6. Flora

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6.1 Introduction

6.1.1 Overview

This chapter provides an assessment of flora values as they relate to the Lower Fitzroy River Infrastructure Project (Project). An ecological study was undertaken to determine the potential impacts on flora within the Project area as a result of raising Eden Bann Weir and developing a new weir at Rookwood. The assessment addresses Part B, Section 5.46- 5.53 of the terms of reference (ToR) for the environmental impact statement (EIS). A table cross-referencing the ToR requirements is provided in Appendix B. Mitigation and management measures are used to inform the Environmental Management Plan (EMP) (Chapter 23) as appropriate.

6.1.2 Approach and methodology

6.1.2.1 Desktop assessment

A detailed literature and field survey report was prepared by Nangura Environmental Services (Nangura) (2007) assessing the potential implications of the Project on native vegetation and terrestrial ecosystems. For the draft EIS, further database searches were undertaken to update the information presented by Nangura (2007), particularly with respect to the presence (or potential presence) and location of conservation significant flora species.

Searches of the following databases were undertaken:

- The Queensland Herbarium HERBRECS database
- The former Environmental Protection Agency WildNet database for conservation significant flora records in the shires of Duaringa, Fitzroy and Livingstone (Nangura 2007)
- Queensland Government Wildlife Online database (2008 and updated 2013)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) Environmental Reporting Tool (2009) and Protected Matters Search Tool (2013)
- The Queensland Department of Natural Resources and Mines (DNRM) Regional Ecosystem (RE) (Version 6.1, 2011), Regrowth Vegetation (Version 2.1, 2011) and Essential Habitat (Version 3.1, 2011) mapping databases.

6.1.2.2 Nangura vegetation assessment methodology

A detailed report prepared by Nangura (2007) forms the basis of this assessment (Appendix H). Nangura undertook a vegetation assessment following the Queensland Herbarium methodology as outlined by Neldner et al. (2004). This was undertaken to refine the accuracy of RE mapping in the Eden Bann Weir and proposed Rookwood Weir study areas. Notably, field verification of REs did not cover the whole, final Project footprint and areas outside of the original field survey extents have subsequently been assessed against DNRM mapping (Section 6.1.2.3). The 2007 Nangura report is still considered valid as land use practices and development within the survey area have not materially changed and therefore the survey results are considered consistent with what was assessed in 2007.

Aerial photo interpretation identified discernible vegetation mapping units. These vegetation mapping units produced a geographic information system layer of REs for the study area. Based on the results of the literature review and the vegetation mapping produced through aerial photo

interpretation, dry season field surveys of the Eden Bann Weir and Rookwood Weir study areas were conducted by Nangura.

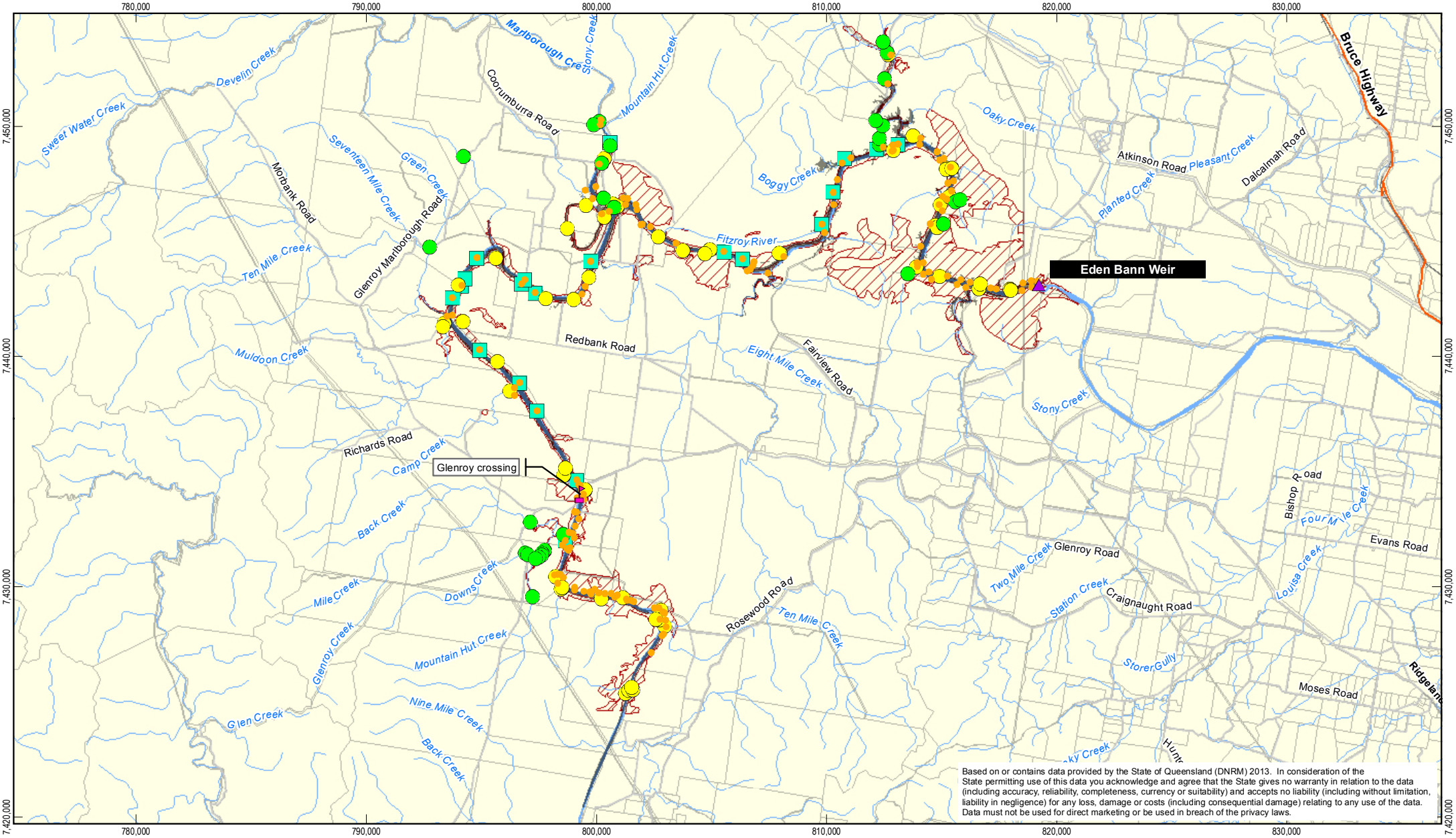
In this chapter, all references to field surveys refer to the Nangura (2007) report (unless otherwise stated). Four-wheel drive vehicle, quad bike, pedestrian and speedboat traverses were conducted at 0.5 km to 4 km spacing depending upon property access and soil / weather conditions. A total of 135 vegetation plots and an additional 300 observational stops were examined. Site data was assembled in a CORVEG compatible database.

Nomenclature for plant names follows Henderson (2002) with the *Eucalyptus* / *Corymbia* group following the Commonwealth Scientific and Industrial Research Organisation (CSIRO) protocols (CSIRO 2006). Plant identification was assisted by the Queensland Herbarium identification service and through general Queensland flora texts and other local area plant books, local botanists and local plant enthusiasts.

Habitat condition was assessed for each vegetation community within the Eden Bann Weir and proposed Rookwood Weir study areas using a bio-condition analysis methodology as outlined by Eyre et al. (2006). Bio-condition habitat assessment provides a method of evaluating a terrestrial ecosystem through examination of characteristics of a selected subset of habitat elements. Sites were sampled at selected locations representative of relevant RE subtypes. Local benchmark values were generated for a key subset of alluvial habitats. Field surveys conducted by Nangura assessed 160 bio-condition sampling sites with a further 28 riparian offset zones examined against their respective bio-condition RE benchmarks. Figure 6-1 and Figure 6-2 show the locations of field survey sites and bio-condition sites for Eden Bann Weir and the proposed Rookwood Weir study areas, respectively.

Disturbed habitat zones were identified during aerial photo interpretation and adjusted during subsequent field surveys. Primarily, disturbed habitat zones were located within the greater river bank, below the adjoining alluvial plain and they were either (a) not identified within any RE polygon in the Queensland Herbarium RE Mapping or (b) would not be considered mappable as remnant vegetation at 1:25,000 in this study. Small areas of 'disturbed habitat' were omitted from this assessment as they were included within RE polygons and thus were technically considered remnant vegetation under the *Vegetation Management Act 1999* (Qld) (VM Act).

Endangered, vulnerable and near threatened flora species under the *Nature Conservation Act 1992* (Qld) (NC Act) and EPBC Act (referred to as conservation significant flora) were identified through database searches in 2006. These species were filtered further with targeting of known conservation significant flora associated with the adjoining serpentinite landscapes, selected targeting of known vine thicket species potentially present within the surrounding district and otherwise selecting species potentially relating to the alluvial plains and riverine ecosystems of the study areas. On-ground searching for conservation significant species was conducted, with any relevant specimens sent to Queensland Herbarium as voucher specimens.



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Kilometres

Map Projection: Universal Transverse Mercator
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LEGEND

- Weir Location
- River Crossing
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Impoundment Area
- Field Survey Site
- Disturbed Zone
- Biocondition Site
- EVR Flora Site
- Cadastre
- Nangura Mapping Extent

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Eden Bann Weir flora field survey sites

Figure 6-1

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Data Source: Sunwater: Waterways, Weir Locations - 2008; NES: Survey Sites, Study Area - 2007; DNRM: Cadastre - 2013, Road - 2011.*See Appendix for disclaimers and copyrights.

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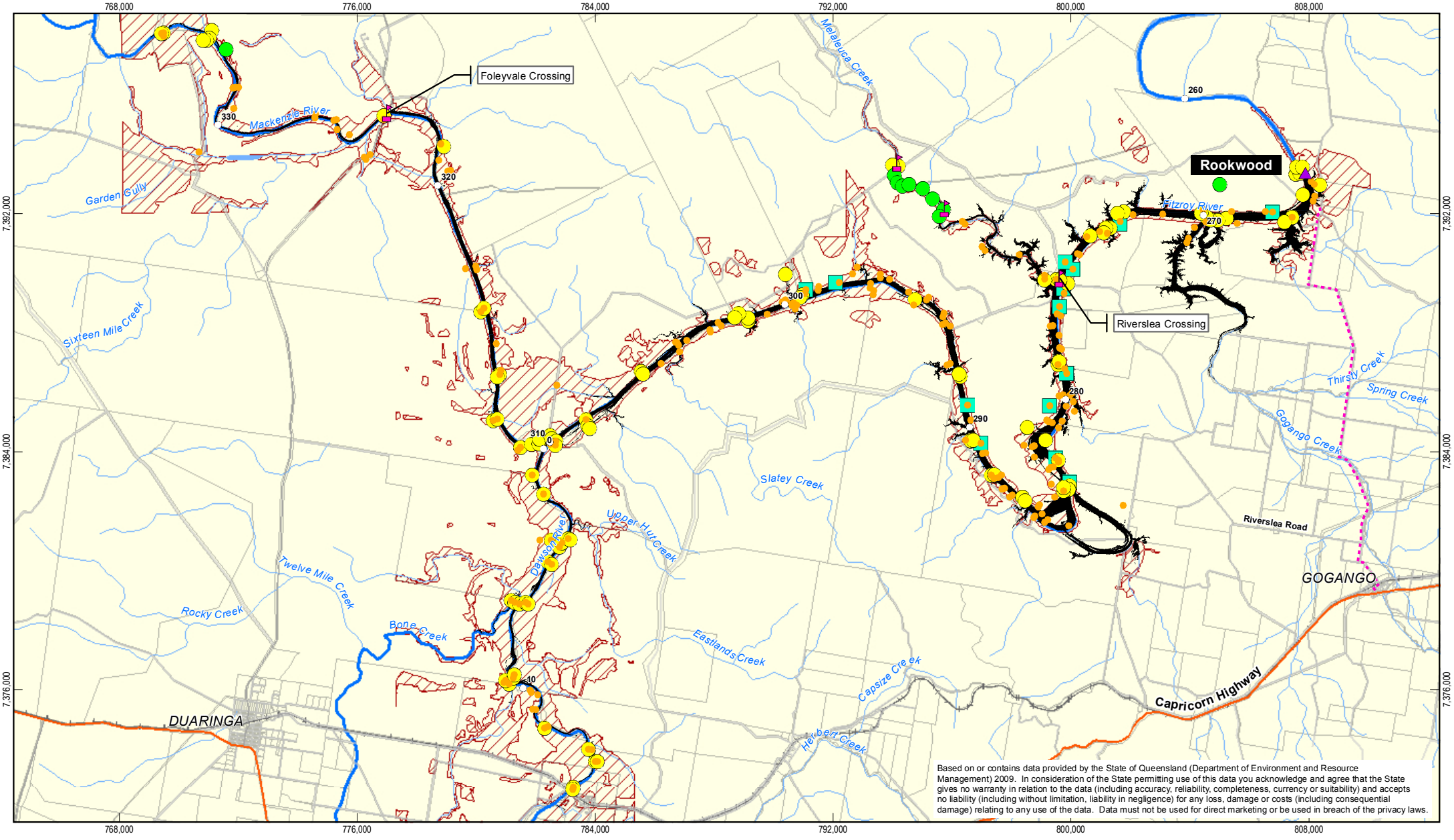

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- Field Survey Site
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Rookwood Weir flora field survey sites

Figure 6-2

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Data Source: Sunwater: Waterways, Weir Locations - 2008; NES: Survey Sites, Study Area - 2007; DNRM: Cadastre - 2013, Road - 2011.*See Appendix for disclaimers and copyrights.

6.1.2.3 Regional ecosystem calculations

To calculate REs affected by the Project footprints, a combined dataset was produced where DNRM RE mapping (Version 6.1, 2011) was used in areas that were not covered by Nangura's mapping. Figure 6-3 and Figure 6-4 show the Nangura mapping extent and the impoundment areas that occur outside this extent for Eden Bann Weir and the proposed Rookwood Weir, respectively.

Calculated hectares for Eden Bann Weir Stage 3 (full supply level (FSL) 20.2 m) and Rookwood Weir Stage 2 (FSL 49 m) are cumulative and are not in addition to the areas affected by Eden Bann Weir Stage 2 (FSL 18.2 m) and Rookwood Weir Stage 1 (FSL 45.5 m).

6.1.2.4 Likelihood of occurrence determination

For conservation significant flora species and ecological communities, a likelihood of occurrence assessment was undertaken to identify which listed species and ecological communities have a high potential (known or likely) to occur in the Project footprint. Determination of likelihood of occurrence considered the following:

- Habitat preferences
- Distribution and relative abundance
- Previous records from the region
- The occurrence of suitable habitat within the Project footprint based on field observations
- The confirmed presence of conservation significant species within the Project footprint.

A likelihood of occurrence ranking was attributed to each conservation significant species or ecological community based on the framework outlined in Table 6-1. Where a difference in likelihood of occurrence outcome exists between Eden Bann Weir and Rookwood Weir, the higher likelihood outcome has been assumed across the Project area to provide a conservative understanding of the potential impact as a result of the Project.

Table 6-1 Likelihood of occurrence determination

Likelihood	Category	Definition supporting information
High	The species or ecological has been observed within the Project footprint (known to occur) or there is a high potential that a species or ecological community occurs within the Project footprint (likely to occur).	Species / community has been recorded during field surveys in the Project footprint. **OR** Species has been recorded within the Project footprint from desktop searches **AND** suitable habitat is present in the Project footprint.
Moderate	Suitable habitat for a species or ecological community occurs on the site, but there is insufficient information to categorise the species or ecological community as high or low potential to occur.	Species' distribution incorporates the Project footprint (or part(s) thereof) **AND** potentially suitable habitat occurs in the Project footprint.
Low	A very low to low potential that a species or ecological community occurs within the Project footprint.	Suitable habitat is absent from Project footprint.

6.1.3 Regulatory framework

Legislation and polices relevant to flora conservation values are listed below and discussed in further detail in Chapter 3 Legislation and project approvals:

- EPBC Act and EPBC Act Environmental Offset Policy (2012)
- NC Act and Nature Conservation (Wildlife) Regulation 2006
- VM Act and the Brigalow Belt and New England Tablelands state code within Module 8 of the State Development and Assessment Provisions in conjunction with the *Sustainable Planning Act 2009* (Qld) (SP Act) (and the Sustainable Planning Regulation 2009 (SP Regulation)). Notably under Schedule 24 of the SP Regulation community infrastructure mentioned in Schedule 2 of the SP Regulation (Section 3.3.15) is considered exempt development (not assessable under Schedule 3, Part 1, Table 4, Item 1) for clearing of native vegetation. This exemption includes the Project as it is considered 'water cycle management infrastructure' under the SP Regulation. Therefore the clearing of native vegetation is considered exempt development for the Project and will not require approval
- *Land Protection (Pest and Stock Route Management) Act 2002* (Qld) (LP Act)
- *Environmental Offsets Act 2014*, Environmental Offsets Regulation 2014 and Queensland Environmental Offsets Policy Version 1.0 (DEHP 2014). However, as the clearing of native vegetation is exempt development and will not require approval or assessment against the Brigalow Belt and New England Tablelands state code, offsets are not proposed. Vegetation offset requirements under the EPBC Act are addressed in Volume 2, Chapter 14 Offsets.

6.2 Existing environment

6.2.1 Sensitive environmental areas

Reserves (primarily for the purposes of camping, water, roads and stock) and protected areas, including state forests, conservation parks, national parks and nature refuges, within proximity to the Project are described in Chapter 5 Land. Sensitive environmental areas downstream of the Project footprint area also discussed in Chapter 5 Land. Great Barrier Reef wetland protections areas are discussed in Chapter 7 Aquatic ecology.

The following sensitive environmental areas relating to flora values will be directly affected by the Project:

- One endangered ecological community known to occur in the Project footprint (Section 6.2.2)
- Endangered, of concern and least concern REs located along sections of the Fitzroy, Mackenzie and Dawson rivers (Section 6.2.3)
- Areas of essential habitat mapped as occurring within the Project area (Section 6.2.5).

6.2.2 Threatened ecological communities

Ecological communities are naturally occurring biological assemblages that comprise a particular habitat type. Threatened Ecological Communities (TECs) are ecological communities that have been assessed under the EPBC Act and assigned to one of three categories related to the status of the threat to the community: vulnerable, endangered and critically endangered. Four TECs listed as endangered under the EPBC Act were predicted to occur in the Project study area based on desktop results. One of these TECs has a high potential to occur within the Project footprint and three have a low potential to occur as detailed in Table 6-2.

Table 6-2 Threatened ecological communities predicted to occur in the Project area

Scientific name	Status EPBC Act	Habitat characteristics	Suitable habitat in Project area	Likelihood of occurrence
Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC)	Endangered	This TEC is defined by the following REs: 6.4.2, 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14, 11.12.21, 12.8.23, 12.9-10.6 (Department of Sustainability, Environment, Water, Population and Communities 2013).	RE 11.3.1 is mapped by DNRM within the Project footprint and field surveys verified the presence at sites within the Rookwood Weir Project footprint. Two small patches of RE 11.3.1 are located above the right bank at the Rookwood Weir site.	High
Semi-evergreen vine thickets the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	This TEC is considered an extreme form of dry seasonal subtropical rainforest and comprises the following 10 REs: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8 and 11.11.18. These REs include areas of low microphyll rainforest, notophyll vine forest, semi-deciduous notophyll rainforest and microphyll / notophyll vine forest.	Two small patches of RE 11.4.1 were mapped by Nangura (2007) as occurring in the landscape outside of the Project footprint. RE 11.4.1 was not detected within the impoundments during field surveys.	Low
Weeping Myall Woodlands	Endangered	The Weeping Myall Woodlands occur in open woodlands to woodlands, generally 4-12 m high, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species. This TEC generally occurs on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. These areas are not associated with active drainage channels and are rarely if ever flooded. This TEC is restricted to small patches that occur within RE 11.3.2 and RE 11.3.28 (TSSC) 2008a).	RE 11.3.2 is mapped along the Fitzroy River, however the floristic composition of RE 11.3.2 is variable such that not all areas of mapped RE 11.3.2 necessarily meet the requirements to be considered this TEC. The flora species that is characteristic of this TEC, namely *Acacia pendula,* was not identified during field surveys such that it is concluded that the Weeping Myall Woodlands TEC does not occur in the Project footprint.	Low
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	This TEC is defined by the following REs: 11.3.21, 11.4.4, 11.4.11, 11.8.11, 11.9.3, 11.9.12, 11.11.17 (TSSC 2008b).	None of the REs associated with this TEC are mapped within the Project area or identified during field surveys.	Low

6.2.3 Regional ecosystems

6.2.3.1 Regional ecosystems within the Project footprint

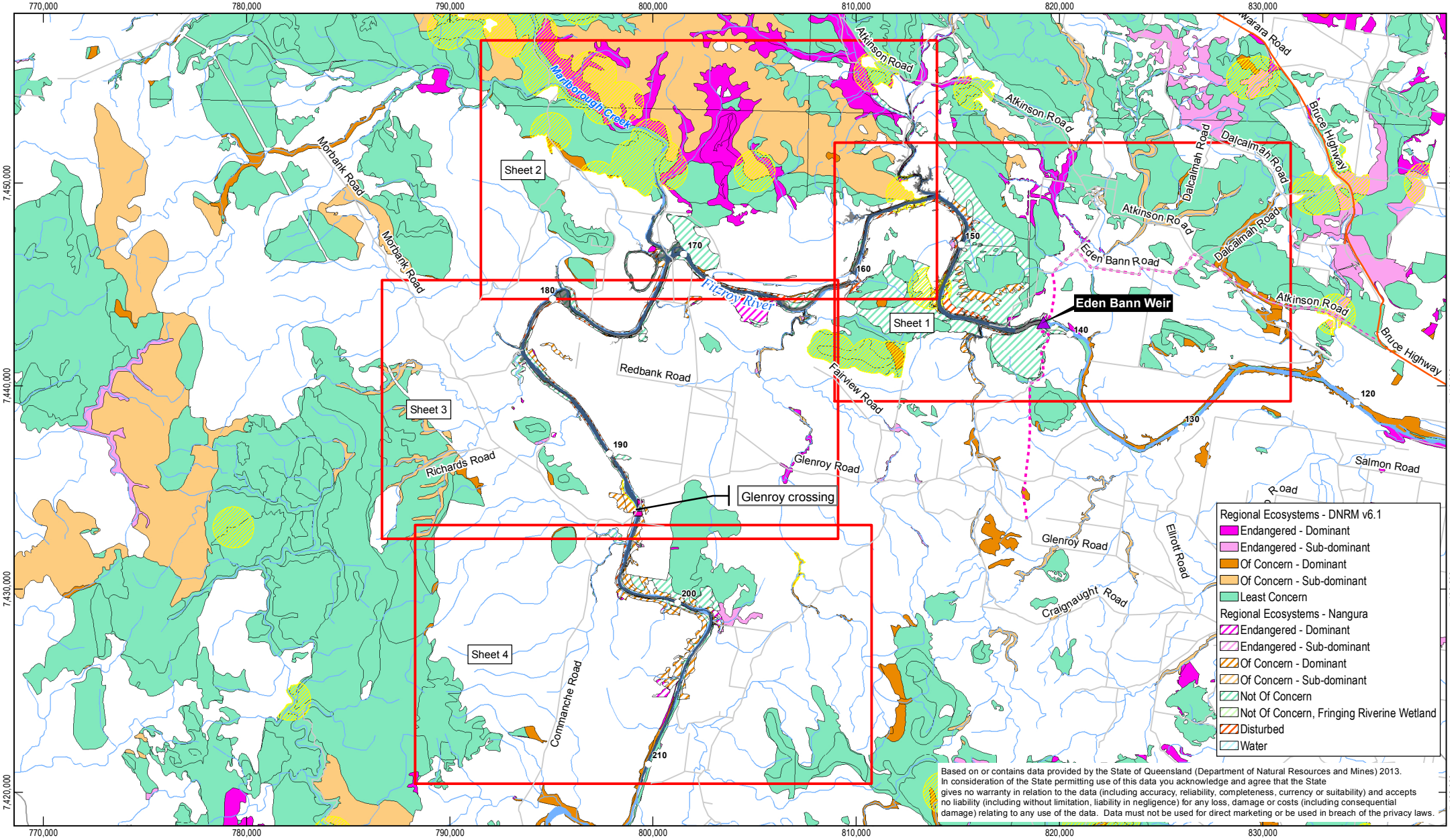
Vegetation mapping undertaken by Nangura (2007) and DNRM RE mapping (Version 6.1, 2011) indicate that a number of REs occur within the Project footprints. A description of each of the REs within the Project footprints is provided in Table 6-3 and the location and extent of these REs is shown in Figure 6-3 and Figure 6-4 for Eden Bann Weir and proposed Rookwood Weir sites, respectively. RE mapping at a scale of 1:30,000 is provided in Appendix I. REs are typically fragmented across the landscape as a result of historic clearing including parts of the riparian zone of the lower Dawson, lower Mackenzie and Fitzroy rivers (Section 6.2.6).

Table 6-3 Regional ecosystems within the Project footprints

RE	Regional ecosystem short description	VM Act class	Eden Bann Weir	Rookwood Weir
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	✓	✓
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of concern	✓	✓
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of concern	✓	✓
11.3.3c	Palustrine wetland. *Eucalyptus coolabah* woodland to open-woodland (to scattered trees) with a sedge or grass understorey in back swamps and old channels	Of concern	✓	
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* tall woodland on alluvial plains	Of concern	✓	✓
11.3.9	*Eucalyptus platyphylla, Corymbia spp.* woodland on alluvial plains	Least concern	✓	
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* fringing drainage lines	Least concern	✓	✓
11.3.25c	Riverine wetland or fringing riverine wetland. *E. camaldulensis* or *E. tereticornis* open-forest to woodland. Occurs fringing drainage lines derived from Serpentinite	Least concern	✓	
11.3.25f	Riverine wetland or fringing riverine wetland	Least concern	✓	✓
11.3.27	Freshwater wetlands	Least concern	✓	
11.3.38	*Eucalyptus tereticornis, Melaleuca viridiflora, Corymbia tessellaris* and *Eucalyptus fibrosa* subsp. (Glen Geddes) tall woodland with a grassy ground layer. Occurs on alluvial plains and broad drainage lines derived from serpentine	Endangered	✓	
11.3.38a	Riverine wetland or fringing riverine wetland. *Melaleuca bracteata* low woodland	Endangered	✓	
11.11.1	*Eucalyptus crebra +/- Acacia rhodoxylon* woodland on old sedimentary rocks with varying degrees of metamorphism and folding	Least concern		✓

RE	Regional ecosystem short description	VM Act class	Eden Bann Weir	Rookwood Weir
11.11.7	*Eucalyptus fibrosa* subsp. (Glen Geddes), *E. xanthope* woodland on serpentine	Least concern	✓	
11.11.7a	*Eucalyptus fibrosa* subsp. *fibrosa* +/- *Corymbia* spp. +/- *Eucalyptus* spp. woodland with a diverse shrub layer including several endemic species. Occurring on undulating low hills and colluvial aprons	Least concern	✓	
11.11.10	*Eucalyptus melanophloia* woodland on deformed and metamorphosed sediments and interbedded volcanics	Of concern	✓	
11.12.1	*Eucalyptus crebra woodland* on igneous rocks	Least concern	✓	
11.12.2	*Eucalyptus melanophloia* woodland on igneous rocks	Least concern	✓	✓

Source: Nangura (2007) and DNRM RE mapping (Version 6.1) (2011)



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LEGEND

- AMTD (km)
- Weir Location
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- Waterway
- Watercourse
- Grid Index
- Essential Habitat

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Eden Bann Weir Regional Ecosystem Mapping overall

Figure 6-3

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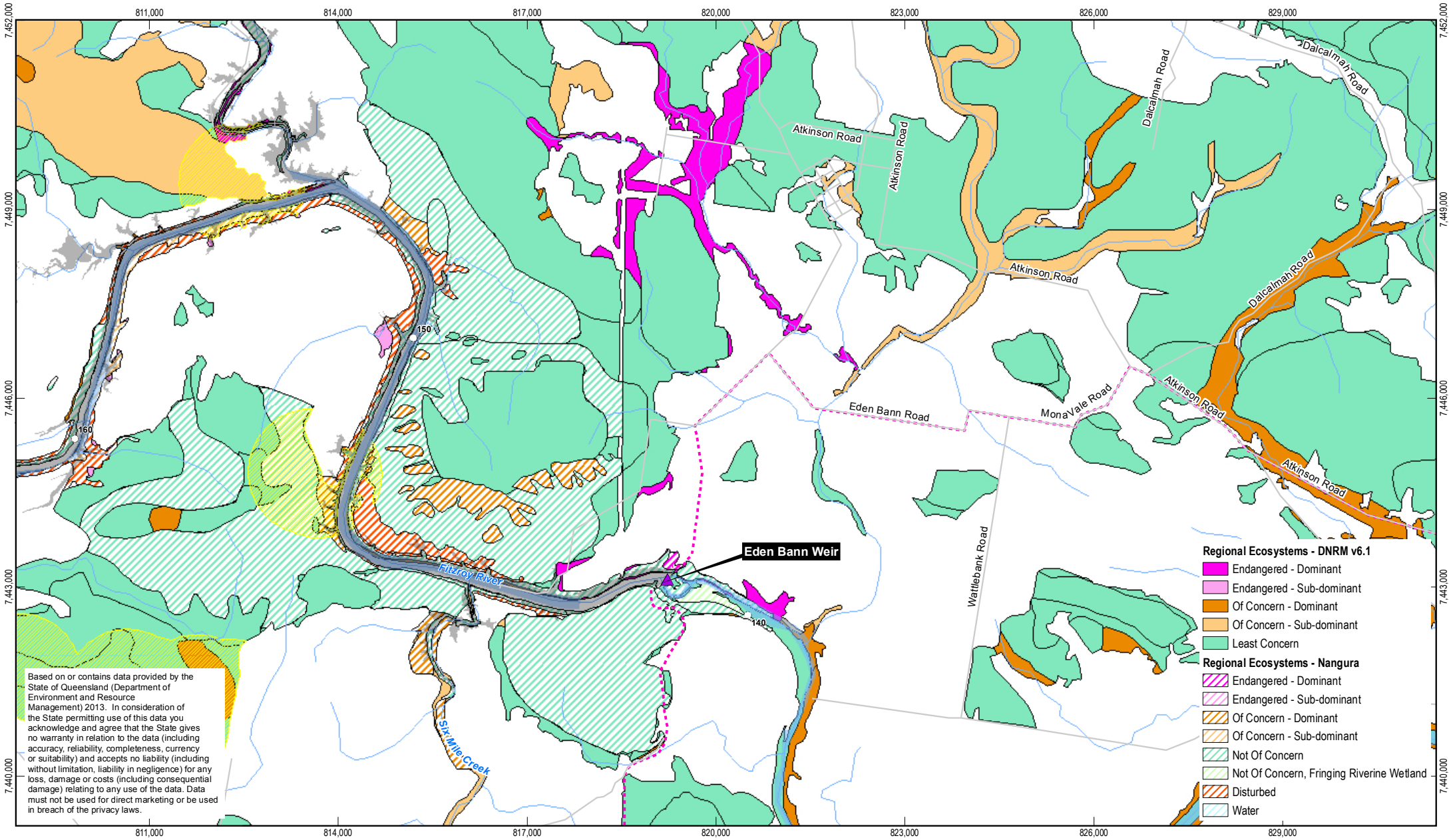

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LEGEND

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Figure 6-3 Sheet 1 of 4

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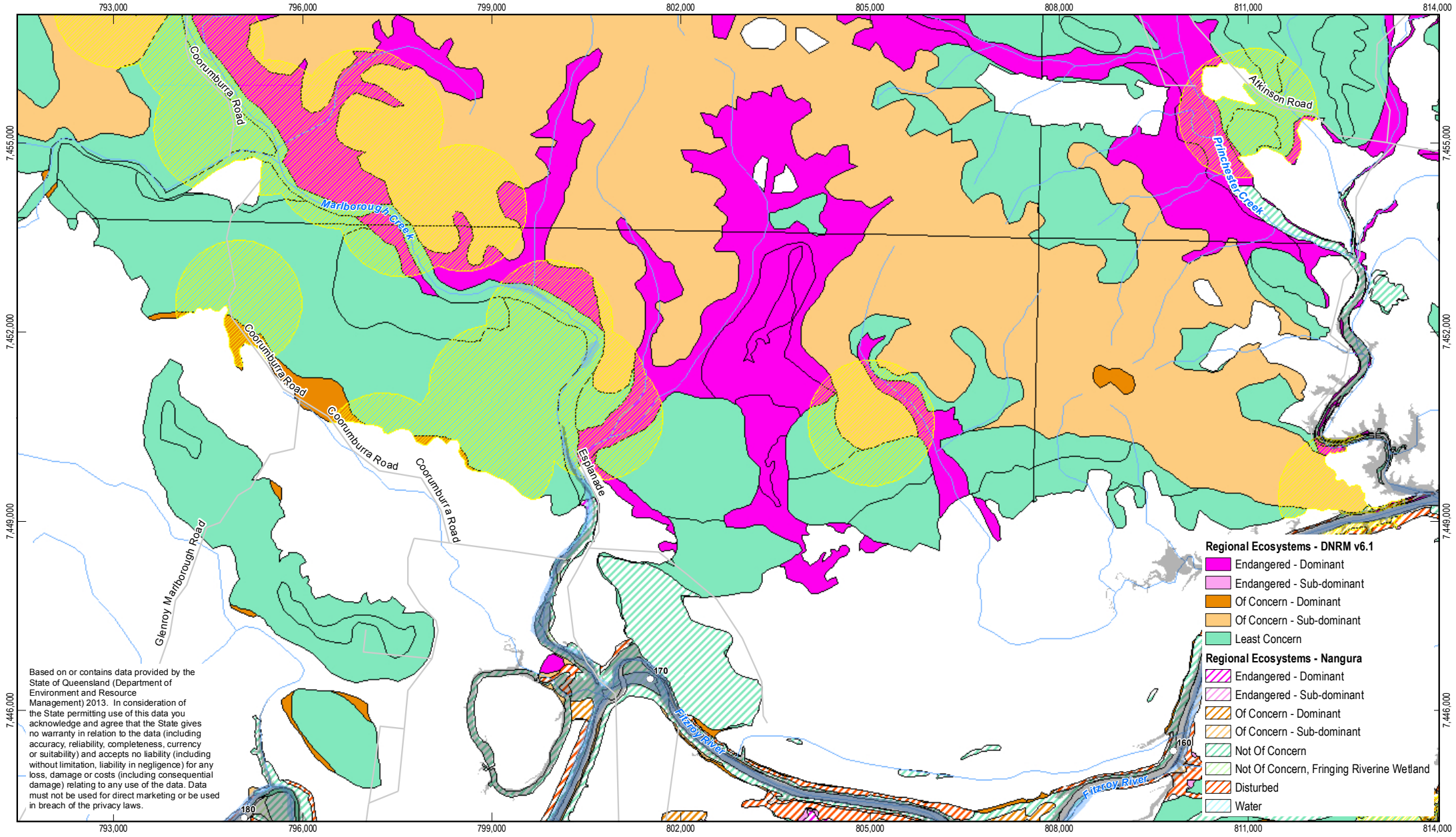

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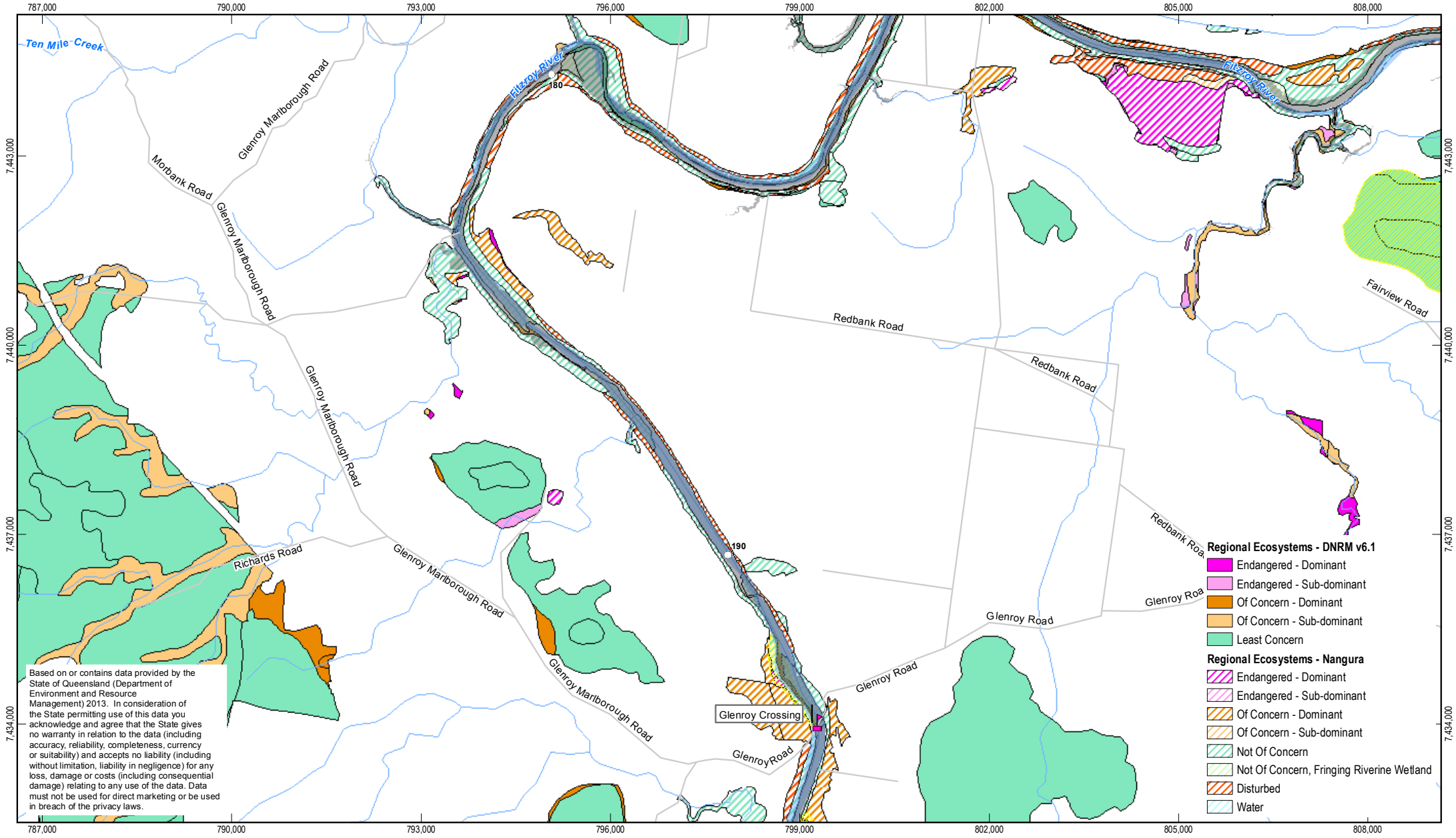

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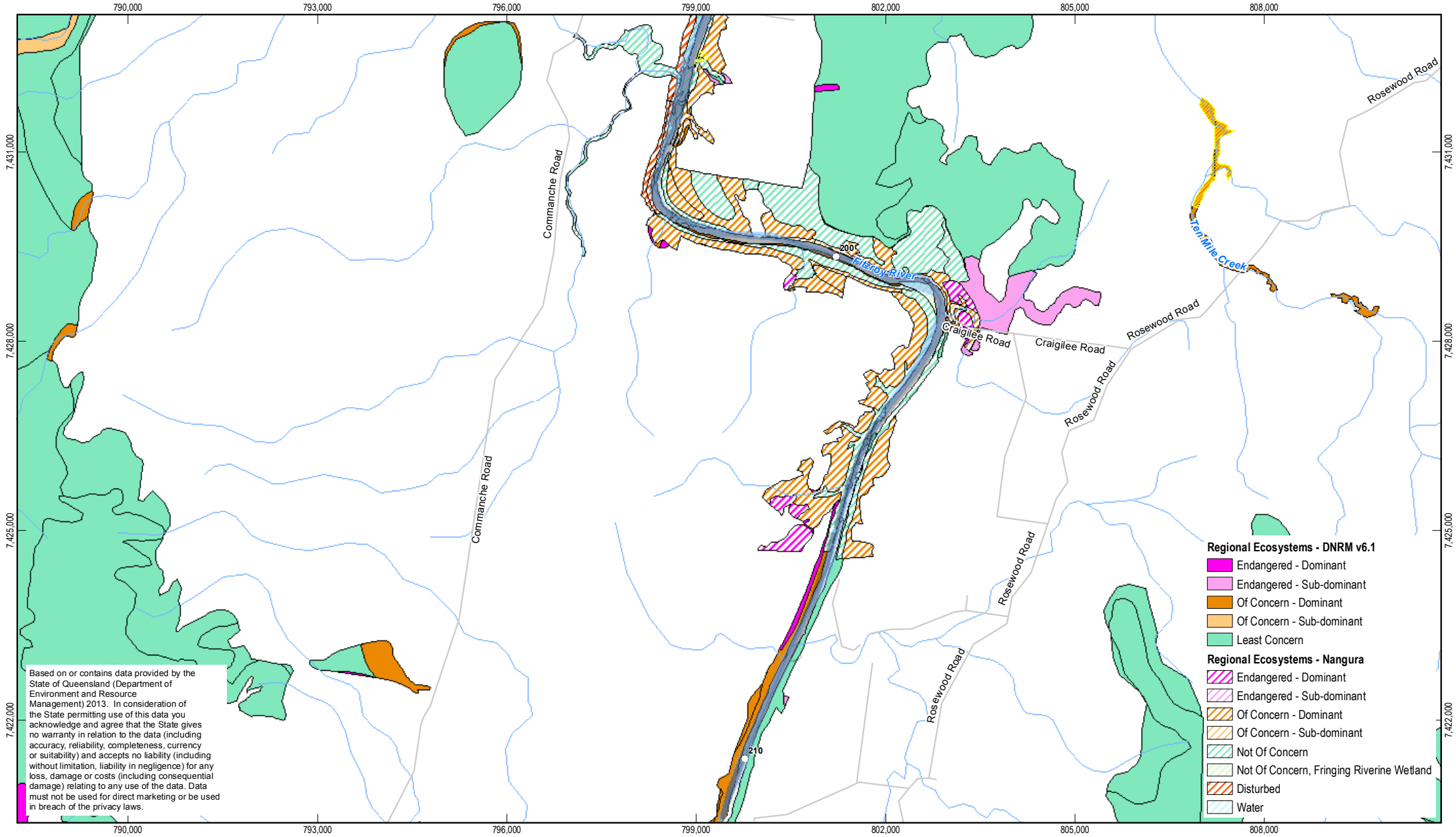

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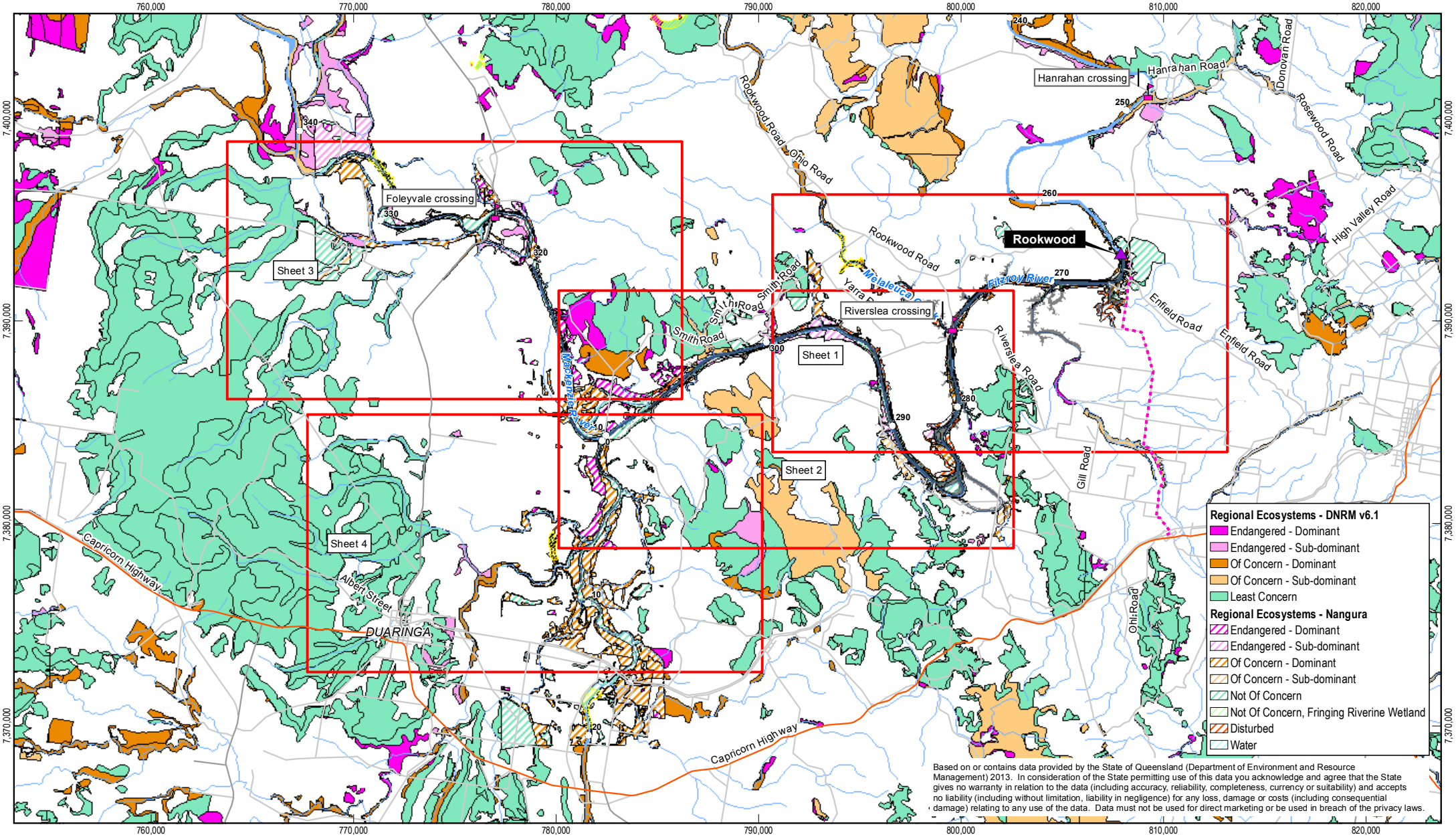

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Highway
- Major Road
- Secondary Roads
- Access Road
- Impoundment Area (Stage 2)
- Watercourse
- Waterway
- Grid Index
- Essential Habitat

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Revision F
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Rookwood Weir Regional Ecosystem Mapping overall

Figure 6-4

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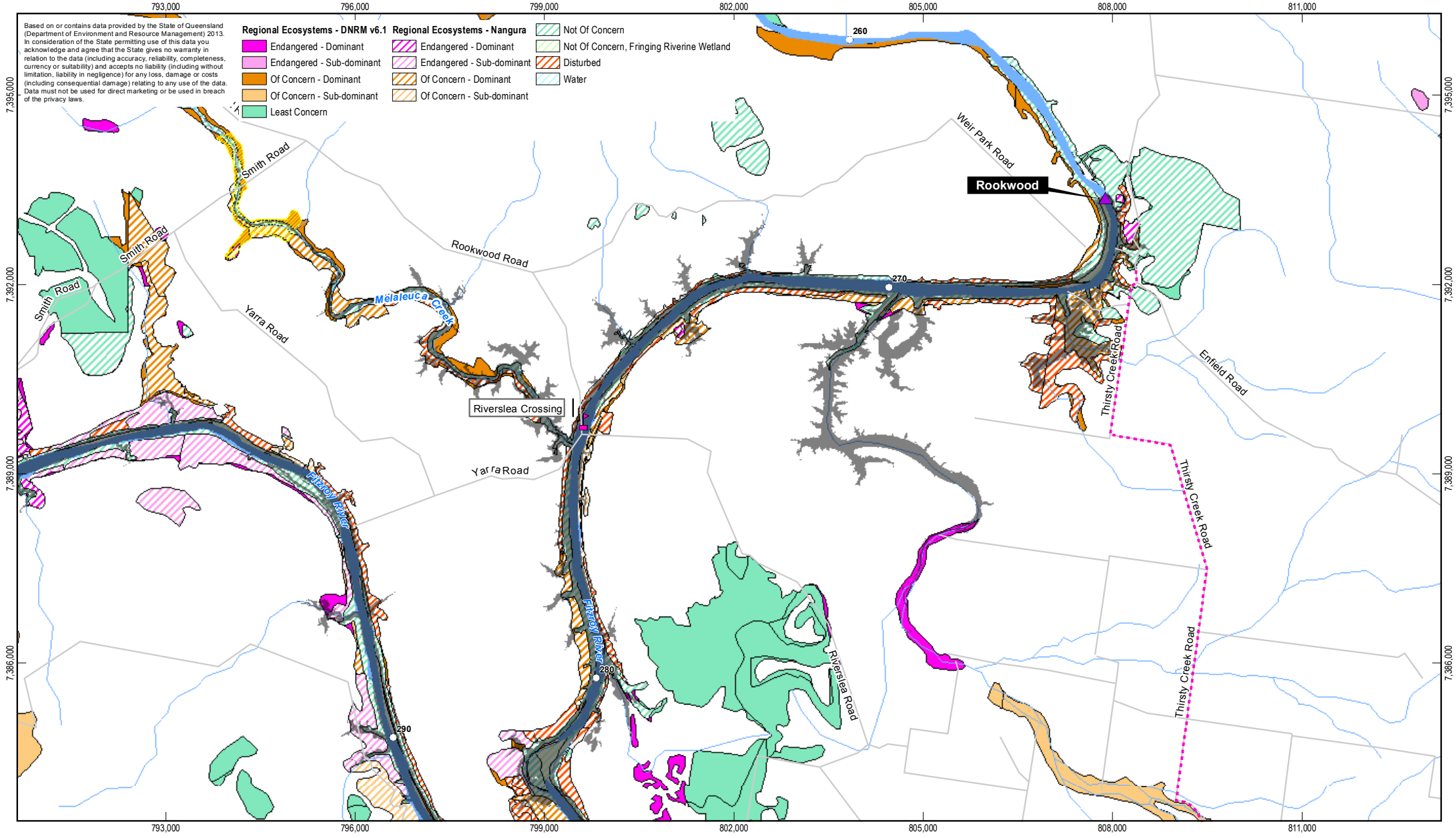

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Highway
- Major Road
- Secondary Roads
- Access Road
- Impoundment Area
- Waterway
- Waterway
- Essential Habitat

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Rookwood Weir Regional Ecosystem Mapping

Figure 6-4 Sheet 1 of 4

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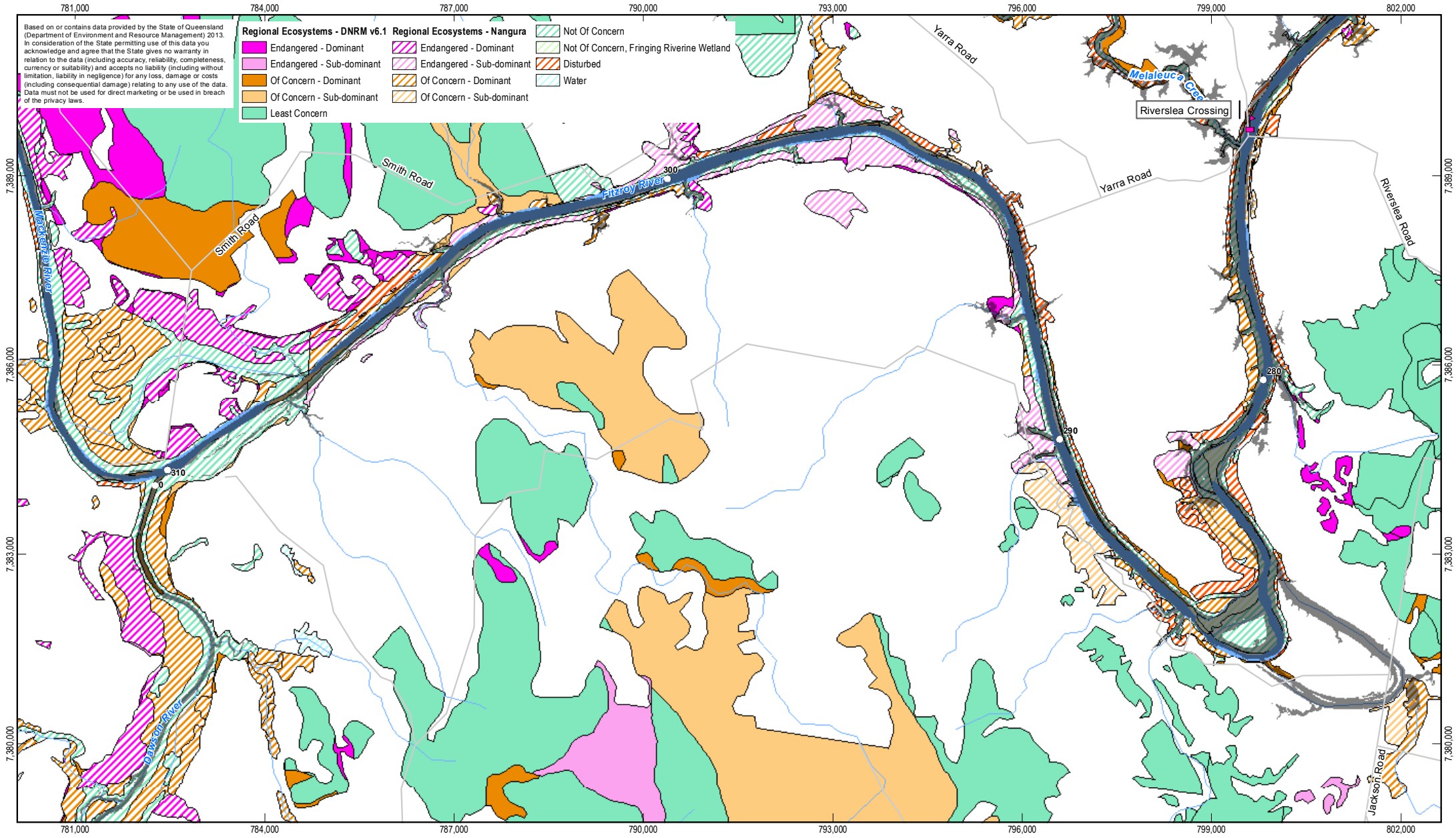

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Highway
- Major Road
- Secondary Roads
- Access Road
- Impoundment Area
- Waterway
- Waterway
- Essential Habitat

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Rookwood Weir Regional Ecosystem Mapping

Figure 6-4 Sheet 2 of 4

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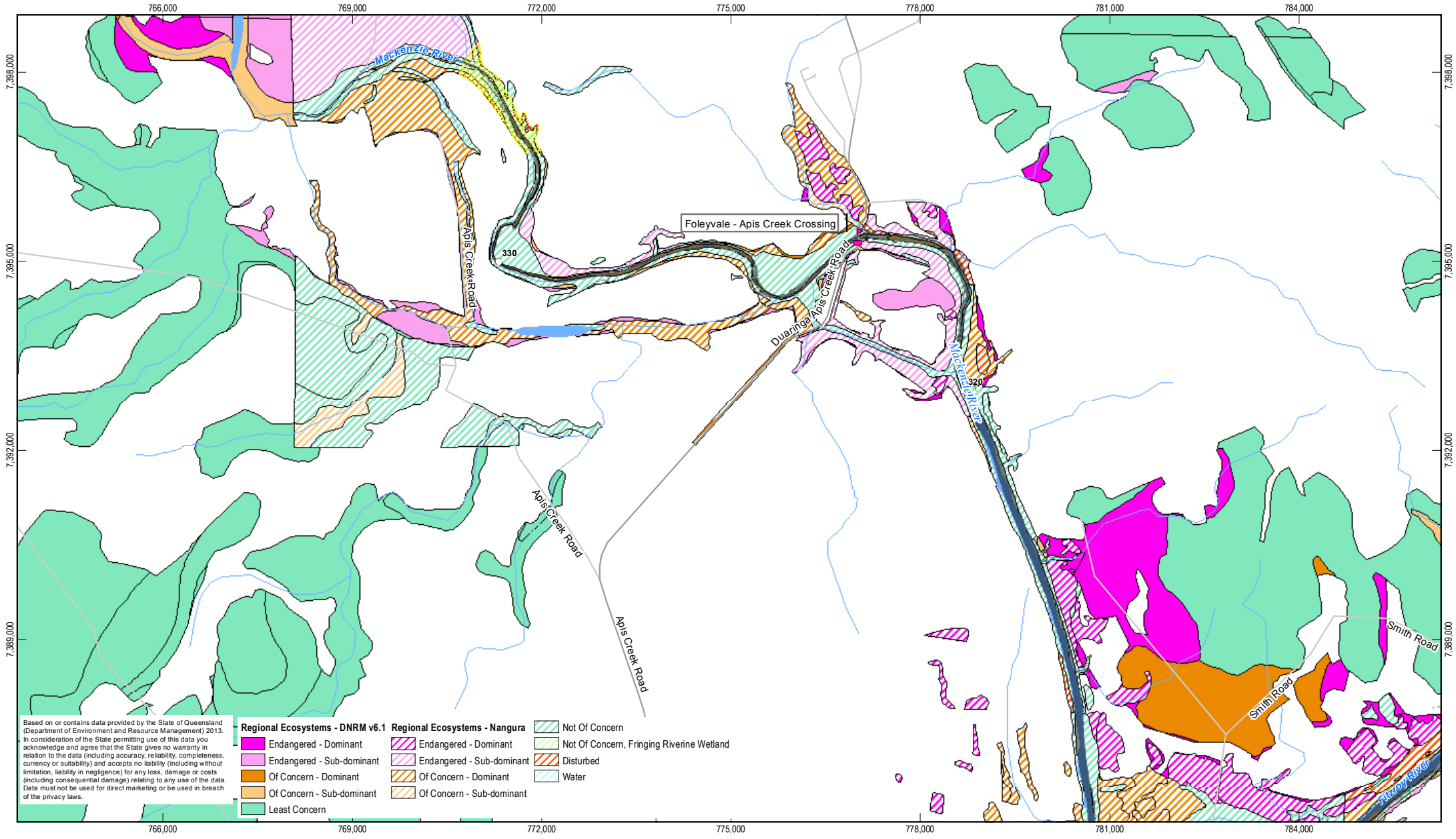

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Highway
- Major Road
- Secondary Roads
- Access Road
- Impoundment Area
- Waterway
- Waterway
- Essential Habitat

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Rookwood Weir Regional Ecosystem Mapping

Figure 6-4 Sheet 3 of 4

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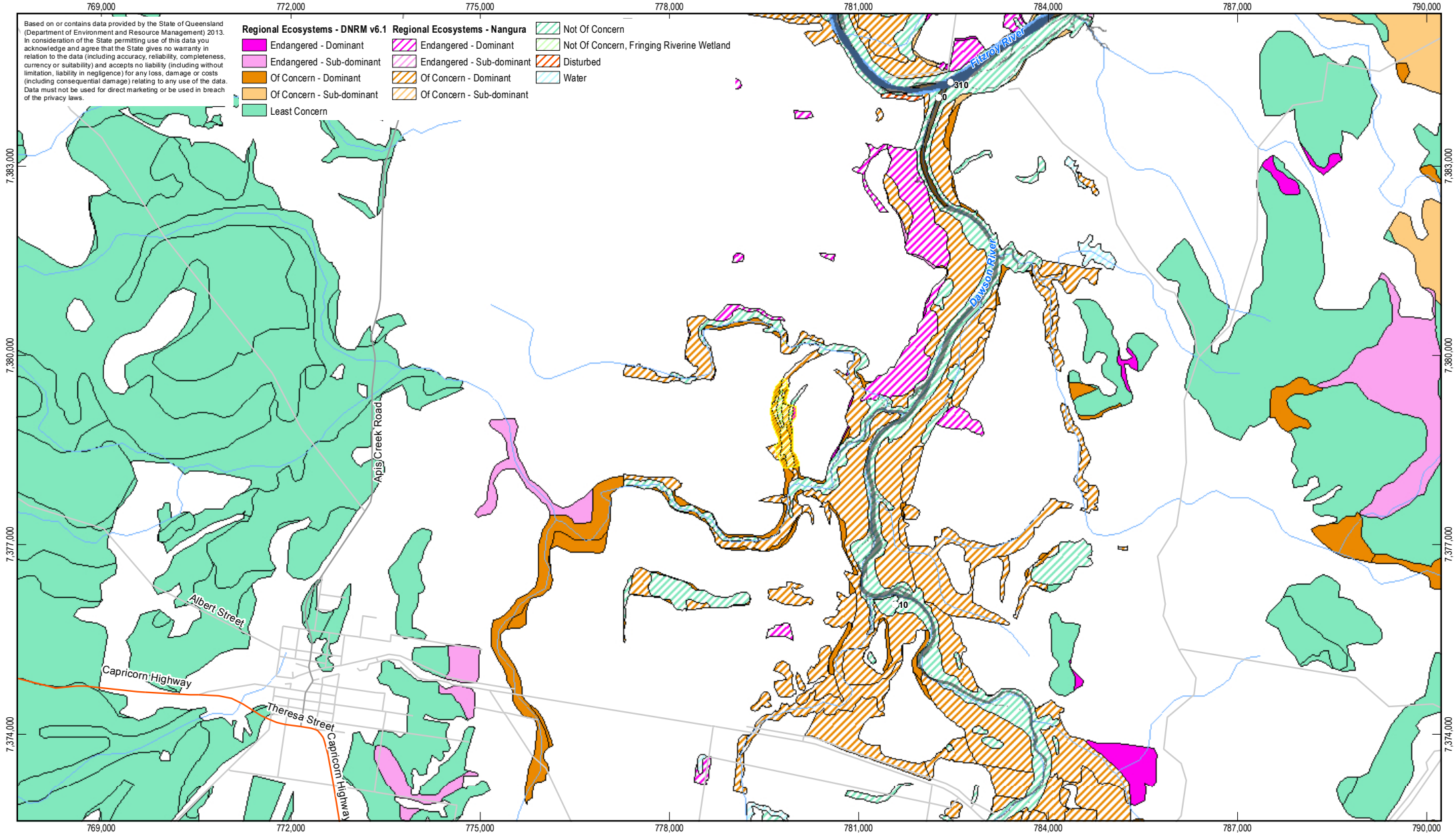

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Kilometres

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LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Highway
- Major Road
- Secondary Roads
- Access Road
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Rookwood Weir Regional Ecosystem Mapping

Figure 6-4 Sheet 4 of 4

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6.2.3.2 Regional ecosystems in the surrounding landscape

REs in adjacent alluvial areas and in the surrounding landscape have been mapped to illustrate any large scale interconnections between areas of remnant vegetation (Figure 6-3, Figure 6-4 and Appendix I). However most of the REs mapped as occurring within the surrounding landscape do not directly connect with those affected by the Project. Further discussion of biodiversity and connectivity is provided in Section 6.2.6.

For the regional ecosystems identified as occurring within the Project footprint (Section 6.2.3.1), Table 6-4 shows the extent of each RE within the surrounding landscape, the Fitzroy Basin catchment and within the Brigalow Belt bioregion. The extent of each RE within protected area estate (national parks, conservation parks, resource reserves, state forests, forest reserves) in both the Fitzroy Basin catchment and the Brigalow Belt bioregion is also provided.

Table 6-4 Extent of relevant regional ecosystems within the region

Regional ecosystem	Within 1 km of the Project footprint (ha)	Within 2 km of the Project footprint (ha)	Within the Fitzroy Basin catchment* (ha)	Within Brigalow Belt bioregion (ha)	Extent within protected area estate within Fitzroy Basin catchment*		Extent within protected area estate within Brigalow Belt bioregion	
					ha	%	ha	%
11.3.1	890	1358	35,153	80,610	4,240	12.0	10,377	12.9
11.3.2	101	129	211,145	517,452	26,374	12.5	47,665	9.2
11.3.3	3,661	4,932	49,567	281,071	1,193	2.4	7,005	2.5
11.3.4	274	380	109,013	183,695	922	0.9	19,709	10.7
11.3.9	4	4	6,477	64,225	892	13.8	1,098	1.7
11.3.25	4,376	4,703	109,576	513,711	2038	1.9	29,490	5.7
11.3.27	165	271	12,768	49,086	357	2.8	2,134	4.4
11.3.38	79	246	8,064	9,577	36	0.4	92	1.0
11.11.1	268	1,003	108,848	160,931	27,512	25.3	49,144	30.5
11.11.7	2,182	4,179	47,821	50,909	3,776	7.9	4,252	8.3
11.11.10	20	136.6	43,941	87,063	3,401	7.7	3,827	4.4
11.12.1	327	955	205,365	847,961	25,668	12.5	65,229	7.7
11.12.2	205	345	5,301	190,352	624	11.7	8,760	4.6

Source: Accad et al. 2012

* The Fitzroy Basin catchment comprises the Comet River, Dawson River, Fitzroy River, Isaac River, Mackenzie River and Nogoa River sub-catchments.

6.2.3.3 Bio-condition analysis

The bio-condition analysis found no sites for any habitat in near-pristine condition yet did conclude that roughly one third of sites were in relatively good condition for the 2006 landscape along the lower Fitzroy alluvial areas (Nangura 2007). Another one third of the bio-condition sampling sites were rated as having 'average' condition and frequently included some weeds in the ground layers and other devaluing impacts that possibly relate to recent grazing regimes and /

or past logging activities (Nangura 2007). Bio-condition scores were impacted negatively by the proximity of extensive areas of cleared alluvial plains across most of the Project area.

6.2.4 High value regrowth

Patches of high value regrowth are mapped by DNRM (2011) along the Fitzroy, Dawson and Mackenzie rivers with approximately 558 ha occurring within the Project footprints (Figure 6-5 and Figure 6-6 for Eden Bann Weir and the proposed Rookwood Weir, respectively). The bio-condition assessment of the non-remnant regrowth areas found that habitat elements essential for long-term recovery were lacking or highly degraded (Nangura 2007). It was noted that many sites would be unlikely to recover rapidly without management support such as fencing to control grazing pressure, revegetation, artificial nest boxes, weed management and other site specific measures.

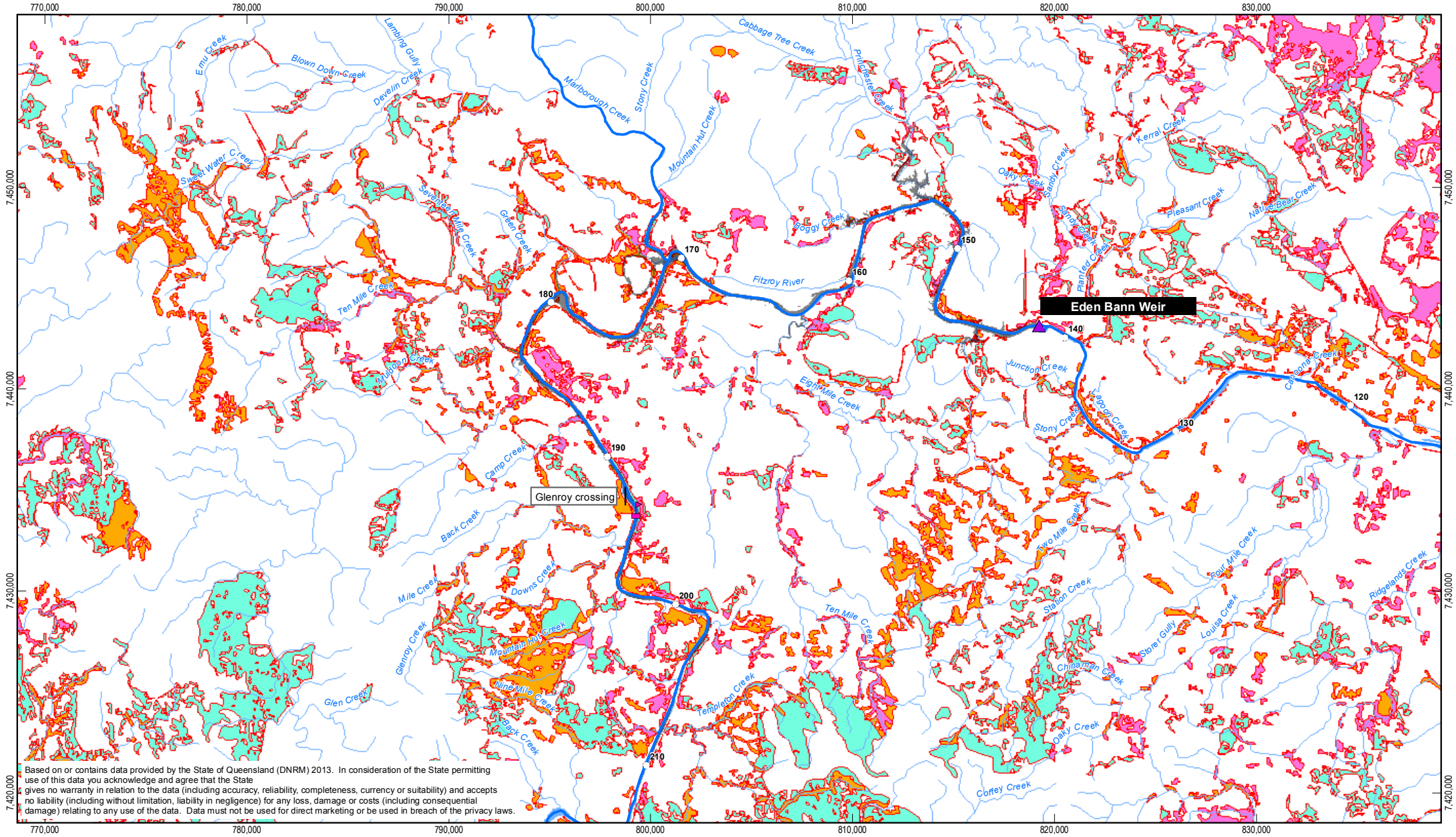
6.2.5 Essential habitat

Nangura's (2007) review of the essential habitat mapping for the Eden Bann Weir study area revealed one flora essential habitat area along Marlborough Creek in the upper reach of the impoundment (Stage 3). This essential habitat mapping area relates to serpentine endemics on hills and colluvials (*Stackhousia tryonii, Pimelea leptospermoides* and *Capparis thozetiana)* and along watercourses (*Neoroepera buxifolia*).

A review of later DNRM Essential Habitat mapping (Version 3.1, 2011) showed additional essential habitat areas within the Project footprints as follows:

- Two areas of essential habitat for *Macrozamia serpentina* and *Capparis humistrata* along the Fitzroy River (adjacent to the existing Eden Bann Weir impoundment) at 147 km and 155 km adopted middle thread distance (AMTD). At 147 km AMTD a small area of RE 11.11.7 occurs within the proposed impoundment. RE 11.11.7 is a mandatory essential habitat factor for *Capparis humistrata and Macrozamia serpentina*. However, the species record for *Capparis humistrata* was made approximately 250 m from the impoundment within habitat different to that within the impoundment. No specimens of *Capparis humistrata* were found during field surveys
- A large area of essential habitat for *Macrozamia serpentina, Capparis thozetiana, Pimelea leptospermoides* and *Stackhousia tryonii* along Marlborough Creek (171 km AMTD) in the upper reach of the proposed Eden Bann Weir impoundment (Stage 3). Field surveys conducted by Nangura did not return evidence of these species within the proposed impoundment
- Essential habitat for the Fitzroy River turtle (*Rheodytes leukops*) at 192 km AMTD on the Fitzroy River in the vicinity of Glenroy Crossing within the proposed Eden Bann Weir impoundment
- Essential habitat for ooline (*Cadellia pentastylis*) along the Mackenzie River at 333 km AMTD within the proposed Rookwood Weir (Stage 3) impoundment. It is considered unlikely that essential habitat for this species occurs within the Project footprint as the mapped area does not support essential habitat factors and the species record is from outside the mapped area.

Essential habitat areas are shown on Figure 6-3 and Figure 6-4 for the Eden Bann Weir and proposed Rookwood Weir Project footprints and Section 6.2.7 provides a summary of the assessment of likelihood of occurrence within the Project footprints for each species.



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Kilometres

Map Projection: Universal Transverse Mercator
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Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Waterway
- Impoundment Area

High Value Regrowth (DERM-2011)

- Containing Endangered regional ecosystems
- Containing Of Concern regional ecosystems
- Is a Least Concern regional ecosystem

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Eden Bann Weir regrowth vegetation

Figure 6-5

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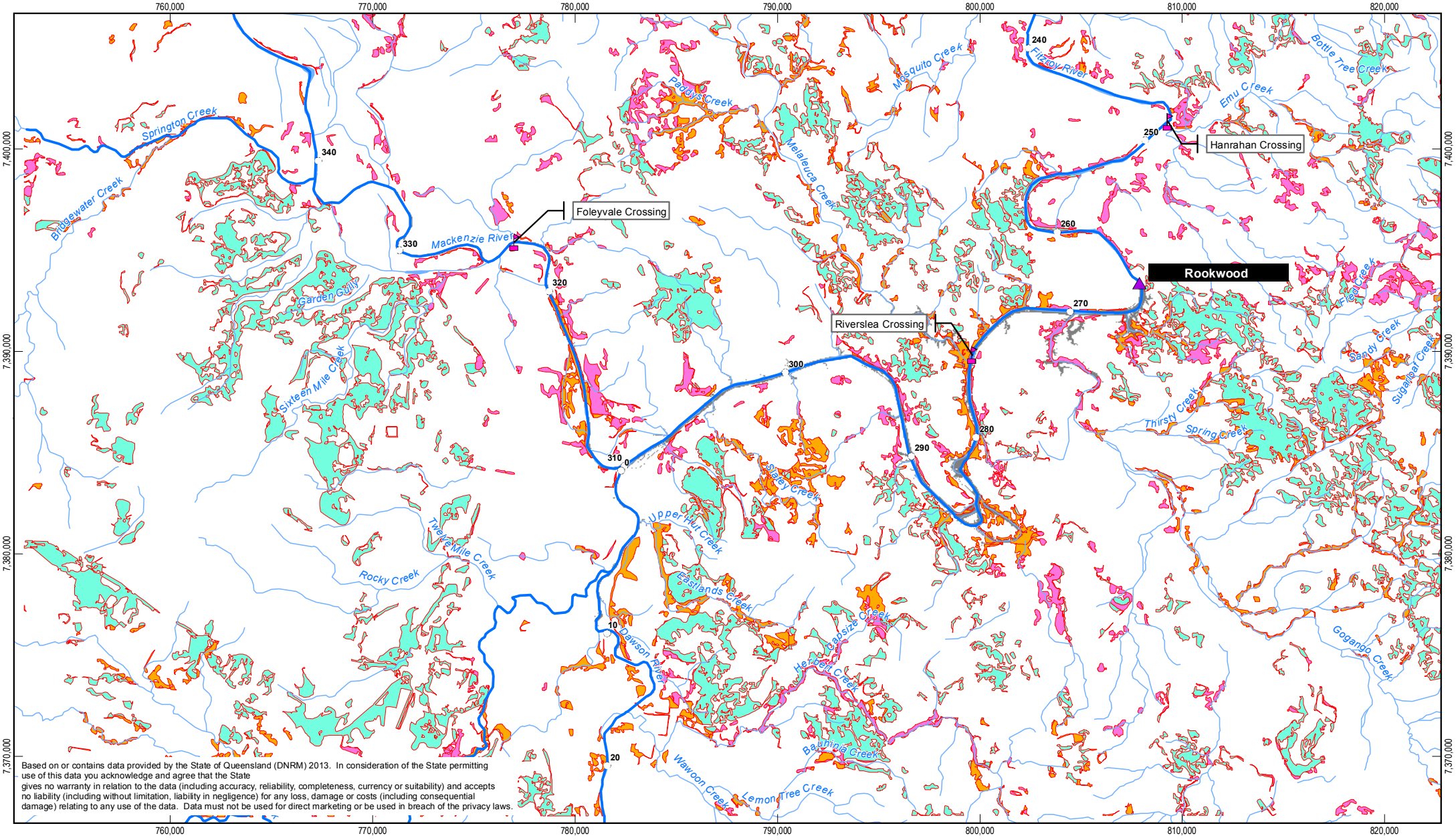

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Kilometres

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N

LEGEND

- AMTD (km)
- Weir Location
- River Crossing
- Waterway
- Impoundment Area

High Value Regrowth (DERM-2011)
- Containing Endangered regional ecosystems
- Containing Of Concern regional ecosystems
- Is a Least Concern regional ecosystem

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Rookwood Weir regrowth vegetation

Figure 6-6

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6.2.6 Biodiversity and connectivity

Habitat connectivity has been impacted on in lower lying areas by vegetation clearing for agriculture. The most extensive areas of interconnected habitat exist on higher reaching ground where limited vegetation clearing has occurred. These areas support extensive networks of open woodland habitats with rocky substrate. Given their connectivity and unique resource values, these areas have high ecological value as habitat and regional corridors for wildlife movement. Under the Queensland Government's Biodiversity Planning Assessment mapping, these areas are classified as being state significant bioregional wildlife corridors (Figure 6-7 and Figure 6-8 for Eden Bann Weir and Rookwood Weir, respectively). Within the agricultural lowland areas, vegetation has been retained predominantly along the riparian fringe. Although this lowland vegetation has been subjected to significant edge effects and impacts from cattle, it plays an important ecological role, providing both habitat and a level of connectivity between habitat remnants.

6.2.7 Conservation significant flora species

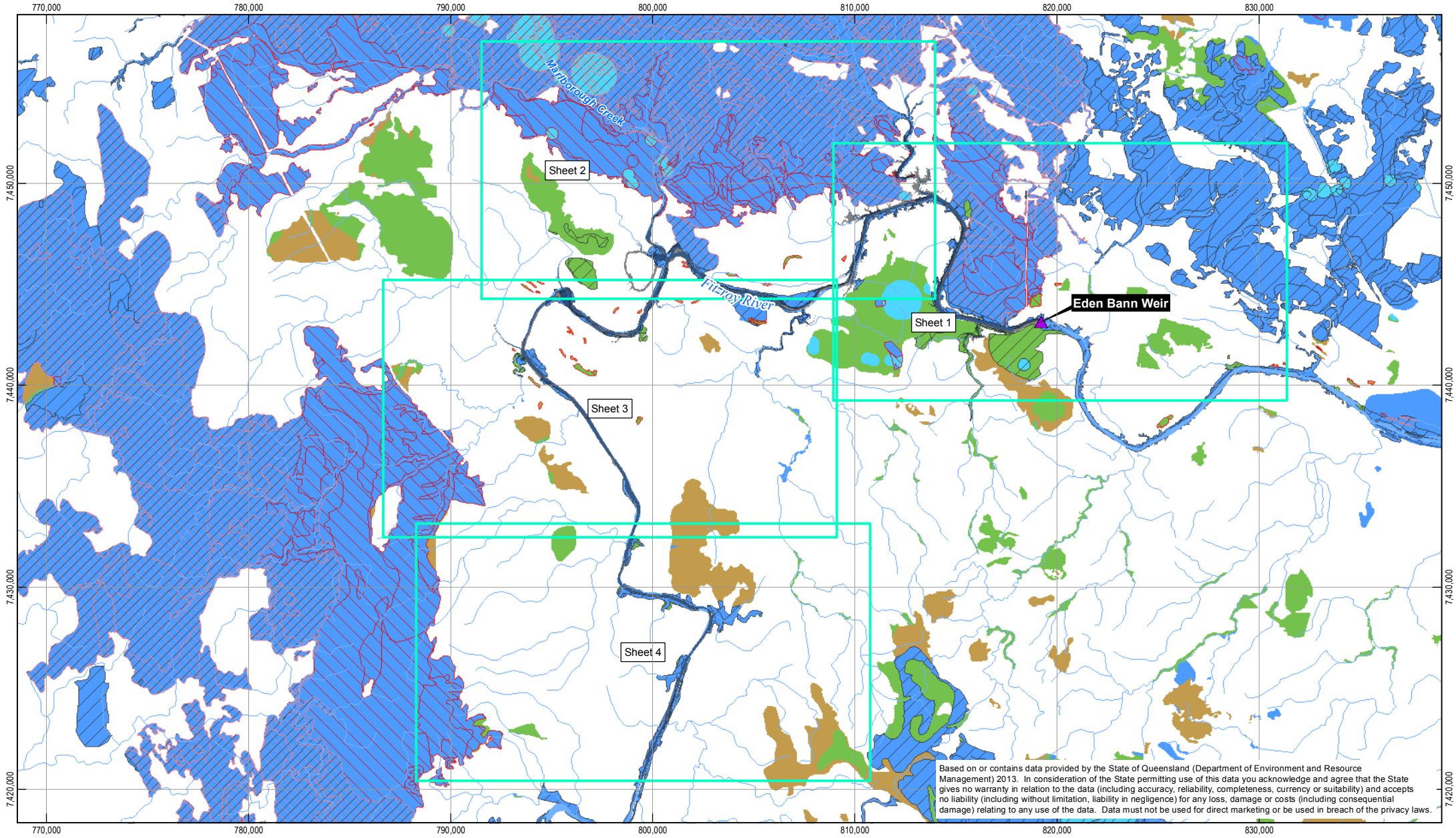
Table 6-5 summarises the conservation significant flora species identified in preliminary desktop searches as potentially present in the Project footprints. Table 6-5 also provides a summary of the assessment of likelihood of occurrence within the Project footprints for each species based on available data and field survey.

6.2.8 Culturally significant flora

A single plant used for medicinal purposes by the Darumbal People has been identified during previous cultural heritage surveys in the vicinity of the Project area (Central Queensland Cultural Heritage Management Pty Ltd 2007) (Chapter 17 Cultural heritage). This plant is commonly called *gumbi gumbi* and is otherwise known as cattlebush (*Pittosporum angustifolium*). It has been described as a multipurpose bush medicine in the central Queensland region, and many Aboriginal groups value its broad medicinal qualities. The plant, previously found in areas that have been subject to large scale land clearing and development, is grazed by cattle. Isolated individual specimens are highly valued, and their location quickly transmitted in the community.

6.2.9 Flora of commercial significance

A number of hardwood species with potential commercial value exist within the Project footprints. Potential timber resources within the Project footprints primarily include forest red gum or blue gum (*Eucalyptus tereticornis*) and river red gum (*Eucalyptus camaldulensis*), with a lower abundance of numerous other species that may include: spotted gum (*Corymbia citriodora*), Moreton Bay ash (*Corymbia tessellaris*), coolabah (*Eucalyptus coolabah*), narrow-leaved ironbark or narrowleaf red ironbark (*Eucalyptus crebra*), grey box or gum-topped box (*Eucalyptus moluccana)* and poplar box or bimble box (*Eucalyptus populnea*). To date, the occurrence of large hardwood individuals within the Project footprints have not been quantified or systematically recorded, although incidental observations of large hardwoods (greater than 600 mm diameter) within the impoundment areas have been noted throughout the Project area. It is expected that areas of remnant Eucalypt-dominated vegetation will feature the highest concentration of potential timber resources.



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Waterway
- Impoundment Area
- Grid Index

BPA Qualifying Information
- Bioregional Corridor
- Habitat Remnant
- Habitat Remnant and Bioregional Corridor

Biodiversity Significance
- State Habitat for EVR taxa
- State
- Regional
- Local or Other Values

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Eden Bann Biodiversity Planning Assessment mapping overview

Figure 6-7

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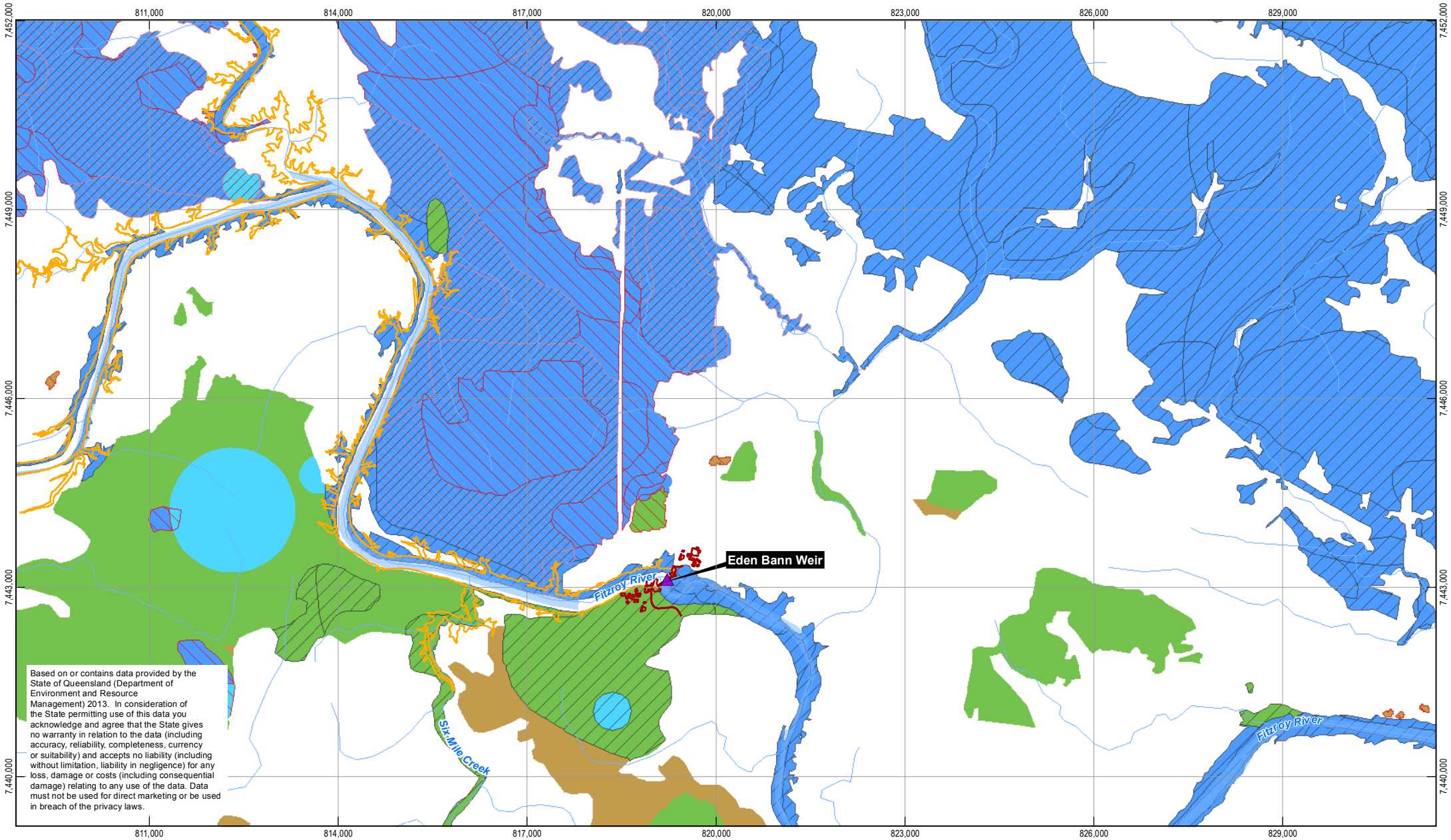

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
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N

LEGEND

- Weir Location
- Waterway
- Impoundment Area
- Construction Footprint

BPA Qualifying Information
- Bioregional Corridor
- Habitat Remnant
- Habitat Remnant and Bioregional Corridor

Biodiversity Significance
- State Habitat for EVR taxa
- State
- Regional
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Eden Bann Biodiversity Planning Assessment mapping sheets

Figure 6-7 Sheet 1 of 4

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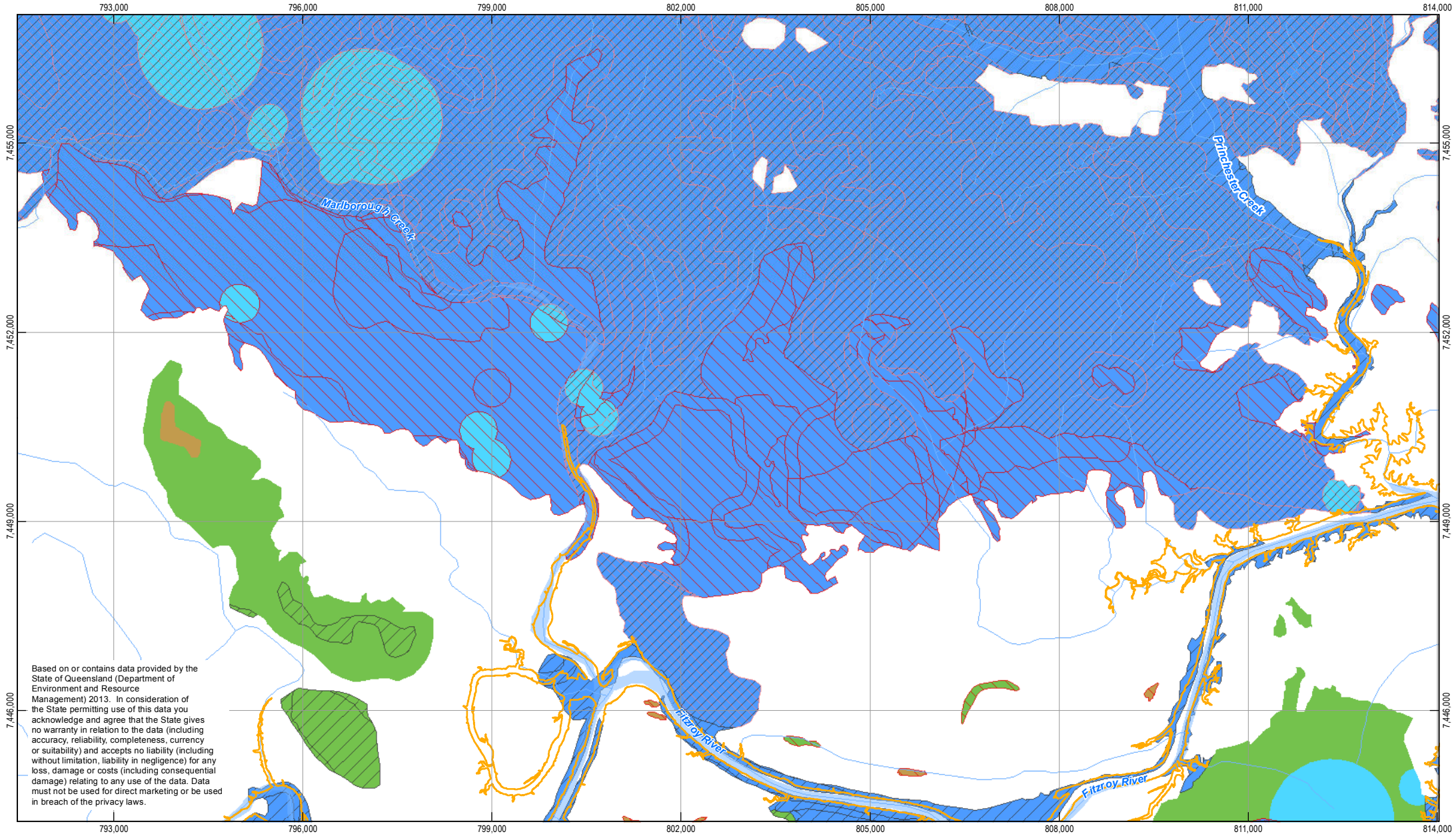

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Horizontal Datum: Geocentric Datum of Australia (GDA94)
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N

LEGEND

- Waterway
- Impoundment Area
- Construction Footprint

BPA Qualifying Information
- Bioregional Corridor
- Habitat Remnant
- Habitat Remnant and Bioregional Corridor

Biodiversity Significance
- State Habitat for EVR taxa
- State
- Regional
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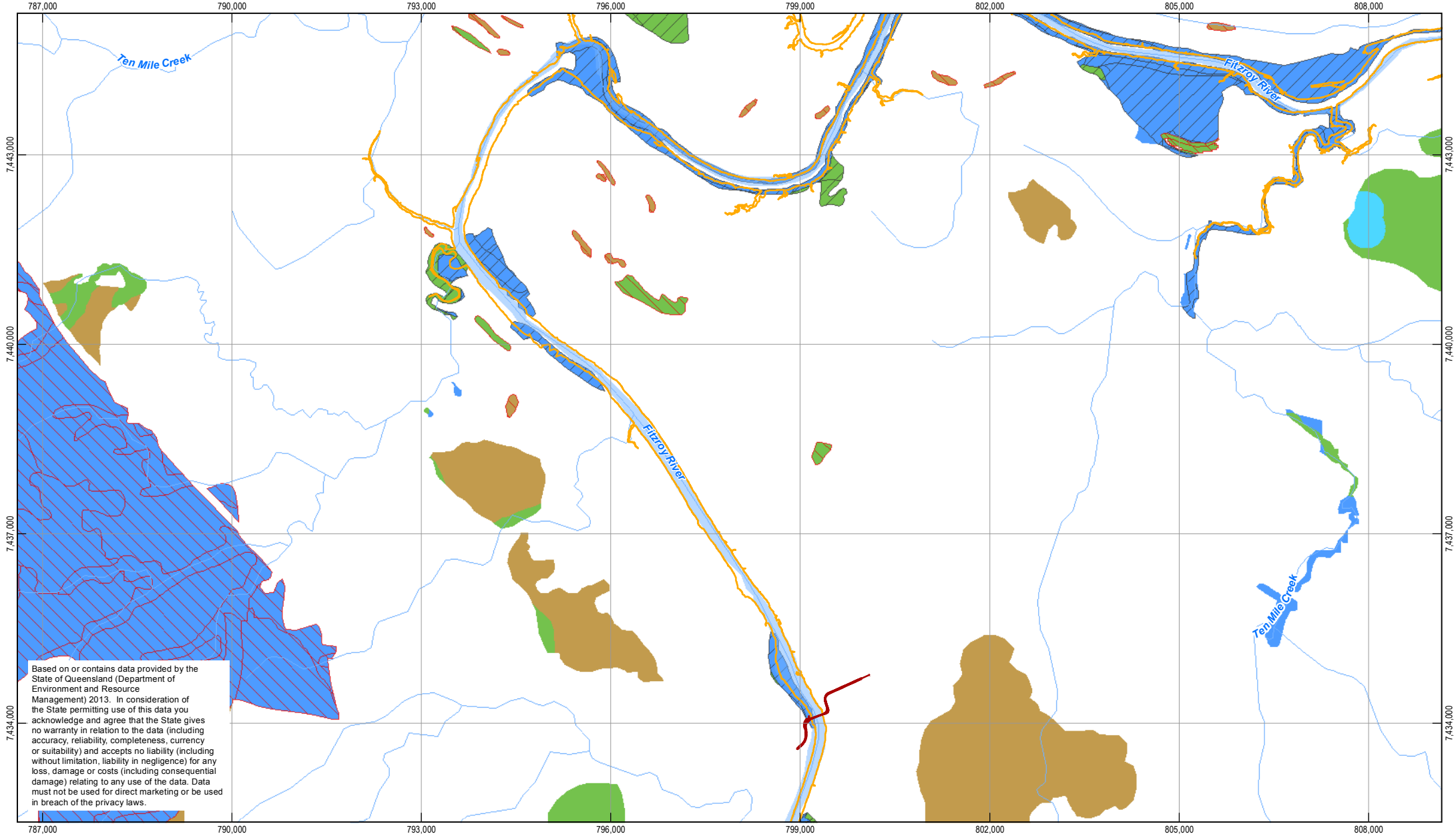

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LEGEND

- Waterway
- Impoundment Area
- Construction Footprint

BPA Qualifying Information
- Bioregional Corridor
- Habitat Remnant

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Eden Bann Biodiversity Planning Assessment mapping sheets

Figure 6-7 Sheet 3 of 4

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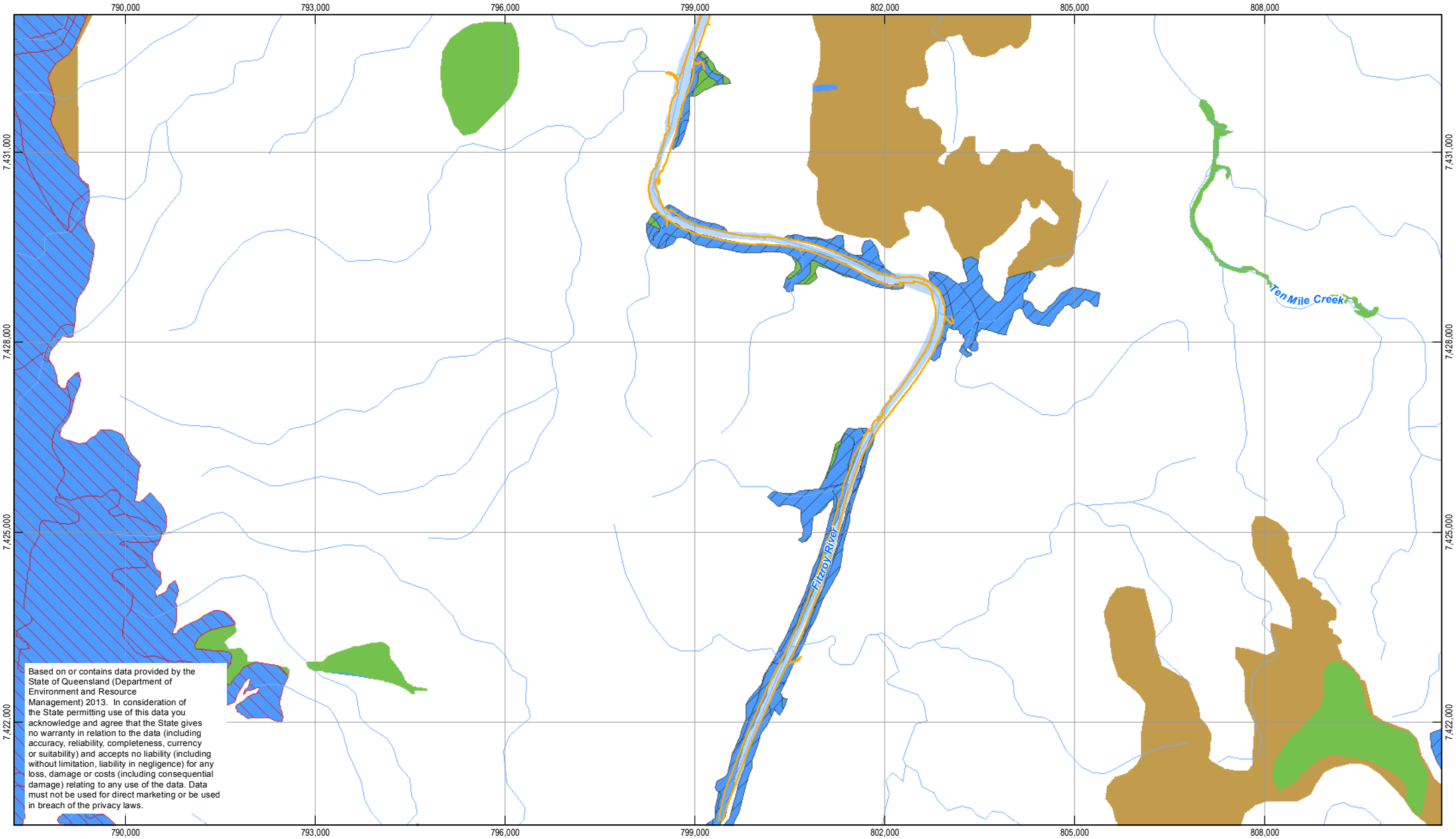

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Waterway
- Impoundment Area
- Construction Footprint

BPA Qualifying Information
- Bioregional Corridor
- Habitat Remnant

Biodiversity Significance
- State
- Regional
- Local or Other Values

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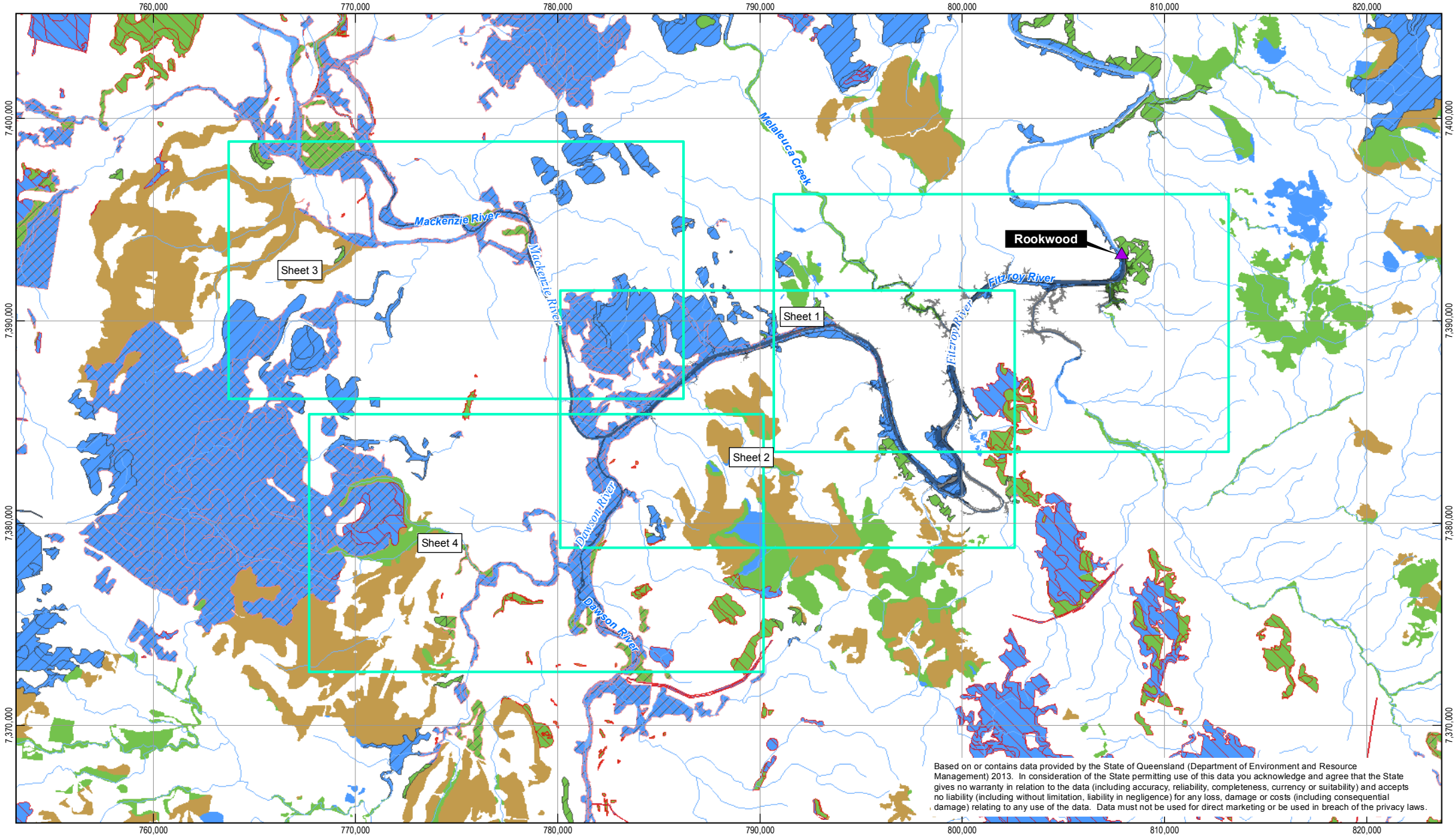

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
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- Grid Index

BPA Qualifying Information
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Biodiversity Significance
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Rookwood Biodiversity Planning Assessment mapping overview

Figure 6-8

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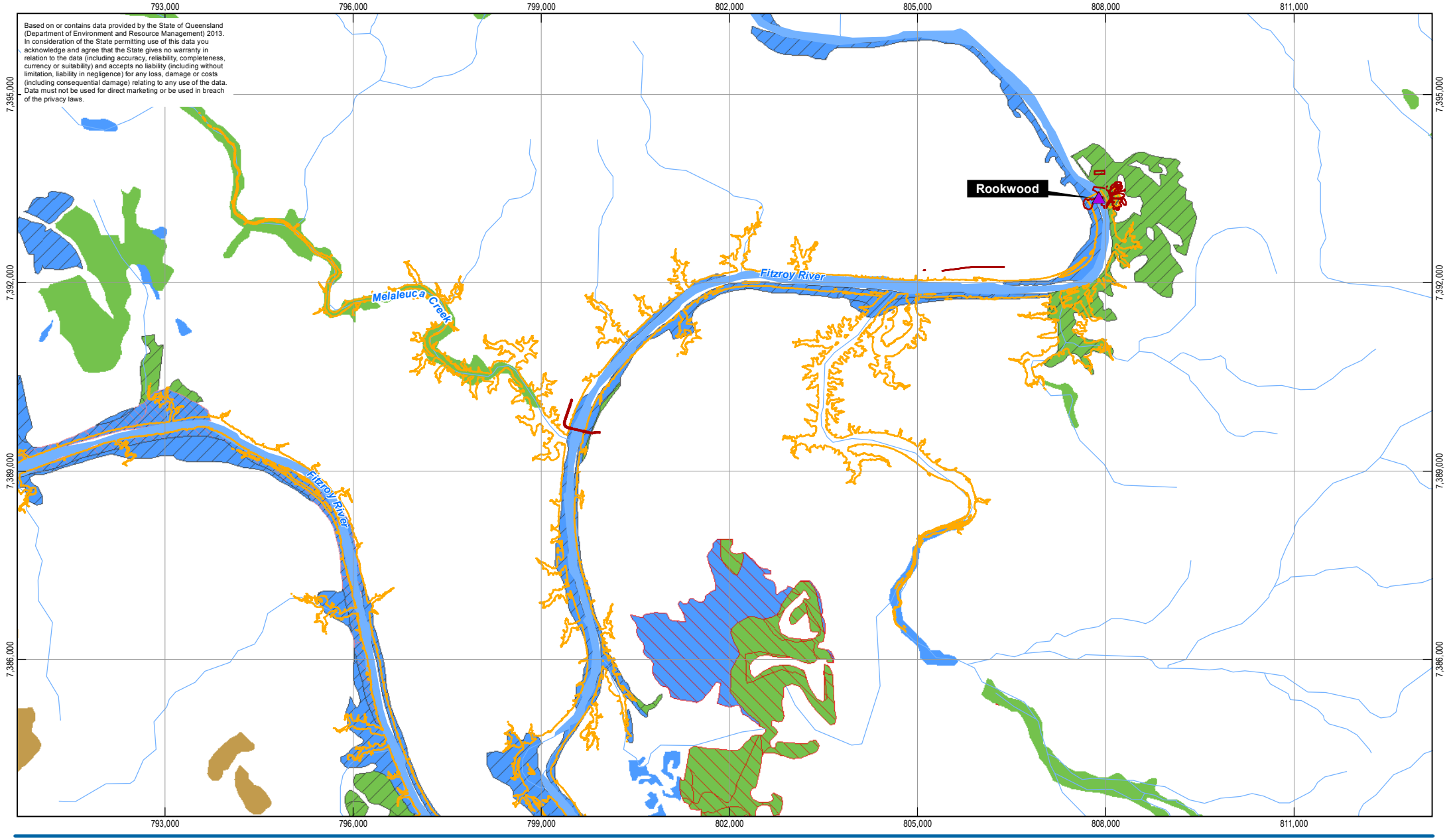

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

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- Impoundment Area
- Construction Footprint

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- Habitat Remnant and Bioregional Corridor

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Rookwood Biodiversity Planning Assessment mapping sheets

Figure 6-8 Sheet 1 of 4

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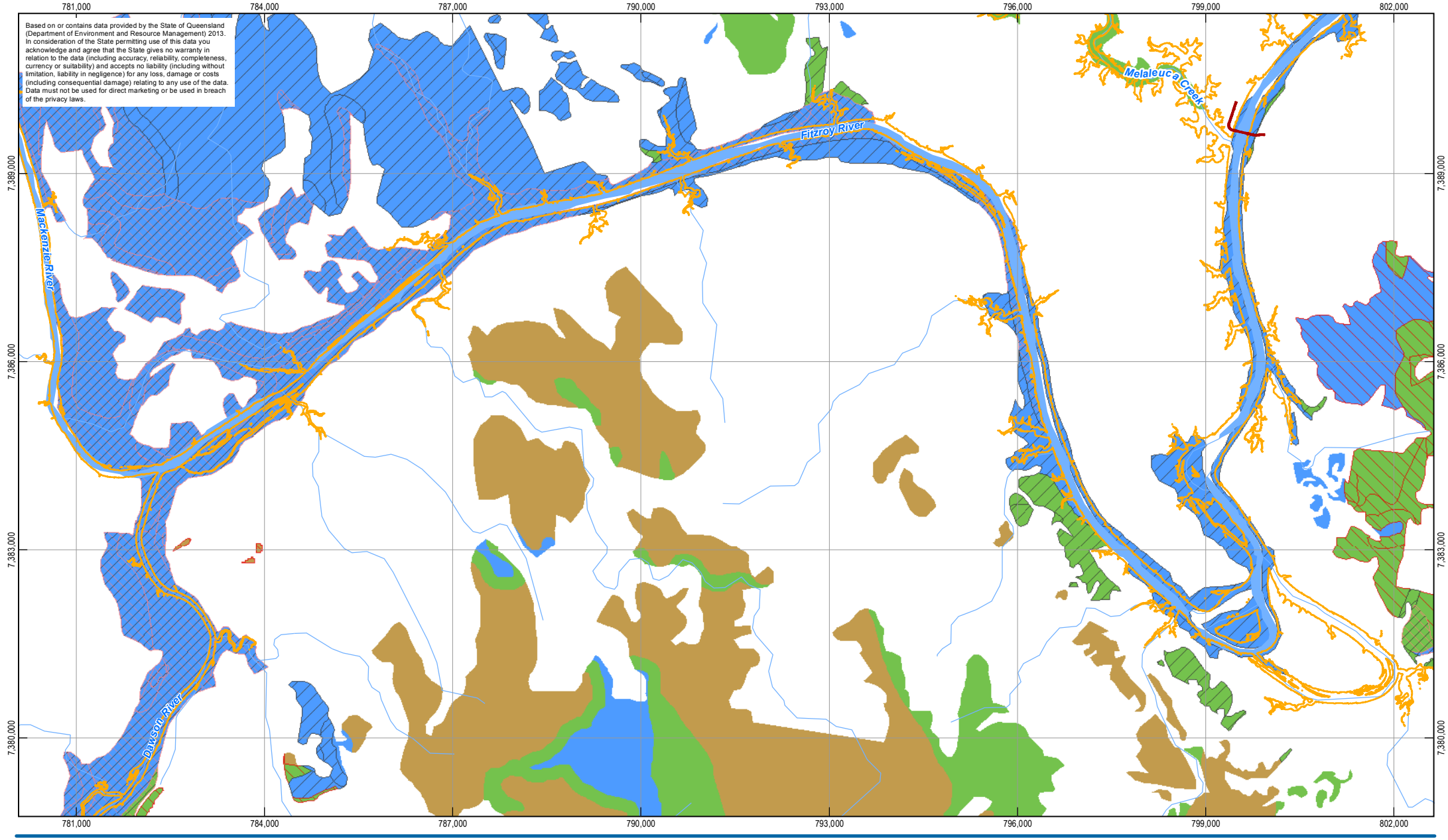

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Rookwood Biodiversity Planning Assessment mapping sheets

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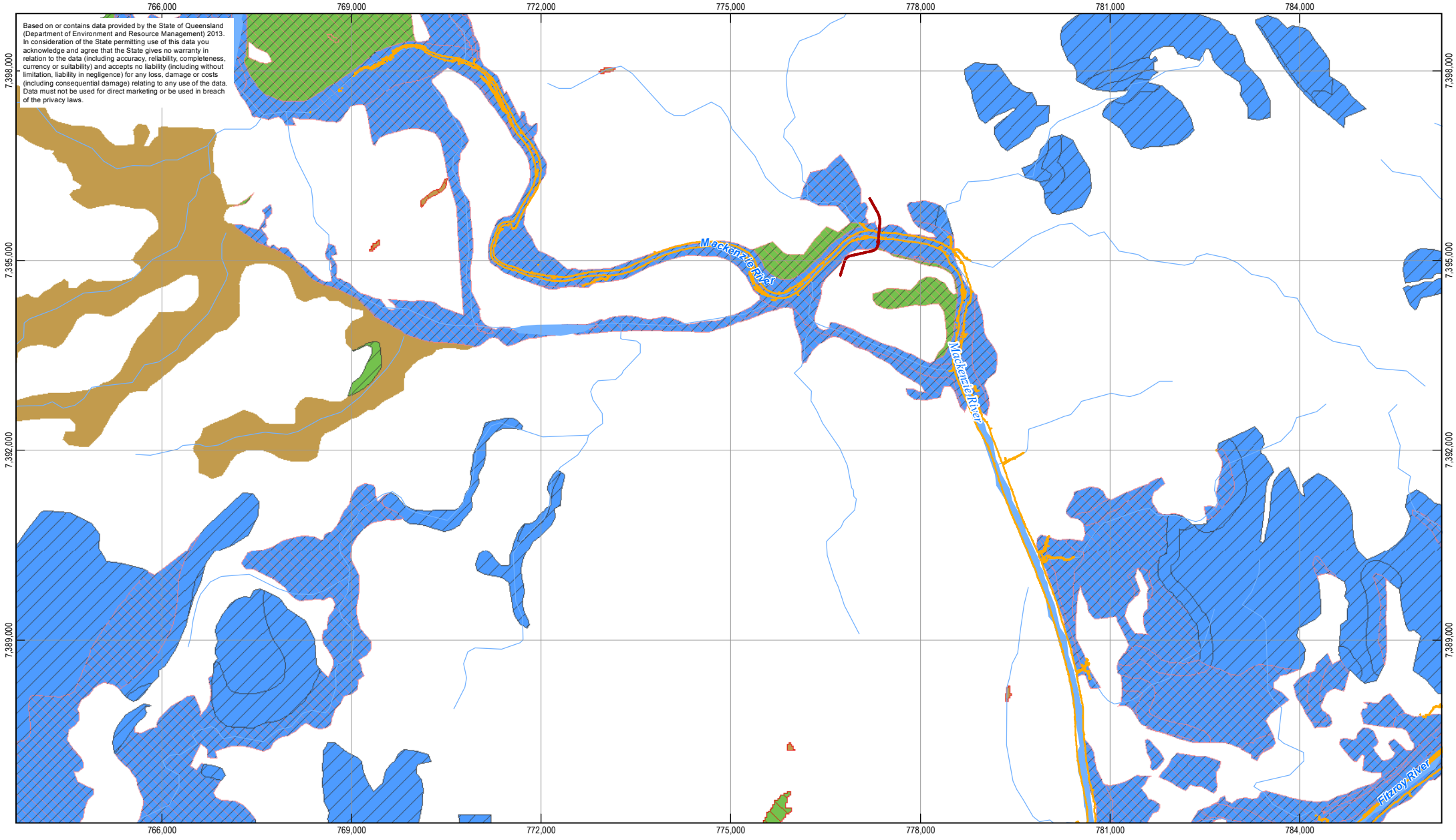

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Rookwood Biodiversity Planning Assessment mapping sheets

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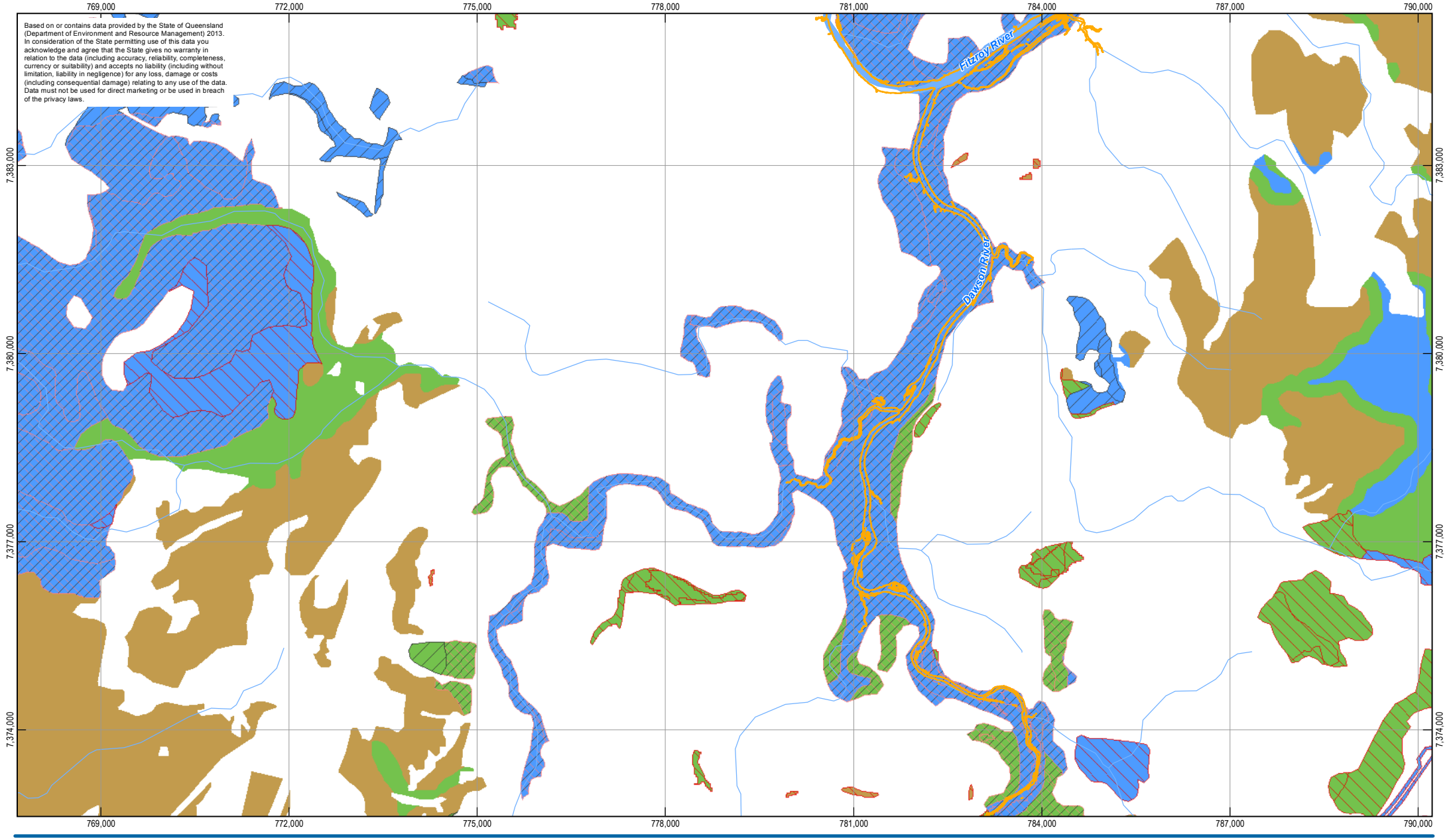

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Rookwood Biodiversity Planning Assessment mapping sheets

Figure 6-8 Sheet 4 of 4

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Table 6-5 Conservation significant flora potentially relevant to the Project footprint

Family	Scientific Name	Status NC Act*	Status EPBC Act*	Likelihood of occurrence
Pittosporaceae	*Bursaria reevesii*	V	-	Moderate potential to occur. Species has not been recorded within desktop search extent but potentially suitable habitat is present within the Project footprint (inhabits drainage lines and creek beds).
Cycadaceae	*Cycas megacarpa*	E	E	Moderate potential to occur. Species has not been recorded within desktop search extent but potentially suitable habitat is present within Project footprint (known REs inhabited by this species include RE 11.3.25 that is within Project footprint).
Poaceae	*Digitaria porrecta*	NT	E	Moderate potential to occur. Species has not been recorded within desktop search extent but potentially suitable habitat is present within Project footprint (inhabits *Eucalyptus tereticornis* communities along drainage lines).
Euphorbiaceae	*Neoroepera buxifolia*	V	V	Moderate potential to occur. Population was located during field surveys in the upper region of Princhester and Marlborough Creeks^. No specimens were recorded within the Project footprint although potentially suitable habitat is present within the proposed Eden Bann Weir impoundment. Unlikely to be any naturally sustainable populations of this species within the Project footprint^.
Surianaceae	*Cadellia pentastylis*	V	V	Low potential to occur. Small population was located during field surveys along the banks of Mackenzie River in the upper reaches of the Rookwood Weir impoundment above FSL 49 m. Unlikely to be any naturally sustainable populations of this species within the Project footprint^.
Capparaceae	*Capparis humistrata*	E	-	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentine soils and stoney ridges). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Capparaceae	*Capparis thozetiana*	V	V	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentine hills). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Apocynaceae	*Cerbera dumicola*	NT	-	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentine hills). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.

Family	Scientific Name	Status NC Act*	Status EPBC Act*	Likelihood of occurrence
Myrtaceae	*Corymbia xanthope*	V	V	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits ridges or hill slopes on serpentinite geology with sandy soils). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Cycadaceae	*Cycas ophiolitica*	E	E	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits hills and slopes, generally on shallow, stony, infertile soils, which are developed on sandstone and serpentinite). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Proteaceae	*Hakea trineura*	V	V	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentinite rocks mostly on gravelly ridges and slopes). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Ericaceae	*Lissanthe brevistyla*	V	-	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits steep hillsides in eucalypt woodlands, on red gravely soil or on loose stony slopes). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Zamiaceae	*Macrozamia serpentina*	E	-	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentine soils). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Asclepiadaceae	*Marsdenia brevifolia*	V	V	Low potential to occur. Species recorded within desktop search extent but potentially suitable habitat is absent from the Project footprint (inhabits serpentine rock outcrops). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Asclepiadaceae	*Marsdenia hemiptera*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits littoral rainforest). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Poaceae	*Paspalidium scabrifolium*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent but potentially suitable habitat is present within Project footprint (inhabits eucalypt woodlands on creek banks).

Family	Scientific Name	Status NC Act*	Status EPBC Act*	Likelihood of occurrence
Thymelaeaceae	*Pimelea leptospermoidies*	NT	V	Low potential to occur. Species has been recorded within desktop search extent but potentially suitable habitat is absent from Project footprint (inhabits serpentine hills). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Fabaceae	*Pultenaea setulosa*	V	V	Low potential to occur. Species has been recorded within desktop search extent but potentially suitable habitat is absent from Project footprint (inhabits serpentine soils often on stony hillsides). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Stackhousiaceae	*Stackhousia tryonii*	NT	-	Low potential to occur. Species has been recorded within desktop search extent but potentially suitable habitat is absent from Project footprint (inhabits serpentine soils excludes the alluvial clay and loam of the inundation area). Therefore, only incidental plants may occur within the Project footprint rather than any naturally sustainable populations of this species.
Euphorbiaceae	*Actephila sessilifolia*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits rainforest and vine thickets).
Combretaceae	*Dansiea elliptica*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits lowland dry rainforest and vine thicket).
Arecaceae	*Livistona nitida*	NT	-	Low potential to occur. Documented distribution of this species does not encompass the Project footprint.
Combretaceae	*Macropteranthes fitzalanii*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits notophyll vine forest and littoral rainforest).
Combretaceae	*Macropteranthes leiocaulis*	NT	-	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits rainforest).
Apocynaceae	*Parsonsia larcomensis*	V	V	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits open heathland and shrubland at or near the summits of mountain peaks).

Family	Scientific Name	Status NC Act*	Status EPBC Act*	Likelihood of occurrence
Orchidaceae	*Phaius australis*	E	E	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits coastal wet heath, swampy grasslands and swamp forests).
Moraceae	*Streblus pendulinus*	LC	E	Low potential to occur. Species has not been recorded within desktop search extent and potentially suitable habitat is absent from the Project footprint (inhabits rainforest and gallery forest).

* NC Act status: endangered (E), vulnerable (V), near threatened (NT), least concern (LC). EPBC Act status: endangered (E), vulnerable (V).

^Source: Nangura 2007

6.2.10 Horticultural crops

There are no horticultural crops within the Project footprints. Irrigated and non-irrigated fodder crops are cultivated on higher ground outside of proposed weirs areas (including access), impoundments and river crossings. Chapter 5 Land provides further detail on land use in the surrounding areas.

6.2.11 Weeds and other non-native plants

The desktop review for weed species identified 98 introduced plant species with a potentially suitable distribution or recorded presence within the Project footprints. Of these, 16 are 'declared plants' under the LP Act and 13 are Weeds of National Significance (WONS). WONS are identified by the Commonwealth Government as most significant based on invasiveness, impacts, potential for spread and socio-economic and environmental values. An additional 36 pest species were identified by the Rockhampton Regional Council (RRC) and the Central Highlands Regional Council (CHRC) as significant to the region, of which 28 are 'declared plants' under the LP Act and eight are declared under local law. There are three classes of declared plants under the LP Act. These plants are targeted for control because they have, or could have, serious economic, environmental or social impacts.

Significant weeds found during field surveys included five WONS and three other weeds that are listed as 'declared plants'. A brief synopsis of their presence is provided in Table 6-6.

Table 6-6 Significant weeds identified during field surveys

Weed species	Declared plant class*	WONS^	Comment
Prickly acacia (*Acacia nilotica*)	Class 2	Yes	Very scarce, only a handful of specimens sighted across the study area.
Mother of millions (*Bryophyllum delagoense*)	Class 2	No	Very scarce, one patch located near the proposed Rookwood Weir site.
Balloon vine (*Cardiospermum grandiflorum*)	Class 3	No	Occasional to sometimes common, mostly on grassy river bank areas.
Rubbervine (*Cryptostegia grandiflora*)	Class 2	Yes	Locally common in a few locations. Dominant population in bed of Melaleuca Creek.
Lantana (*Lantana camara*)	Class 3	Yes	Occasional presence, rarely common.
Pickly pear (*Opuntia sp*)	Class 2	No	Occasional presence, usually not on lower river banks.
Parkinsonia (*Parkinsonia aculeata*)	Class 2	Yes	Occasional presence, rarely common. Controlled on most properties.
Parthenium (*Parthenium hysterophorus*)	Class 2	Yes	Occasional to common in actively grazed areas. Scarce or absent in many areas surveyed. Rapid changes to population with rainfall.

With the exception of lantana, all of the weeds are identified as high priority in the RRC Pest Management Plan 2012-2016 and all are identified as plants of significance by the CHRC. Non-native plant species were the predominant cover in the ground layer in about 30 per cent of sites visited in during field surveys. In most of these sites the non-native dominance was expressed by introduced pasture grasses, especially green panic (*Megathyrsus maximus var pubiglumis*) and buffel grass (*Cenchrus ciliatus*) with a far smaller proportion of cover taken by Rhodes grass (*Chloris sp*) and Sabi grass (*Urochloa mosambicensis*). Other non-native species to dominate parts of the ground layer were parthenium and gallweed (*Zygophyllum apiculatum*). Mimosa bush (*Acacia farnesiana*) (a naturalised thorny acacia) with sparsely branched and creeping habit was found on the highest proportion of sites in the study area although at very low density. The greater share of sites dominated by the non-native grasses existed on the lower part of the Eden Bann Weir section, where the green panic dominance was often over 75 per cent. Buffel grass was more common in areas that had a relatively sparser or damaged woodland canopy cover whereas Rhodes grass and Sabi grass seldom covered any more than 10 per cent of the ground cover in any site.

6.3 Potential impacts and mitigation measures

6.3.1 Overview

Vegetation loss will occur as a result of the Project. Vegetation will be cleared for the construction of the weir infrastructure, crossing upgrades at Glenroy, Riverslea, Foleyvale and Hanrahan crossings and the proposed right bank access road to Eden Bann Weir. The proposed raising of Eden Bann Weir and construction of Rookwood Weir will result in the impoundment and subsequent loss of riparian vegetation along the main Fitzroy River channel and in the lower reaches of tributaries and adjoining creeks.

Potential impacts on flora values as a result of the construction and commissioning of the Project include:

- Loss of vegetation resulting in:
  - Loss of TECs
  - Loss of remnant vegetation
  - Loss of high value regrowth
  - Loss of essential habitat
  - Loss of conservation significant flora
  - Loss of culturally and commercially significant flora.
- Habitat fragmentation and loss of connectivity.

During construction and operation, the Project has the potential to introduce and or spread weeds and non-native plants.

Potential impacts associated with altered operational flow regimes, for example channel contraction, are addressed in Chapter 9 Surface water resources. Potential impacts on water quality from impoundment are addressed in Chapter 11 Water quality.

6.3.2 Loss of vegetation

6.3.2.1 Loss of threatened ecological communities

Clearing of Brigalow TEC to facilitate construction activities at the weir sites, along existing and new access roads and at river crossings have been avoided as far as is practicable based on current survey and design. In the order of 1.6 ha will be cleared during construction activities associated with Rookwood Weir (Table 6-7). While geological constraints dictate the location of the weir at Rookwood, further opportunities to limit the extent of clearing of this TEC will be considered during detailed design. Inundation of Brigalow TEC is an unavoidable consequence of the Project. Based on existing mapping (Nangura and DNRM RE mapping), approximately up to 18.5 ha of Brigalow TEC will be impacted as a result of impoundment at the upper limits of development as shown in Table 6-7 (along with incremental loss for intermediate developments).

Table 6-7 Affected Brigalow TEC

Threatened ecological community	Eden Bann Weir Stage 2	Eden Bann Weir Stage 3	Rookwood Weir Stage 1	Rookwood Weir Stage 2	Eden Bann Weir construction area	Rookwood Weir construction area	Glenroy Crossing	Riverslea Crossing	Foleyvale Crossing	Hanrahan Crossing	Eden Bann Weir access road (new)
Brigalow (*Acacia harpophylla* dominant and co-dominant)	0.3	0.7	2.3	17.8	0	1.4	0	0	0.2	0	0

*Values for Eden Bann Weir Stage 3 (FSL 20.2 m) and Rookwood Weir Stage 2 (FSL 49 m) are cumulative so include the areas affected by lower development levels.

The protected Brigalow TEC RE 11.3.1 mapped within the Project footprint is known to occur within the landscape immediately surrounding the Project footprint and across the region. Residual impacts from loss across the Project area are less than 0.03 per cent of the bioregional extent of the TEC (Table 6-4). In the order of 612 ha of remnant RE 11.3.1 is mapped within 500 m from the watercourse, and 35,153 ha is mapped within the catchment, with the area of impact equating to 3.3 per cent and 0.06 per cent respectively. Brigalow TEC is well represented in the surrounding landscape and a relatively small proportion is impacted across the Project footprint. It is proposed to undertake further field assessment to fully quantify the area of this TEC that may be lost due to impoundment as it is considered possible that a significantly lower area of Brigalow TEC will be inundated than that currently mapped by the Herbarium but not covered by the Nangura (2007) field survey. The Nangura (2007) field survey substantially reduced the area of this TEC within their survey limits. Where loss due to impoundment is unavoidable, an offset will be provided (Volume 2, Chapter 14 Offsets).

6.3.2.2 Loss of remnant vegetation

Table 6-8 provides the spatial extent of REs that will be lost as a result of the Project. At the upper limits of development, approximately 26 ha of endangered REs, 240 ha of concern REs and 1,681 ha of least concern REs will be lost as a result of clearing for construction and inundation of riparian vegetation as shown in Table 6-9, along with losses at incremental development levels. In summary from Table 6-9, impacts to REs are as follows:

- Eden Bann Weir Stage 2 (including construction areas, access roads and associated works such as river crossings): 363.7 ha
- Eden Bann Weir Stage 3 (assuming construction areas are considered previously disturbed and no further augmentation is required for access): 297.4 ha (additional to Stage 2 area)
- Rookwood Weir Stage 1 (including construction areas and associated works such as river crossings): 737.9 ha
- Rookwood Weir Stage 2 (assuming construction areas are considered previously disturbed and no further augmentation required to access): 548.5 ha (additional to Stage 1 area).

As described in Chapter 3 Legislation and project approvals, the VM Act in conjunction with the SP Act (and the SP Regulation) regulates operational work that is the clearing of native vegetation. However the Project is deemed to be 'other community infrastructure', specifically 'water cycle management infrastructure' under the SP Regulation and is considered not assessable development (under Schedule 3, Part 1, Table 4, Item 1). The clearing of native vegetation is therefore exempt development and will not require approval or assessment against the Brigalow Belt and New England Tablelands state code. Subsequently offsets are not proposed. Vegetation offset requirements under the EPBC Act are addressed in Volume 2, Chapter 14 Offsets.

Table 6-8 Remnant vegetation within the Project footprint (ha)

RE	VM Act class	Eden Bann Weir construction area	Rookwood Weir construction area	Eden Bann Weir impoundment		Rookwood Weir impoundment		Glenroy Crossing #1	Riverslea Crossing #2	Foleyvale Crossing #3	Hanrahan Crossing #4	Eden Bann access road	Total^
				Stage 2	Stage 3*	Stage 1	Stage 2*						
11.3.1	Endangered	0	1.4	0.3	0.7	2.3	17.8	0	0	0.2	0	0	20.1
11.3.2	Of concern	0	0	0.7	2.0	1.0	4.3	0	0	0	0	0	6.3
11.3.3	Of concern	0	1.2	4.4	12.3	89.1	186.3	1.2	0	0.4	0.2	0	201.6
11.3.3c	Of concern	0	0	0.1	0.1	0	0	0	0	0	0	0	0.1
11.3.4	Of concern	0	0	10.2	27.0	1.8	4.2	0	0	0	0	0	31.2
11.3.9	Least concern	0	0	0.3	0.6	0	0	0	0	0	0	0	0.6
11.3.25	Least concern	6.4	1.1	190.8	398.5	504.1	903.4	0.4	0.4	0.1	0.1	0.1	1310.5
11.3.25c	Least concern	0.4	0	0.9	6.7	0	0	0	0	0	0	0	7.1
11.3.25f	Least concern	2.2	0.5	89.2	128.6	124.8	148.2	0.1	0.1	0	0	0	279.7
11.3.27	Least concern	0	0	29.2	39.9	0	0	0	0	0	0	0	39.9
11.3.38	Endangered	1.5	0	1.0	2.5	0	0	0	0	0	0	0	4.0
11.3.38a	Endangered	0	0	1.0	2.3	0	0	0	0	0	0	0	2.3
11.11.1	Least concern	0	0	0	0	0.1	0.7	0	0	0	0	0	0.7
11.11.7	Least concern	18.3	0	2.0	5.8	0	0	0	0	0	0	1.0	25.1
11.11.7a	Least concern	0	0	0.1	0.3	0	0	0	0	0	0	0	0.3
11.11.10	Of concern	0	0	0	0	0	0	0	0	0	0	0.5	0.5
11.12.1	Least concern	0	0	0	0.2	0	0	0	0	0	0	1.4	1.6
11.12.2	Least concern	0	6.7	0	0.1	2.3	8.4	0	0	0	0	0	15.2
Total		**28.8**	**10.9**	**330.2**	**627.6**	**725.5**	**1273.3**	**1.7**	**0.5**	**0.7**	**0.3**	**3.0**	**1946.8**

Source: Nangura (2007) and DNRM RE mapping Version 6.1 (2011)

*Values for Eden Bann Weir Stage 3 (FSL 20.2 m) and Rookwood Weir Stage 2 (FSL 49 m) are cumulative so include the areas affected by previous stage development levels.

^Total of each RE assumes maximum development at both sites.

#1 Associated with Eden Bann Stage 2; #2 Associated with Rookwood Weir Stage 1; #3 Associated with Rookwood Weir Stage 2; #4 Associated with Rookwood Weir Stage 1

Table 6-9 Impacted regional ecosystems by VM Act class

Component	Regional ecosystem VM Act Class		
	Endangered (ha)	Of concern (ha)	Least concern (ha)
Eden Bann Weir			
Impoundment – Stage 2	2.3	15.4	312.5
Impoundment – Stage 3*	5.5	41.4	580.7
Eden Bann Weir construction area	1.5	0	27.3
Glenroy Crossing	0	1.2	0.5
Eden Bann Weir access road	0	0.5	2.5
Eden Bann Weir total ^	7	43.1	611
Rookwood Weir			
Impoundment – Stage 1	2.3	91.9	631.3
Impoundment - Stage 2*	17.8	194.8	1060.7
Rookwood Weir construction area	1.4	1.2	8.3
Riverslea Crossing	0	0	0.5
Foleyvale Crossing	0.2	0.4	0.1
Hanrahan Crossing	0	0.2	0.1
Rookwood Weir total^	19.4	196.6	1069.7
Total^	**26.4**	**239.7**	**1680.7**

Source: Nangura (2007) and DNRM RE mapping Version 6.1 (2011)
*Values for Eden Bann Weir Stage 3 (FSL 20.2 m) and Rookwood Weir Stage 2 (FSL 49 m) are cumulative so include the areas affected by lower development levels.
^Totals assume maximum development at both sites.

Clearing of remnant vegetation to facilitate construction activities at the weir sites, along existing and new access roads and at river crossings have been minimised as far as is practicable by locating infrastructure and work areas within existing cleared or non-remnant vegetation, making use of existing roads and tracks and co-locating new access along utility easements. Further opportunities to reduce the loss of endangered and of concern REs, in particular, associated with construction activities and access will be identified during detailed design. Inundation of riparian vegetation is an unavoidable consequence of the Project.

6.3.2.3 Loss of high value regrowth

As far as is practicable clearing of high value regrowth in construction areas, along access routes and at river crossings has been avoided as far as is practicable. Loss of high value regrowth will occur as an unavoidable impact of impoundment. A total of approximately 558 ha of mapped high value regrowth vegetation occurs within the Project footprint at the upper limits of development containing endangered, of concern and least concern REs as shown in Table 6-10. High value regrowth areas have not been field verified, and these values (derived from mapping) are likely to be conservative as bio-condition assessments undertaken by Nangura (2007) found that habitat elements essential for long-term recovery were lacking or highly degraded in regrowth areas.

Table 6-10 High value regrowth impacted by the Project

Component	Regional ecosystem VM Act Class		
	Endangered (ha)	Of concern (ha)	Least concern (ha)
Eden Bann Weir			
Impoundment Stage 2	7.2	51.8	28
Impoundment Stage 3*	27.2	107.8	45.9
Eden Bann Weir construction area	2	0	0
Glenroy Crossing	1.3	0.5	0.2
Eden Bann Weir access road	0	0.4	0.6
Rookwood Weir			
Impoundment Stage 1	59.4	90.1	3.4
Impoundment Stage 2*	130.8	223.7	12.8
Rookwood Weir construction area	0	0	3.3
Riverslea Crossing	0	1.2	0
Foleyvale Crossing	0.4	0.1	0
Hanrahan Crossing	0	0	0
Total^	**161.7**	**333.7**	**62.8**

Source: DNRM Regrowth vegetation mapping (Version 2.1, 2011)
* Values for Eden Bann Weir Stage 3 (FSL 20.2 m) and Rookwood Weir Stage 2 (FSL 49 m) are cumulative so include the areas affected by lower development levels.
^Total assumes maximum development at both sites.

The Project is however deemed to constitute a significant community project for the purposes of assessment against the Brigalow Belt and New England Tablelands state code (pers.com. DERM 2010) and clearing of high value regrowth is exempt from approval.

6.3.2.4 Loss of essential habitat

Approximately 40 ha of mapped essential habitat (DNRM 2011) is estimated to be lost within the Eden Bann Weir (Stage 3) impoundment (Table 6-11) and 11 ha within the Rookwood Weir (Stage 2) impoundment (Table 6-12). No essential habitat will be impacted by other Project components such as construction footprints and access roads.

Table 6-11 Mapped essential habitat affected by the Eden Bann Weir impoundment

Approximate location	Area inundated (ha)		Species	Summary
	Stage 2	Stage 3 m*		
Fitzroy River 147-148 km AMTD	6	13.5	*Macrozamia serpentina*	It is unlikely that essential habitat for this species occurs within the Project footprint. The mapped area generally supports the required essential habitat factors, however, this species was not recorded during Nangura's (2007) survey at this locality (recorded 230 m away from the impoundment in non-remnant vegetation and pre-clear RE is different to that within the Project area).
			Capparis humistrata	It is unlikely that essential habitat for this species occurs within the Project footprint. Mapping within the Project area is not considered appropriate as essential habitat factors are absent (including absence of the mandatory requirements) and the species record is from approximately 250 m away from the Project area and within habitat different to that within the Project area. Nangura's (2007) survey is considered sufficient for detection of this species.
Fitzroy River 154-156 km AMTD	5.2	9.9	*Macrozamia serpentina*	It is likely that essential habitat for this species occurs within the Project footprint. The mapped area supports the required essential habitat factors and the species is recorded in contiguous habitat.
Marlborough Creek 171 km AMTD	0	3.6	*Macrozamia serpentina*	It is unlikely that essential habitat for this species occurs within the Project footprint. The mapped area generally supports the required essential habitat factors, however, surveys indicated that species was not present at this locality.
			Capparis thozetiana	It is likely that essential habitat for this species occurs within the Project footprint. The mapped area supports the required essential habitat factors and the species is recorded in contiguous habitat.
			Pimelea leptospermoides	It is likely that essential habitat for this species occurs within the Project footprint. The mapped area supports the required essential habitat factors and the species is recorded in contiguous habitat.

Approximate location	Area inundated (ha)		Species	Summary
	Stage 2	Stage 3 m*		
			Stackhousia tryonii	It is likely that essential habitat for this species occurs within the Project footprint. The mapped area supports the required essential habitat factors and the species is recorded in contiguous habitat.
Fitzroy River – Glenroy Crossing 192 km AMTD	7.5	12.8	Fitzroy River turtle	Chapter 7 Aquatic ecology for assessment; Appendix L

Source: DNRM Essential habitat mapping (Version 3.1, 2011)

* Values for Eden Bann Weir Stage 3 (FSL 20.2 m) are cumulative so include the areas affected by lower development levels

Table 6-12 Mapped essential habitat affected by the Rookwood Weir impoundment

Approximate location	Area inundated (ha)		Species	Summary
	Stage 1	Stage 2*		
Mackenzie River 333 km AMTD	0	11.1	Ooline	It is unlikely that essential habitat for this species occurs within the Project footprint. The mapped area does not support essential habitat factors (including the mandatory RE) and the species record is from outside the mapped area (25 m away). It is considered unlikely that this is a naturally sustainable population (Table 6-5).

Source: DNRM Essential habitat mapping (Version 3.1, 2011)

Note: An additional area of essential habitat for blackironbox (*Eucalyptus raveretiana)* is mapped on Melaleuca Creek however this species is no longer listed under the NC Act.

* Values for Rookwood Weir Stage 2 (FSL 49 m) are cumulative so include the areas affected by lower development levels.

As per Section 6.3.2.2, the Project is deemed to be 'other community infrastructure' under the SP Regulation and is considered not assessable development (under Schedule 3, Part 1, Table 4, Item 1). The clearing of native vegetation is therefore exempt development and will not require approval or assessment against the Brigalow Belt and New England Tablelands state code.

6.3.2.5 Loss of conservation significant flora species

Table 6-5 (Section 6.2.9) indicates that there are no conservation significant flora species that have a high potential to occur in the Project footprint.

6.3.2.6 Loss of culturally and commercially significant flora

As identified in Section 6.2.8, one culturally significant plant has been identified during previous cultural heritage surveys in the vicinity of the Project area. Cultural Heritages Management Plans (CHMPs) have been approved for the Project and allow for the survey of the Project footprints prior to construction and subsequent impoundment. Management of culturally significant flora will be undertaken in accordance with the CHMPs.

The proponent will liaise with the Department of Agriculture and Fisheries (DAF) prior to construction regarding the harvesting of timber within the Project footprint in accordance with the *Forestry Act 1959* (Qld) (Chapter 3 Legislation and project approvals). Harvesting activities will be undertaken such that they do not adversely impact on retained riparian vegetation.

6.3.3 Habitat fragmentation and loss of connectivity

Within the impoundments, the inundation of riparian vegetation as a result of the Project has the potential to disrupt connectivity between habitats, thereby further fragmenting habitats within the Project footprint (and the wider study area). This is likely to be most prevalent in the lower reaches of the impoundment, where the raised water level is predicted to inundate riparian bankside vegetation (as opposed to in-stream vegetation only in the upper reaches of the impoundment). This reduction in connectivity along the riparian zone is likely to be most notable where only a thin strip of fringing riparian vegetation, abutted by cleared agricultural land, occurs. Impacts on habitat fragmentation are discussed further in Chapter 8 Terrestrial fauna.

6.3.4 Introduction of weed and non-native plants

Construction activities have the potential to introduce and / or spread weeds, which can increase the edge effects associated with vegetation clearing. Generally, the landscape surrounding the site of Eden Bann Weir and proposed weir at Rookwood is highly fragmented, and as such, isolated patches of vegetation are presently exposed to these processes. Earthworks and increased vehicle movements associated with construction activities at the weir site have the potential to exacerbate local levels of weed infestation.

During operations vehicle movements are limited to maintenance and emergency works where use is made of existing roads and tracks. It is not expected that operational traffic will introduce weeds to the site. Chapter 11 Water quality describes potential impacts associated with impoundment of water within the storages and the potential increases of algal blooms within the impoundment and downstream through operational water releases.

6.3.5 Mitigation measures

Where possible, concept design of weir construction areas, access roads and river crossings has sought to minimise the amount of vegetation cleared. To mitigate the loss of vegetation resultant from construction activities, the following measures will be implemented:

- Clearing for site works will be restricted to the smallest practical area and only where necessitated by the approved construction of roads, services, access and cut and fill. The amount of time the area is cleared prior to construction will also be minimised
- Clearly demarcate no-go areas of highly sensitive vegetation, including all vegetation not to be cleared. All vegetation to be retained should be surveyed and clearly demarcated
- Where practicable, revegetation activities would be commenced in and adjacent to construction areas as soon as possible after the completion of local construction works

- It is not intended that for the Project pre-clearing of vegetation within the impoundment areas would be undertaken. However, as per agreement with the (then) Department of Agriculture, Forestry and Fisheries (DAFF), harvesting of forestry timber products as appropriate and necessary in accordance with the requirements of the *Forestry Act 1959* (Qld) will be undertaken where such activities would not cause adverse environmental impacts.
- Implement CHMPs inclusive of survey prior to construction and impoundment. Implement agreed management measures which may include translocation of culturally significant flora
- A Weed Management Plan (Chapter 23 Environmental management plan) would be prepared for the construction phase that outlines measures to prevent the introduction of new weed species into the area and minimise the spread of declared weeds within the site. Measures would include:
  - Vehicles, plant and equipment will be cleaned prior to entering site to prevent the introduction of weeds
  - Machinery used for clearing and grading will have their wheels cleaned with an air compressor before entering and leaving the site
  - Key personnel on site will be capable of identifying declared weed species within the site / surrounding area and prevent their spread and translocation. During an initial site inspection, declared weeds will be identified and flagged and recorded in a site register. Declared weeds will be treated to prevent spread using methods consistent with advice from DAF, RRC and CHRC, as applicable
  - Where weeds and infestations are detected or identified within the work site (particularly on stockpiles and post rehabilitation), they will be removed or destroyed using methods consistent with advice from DAF, RRC and CHRC, as applicable.
- Weed management would be undertaken with reference to relevant Queensland and local government legislation, guidelines and plans including:
  - LP Act
  - *Plant Protection Act 1989* (Qld)
  - Biosecurity Queensland policies and guidelines
  - DAF pest factsheets
  - RRC Pest Management Plan 2012-2016
  - CHRC Draft Area Pest Management Plan 2014-2016
- Temporarily disturbed areas will be rehabilitated to replicate as closely as possible the habitat resources available prior to construction. This will include:
  - Utilising stockpiled topsoil and chipped and mulched vegetation during landscaping and revegetation efforts
  - Revegetating areas that are temporarily disturbed using local indigenous species appropriate to the position in the landscape
  - Where practical, commencing revegetation activities in and adjacent to construction areas as soon as possible after the completion of construction
  - Regular post-construction monitoring of rehabilitation areas.

Chapter 23 Environmental management plan provides further detail on rehabilitation.

6.4 Summary

A detailed report prepared by Nangura (2007) forms the basis of the flora assessment presented in this chapter. Desktop assessments, vegetation mapping, field surveys and bio-condition assessments were undertaken to determine existing flora values and potential impacts on flora values as a result of the Project.

The unavoidable loss of vegetation within the Project footprint includes the loss of endangered, of concern and least concern REs as shown in Table 6-13. The Project is deemed to be 'other community infrastructure', specifically 'water cycle management infrastructure' under the SP Regulation and is considered not assessable development. The clearing of native vegetation is therefore exempt development and will not require approval or assessment against the Brigalow Belt and New England Tablelands state code. Subsequently offsets are not proposed.

Approximately 20 ha of Brigalow TEC (as a conservative estimate based on current mapping) will be impacted as a result of the Project (Table 6-13). Brigalow TEC is well represented in the surrounding landscape and a relatively small proportion is impacted across the Project footprint. However, where loss due to impoundment is unavoidable, an offset in accordance with EPBC Act provisions will be provided. Prior to the commencement of Project activities, further ecological surveys will be undertaken to verify the area of Brigalow TEC present and impacted as a result of the Project.

In addition, 185.9 ha of high value regrowth will be lost within the Eden Bann Weir Project footprint and 372.3 ha of high value regrowth within the Rookwood Weir Project footprint. Approximately 40 ha of essential habitat are mapped within the Eden Bann Weir Project footprint and 11 ha of within the Rookwood Weir Project footprint.

The Project is deemed to be 'other community infrastructure', specifically 'water cycle management infrastructure' and is considered not assessable development. The clearing of native vegetation including regrowth vegetation and essential habitat is exempt development and will not require approval or assessment against the Brigalow Belt and New England Tablelands state code. Offsets are not proposed.

Introduced plants and weeds are ubiquitous across the Eden Bann Weir and Rookwood Weir study areas. Eight weeds listed under Queensland legislation, five of which are Weeds of National Significance were recorded during field studies. A Weed Management Plan would be prepared and implemented to prevent the introduction of new weed species into the area and minimise the spread of weeds within the site.

Table 6-13 Remnant vegetation within the Project footprint and surrounding region

TECs and REs	Eden Bann Weir Project footprint	Rookwood Weir Project footprint	Within 2 km of the Project footprint		Within the Fitzroy Basin catchment*		Within Brigalow Belt bioregion	
			ha	% impacted	ha	% impacted	ha	% impacted
Threatened ecological communities								
Brigalow	0.7	19.4	1358	1.5	35,153	0.06	80,610	0.03
Endangered regional ecosystems								
11.3.1	0.7	19.4	1358	1.5	35,153	0.06	80,610	0.03
11.3.38	6.3	0	246	2.6	8,064	0.08	9,577	0.07
Of concern regional ecosystems								
11.3.2	2.0	4.3	129	4.9	211,145	0.00	517,452	0.00
11.3.3	13.5	188.1	4,932	4.1	49,567	0.41	281,071	0.07
11.3.4	27.0	4.2	380	8.2	109,013	0.03	183,695	0.02
11.11.10	0.5	0.0	137	0.4	43,941	0.00	87,063	0.00
Least concern regional ecosystems								
11.3.9	0.6	0.0	4	15.0	6,477	0.01	64,225	0.00
11.3.25	543.4	1053.9	4,703	34.0	109,576	1.46	513,711	0.31
11.3.27	39.9	0.0	271	14.7	12,768	0.31	49,086	0.08
11.11.1	0.0	0.7	1,003	0.1	108,848	0.00	160,931	0.00
11.11.7	25.4	0.0	4,179	0.6	47,821	0.05	50,909	0.05
11.12.1	1.6	0.0	955	0.2	205,365	0.00	847,961	0.00
11.12.2	0.1	15.1	345	4.4	5,301	0.3	190,352	0.01