidae	<i>Craterocephalus fulvus</i>	Unspecked Hardyhead				S	Fast	Likely
Atherinidae	<i>Craterocephalus marjoriae</i>	Marjorie's freshwater hardyhead		Lives in clear flowing streams where it is common along the vegetated margin.	Widespread throughout	S		Unlikely
Atherinidae	<i>Craterocephalus stercusmuscarum</i>	Flyspecked hardyhead	Recorded movements from dry season refuges (escarpment habitats, sandy creek habitats to occupy all available habitats during wet season). Observed migrating in high flows. Particularly abundant in ephemeral streams and isolated refugia pools.	Found in large floodplain rivers, billabongs, small streams, river impoundments. Particularly abundant in ephemeral streams and isolated refugia pools.	Widespread throughout	S	High	Likely
Ceratodontidae	<i>Neoceratodus forsteri</i>	Australian lungfish		Slow-flowing rivers and still water (including reservoirs) that have some aquatic vegetation present on banks.	Native only to the Mary and Burnett River systems in south-eastern Queensland. It has been successfully distributed to other, more southerly rivers, including the Brisbane, Albert, Stanley, and Coomera Rivers, and the Enoggera Reservoir in the past century. Confined to the larger streams and waterholes.	L	Slow	Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Cichlidae	<i>Oreochromis mossambica*</i>	Mozambique mouthbrooder				L		Unlikely
Cichlidae	<i>Tilapia mariae*</i>	spotted tilapia						
Clupeidae	<i>Nematalosa erebi</i>	Bony Bream	Predominantly diurnal. Can make substantial longitudinal movements.	Wide array of habitats including salt lakes, lowland rivers, floodplain billabongs, lagoons, impoundments to rainforest streams.	Widespread, abundant	L	All	Likely
Cyprinidae	<i>Carassius auratus*</i>	Goldfish			Widespread, abundant were present			Likely
Cyprinidae	<i>Cyprinus carpio*</i>	European carp			Widespread, abundant were present			Likely
Eleotridae	<i>Gobiomorphus australis</i>	striped gudgeon		Found in a wide variety of habitats from clear streams with rapid currents to muddy still waters such as ponds and waterholes.	Widespread throughout	S		Unlikely
Eleotridae	<i>Gobiomorphus coxii</i>	Cox gudgeon		Occurs in coastal and inland freshwaters up to around 700 meters in altitude where it is normally found in upland streams with reasonable fast currents, even in rapids.	Widespread throughout	S	All	Unlikely
Eleotridae	<i>Hypseleotris compressa</i>	empire gudgeon		Commonly found in freshwater flowing rivers or streams but is also found in still water.	Found in eastern part of the Brisbane River catchment to Lowood in the west	S		Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Eleotridae	<i>Hypseleotris galii</i>	Firetail gudgeon		Occurs in streams, ponds, swamps and drains, usually among aquatic weeds.	Widespread throughout	S		Unlikely
Eleotridae	<i>Hypseleotris klunzingeri</i>	Western carp gudgeon	Unknown requirements. Does undertake mass movements upstream.	Broad habitat requirements from headwater streams through to the lower coastal floodplain habitats.	Widespread throughout	S		Unlikely
Eleotridae	<i>Mogurnda adspersa</i>	Southern purplespotted gudgeon	Undertakes frequent small-scale movements.	Occupies a broad range of habitat types.	Widespread throughout	M	Moderate	Likely
Eleotridae	<i>Oxyeleotris lineolata</i>	sleepy cod		Adults inhabit rivers, creeks and billabongs, usually in quiet or slow-flowing water among vegetation, around log debris or beneath undercut banks.		M	Slow	Unlikely
Eleotridae	<i>Philypnodon grandiceps</i>	Flathead gudgeon	Known to move through fishways and barrages. Unknown requirements otherwise.	Occurs in a variety of habitats including small coastal streams, throughout large rivers and their floodplain habitats. Can also be found in brackish and estuarine waters.	Occurs through the lower Murray-Darling and in the eastern headwaters of NSW and Victoria.	M		Unlikely
Eleotridae	<i>Philypnodon macrostomus</i>	Dwarf flathead gudgeon		Calm waters and occur over mud and rock substrates or in weedy areas. Estuaries and freshwater rivers from Baffle Creek in central Queensland through New South Wales and eastern Victoria to Wilsons Promontory. Inland the range extends westward	Throughout catchment	S		Unlikely

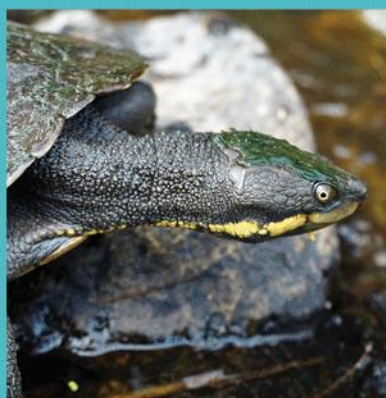
Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
				along the Murray River into South Australia.				
Gobiidae	<i>Redigobius bikolanus</i>	Bigmouth goby		Species of goby native to marine, fresh and brackish waters along the coasts of Asia from Japan to Australia. Inhabits streams, creeks and estuaries, often being found upstream beyond the tidal zones of rivers.	Brisbane River upstream to about Fernvale	S	All	Unlikely
Hemiramphidae	<i>Arrhamphus sclerolepis</i>	Jumping halfbeak		Coastal species that extend into fresh water. Occurs in brackish estuaries, but frequently found in the lower, tidal portions of freshwater streams.	Brackish estuaries only.	L		Unlikely
Melanotaeniidae	<i>Melanotaenia duboulayi</i>	Crimsonspotted rainbowfish		Found in rivers, creeks, drains, ponds, dune lakes and reservoirs. Usually occurs in still or slow-flowing conditions near the surface or around vegetation, log snags, or other debris. Occurs in both sandy coastal habitats and forested areas farther inland.	Widespread throughout	S	All	Likely
Mugilidae	<i>Mugil cephalus</i>	sea mullet		Cosmopolitan in coastal waters of the tropical, subtropical and temperate zones of all seas		L	All	Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Mugilidae	<i>Trachystoma petardi</i>	pinkeye mullet	Spawn in estuaries or at sea following a downstream migration in summer.	Often occurs in small groups in deep pools where stream flow is slow. Inhabit deep, gently flowing sections of rivers. Also occur in estuaries and coastal seas during spawning runs. Tolerant of temperatures between 9° and 27°C. Form small shoals (Ref. 44894). Mainly herbivorous. Feed on filamentous green algae, microscopic plants and animals as well as detritus. Also consume benthic invertebrates. Oviparous, eggs are pelagic and non-adhesive (Ref. 205). Spawn in estuaries or at sea following a downstream migration in summer. Peak spawning activity is in February. Sexual maturity is reached after 4 years at a length of about 30 centimeters. Maximum life span is approximately 14 years (Ref. 44894).		M	Slow	Unlikely
Percichthyidae	<i>Macquaria ambigua</i>	Yellowbelly, Golden Perch	Recorded movements of >1000km.	Inhabits rivers, creeks, billabongs and lakes preferring deep, slow-flowing water, cover, shade and shelter.	Widespread, abundant	L	All	Likely
Percichthyidae	<i>Macquaria novemaculeata</i>	Australian bass	Strong swimmers at all sizes and can easily traverse rapids and fast-flowing water.	Primarily freshwater (but estuarine spawning) species of fish found in coastal		M	All	Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
				rivers and streams along the east coast of Australia.				
Plotosidae	<i>Porochilus rendahli</i>	Rendahli's catfish	Unknown requirements	Recorded from riverine and off-channel habitats. Benthic species preferring low flow habitats with muddy substrates. Occurs in billabongs and streams in slow to fast-flowing water that is clear to turbid with rock, gravel or sand bottoms	Uncommon, found in the Condamine-Balonne system	M	All	Unlikely
Plotosidae	<i>Tandanus tandanus</i>	Eel-tailed catfish	Generally sedentary with a small home range. Small movements recorded of between 0-8 kms. Studies have seen movements through fishways.	Benthic habitats frequently in deeper, slow waters over a mixed substrate with a high proportion of mud and sand.	Widespread throughout Murray-Darling Basin, excluding the Paroo River catchment.	L	Slow	Unlikely
Poeciliidae	<i>Gambusia holbrooki</i> *	Mosquitofish				S	Slow	Likely
Poeciliidae	<i>Poecilia reticulata</i> *	guppy						Unlikely
Poeciliidae	<i>Xiphophorus maculatus</i> *	platy						Unlikely
Pseudomugilidae	<i>Pseudomugil signifer</i>	Pacific blue eye	Fish can breed in fresh and salt water.	Occurs in clear, cool, fast-flowing streams and also brackish mangrove estuaries. Inhabits tidal mangrove creeks or fringing coastal mangrove and around offshore islands. Also common in clear, forest streams.		S	All	Unlikely

Family	Species	Common Name	Movement	Habitat	Distribution in Region	Body Size	Flow	Likelihood of Occurrence
Retropinnidae	<i>Retropinna semoni</i>	Australian smelt	Mass migrations in freshwater have been frequently recorded across a range of flow conditions.	Can inhabit a range of habitat types but prefers deeper billabongs.	Widespread, common	S	All	Unlikely
Scorpaenidae	<i>Notesthes robusta</i>	bullrout		Occur in freshwater streams and brackish shore areas. Inhabit still or gently flowing freshwater streams over rock, mud or gravel, a bottom-dwelling fish.		M		Unlikely
Terapontidae	<i>Amniataba percoides</i>	Barred grunter	Potamodromous	Variety of environment from still ponds and isolated rock pools to fast-flowing streams.	Widespread throughout	M	All	Unlikely
Terapontidae	<i>Leiopotherapon unicolor</i>	Spangled perch	Highly mobile species, moving both up and downstream across all flows	Found in nearly every habitat including desert springs, billabongs, impoundments, rivers and creeks.	Widespread throughout	M	All	Likely

* Exotic, or native introduced species.



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